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A Hypothesis in Simplicity for the Mechanism that Generates Equations in the Brain

William L. Abler

Arcata, California , USA
ehlert-abler@sbcglobal.net

Abstract: *Numbers and equations are a product of the mind. They are not the outside world, but are a model of it because both systems, internal and external, are independently generated according to the same principles, even the same mechanisms. Using arguments, some old, some new, I propose here that integers in the mind and the external world are generated by a mechanism of resonation. Equations are generated under Newton's 3rd law, "equal and opposite reaction", by attaching symbols to the symmetrically opposite points of a growing water crystal at body temperature. This hypothesis re-directs the study of the brain from chaos and complexity to simplicity, and the planning of equations in the action of a single cell.*

Keywords: Equation; sentence; water; ice; crystal; brain; physics; Newton's laws

Introduction

With the discovery that language gets half its structure from physics, comes the possibility that it gets the other half from physics, too (Abler, 1989). Integers in the mind are a model of the external world, but they are not the external world. They are a model of it because properties of both systems are generated independently according to the same principles, even by the same mechanisms.

The outside world does not calculate its properties as we do, by pen-and-paper. Instead, such properties are the result of spontaneously-occurring, self-organized mechanisms, starting with the integer "one" and its compounds, one chicken, two eggs, three apples. In his 1928 Nobel Prize acceptance lecture, Louis de Broglie (1928) explains, "determination of the stable motion of electrons in the atom introduces integers; and up to this point the only phenomena involving integers in Physics were those of interference and of normal modes of vibration". In other words, it is resonation that introduces integers to physics, by generating them (along with the wave-particle duality); and I propose that, in some way, processes of resonation

generate integers independently in the outside world and in the mind, that is to say, in the brain. The arithmetical word integer, then, both in the mind and in the outside world, is the same as quantum or atom in physics, and particulate in genetics, and discrete in linguistics.

Interior vs. Exterior

Like numbers, equations are a product of the mind (Einstein, 1922, p. 28). They are not the external world, but are a model of it (Wigner, 1960) because properties of both systems are generated independently according to the same principles, even by the same mechanisms. As there was no call for mathematical formulas during the formative period, natural selection must be ruled out as the cause of such formulas. Further, values calculated in the mind, and those measured in the outside world, may agree to "one part in ten millions" (Wigner, 1960, p. 9); and Wigner (1960, p. 3) comments, "certainly it is hard to believe that our reasoning power was brought, by Darwin's process of natural selection, to the perfection which it seems to enjoy". Instead, we must look to some spontaneously-occurring, self-organized mechanism in the brain, corresponding independently to some mechanism in the outside world, as the source of equations.

Equal and Opposite Reaction

Because the two sides of an equation are equal to one another and opposite to one another across the "equals" (Abler, 2019, p. 64), to a first approximation, equations are a model of physics because properties of both systems are generated under the same law, Newton's 3rd, "For every action, there is an equal and opposite reaction." "Equal and opposite reaction" is another way of saying, "I am symmetrical" and "Do the same thing to both sides".

Water Crystals

While it is too soon to guess the precise resonating mechanism that generates integers in the brain, the two sides of a single arm of a water crystal (Abler, 2019, p. 68) are dynamically equal to one another and opposite to one another across the arm's axis of symmetry –and water crystals at room temperature have been demonstrated by Andrei Sommer and colleagues (2008). See Figure 1. At a submicroscopic scale, the spontaneously-occurring, self-organized water crystal might attain the perfect molecular symmetry that generates the "almost fantastic accuracy" of agreement between external measurement and internal calculation so admired by Eugene Wigner (1960, p. 10).

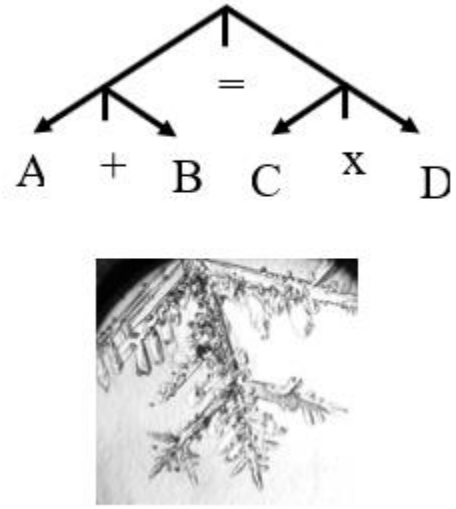

Figure 1 Water crystal has the same fractal symmetry as the mechanism that generates equations. See text. Water crystal preserved in acrylic by Kevin Lamb. Photography by the author.

Further, the unlimited variety in the configuration of water crystals (Bentley & Humphreys, 1931, 1962), all within the dynamic template of bifurcating fractal symmetry, means that, if you control the right mechanism, you can bring the growth of water crystals under voluntary or conscious control. This is exactly the kind of system that can be modified without disrupting its underlying order, and that would make possible the planning of equations, and of everyday sentences with their clauses and phrases, and their asymmetrical Subject-Object relation. At the submicroscopic scale, crystal formation may take place with explosive force and rapidity, causing ripples in nearby materials. Stretch receptors in the membrane of nerve cells (Coste et al., 2010) might convert the growth or configuration of water crystals into neural information. See Figure 2.

Figure 2 Hypothetical view showing water crystals forming among stretch receptors in the membrane on the surface of nerve cells. Like the glass on the front of a cell-phone, the stretch receptors can

compute the precise configuration of the water crystal. The water crystals must be understood not as static objects, but as developing and decaying dynamically over periods of seconds. See text.

Mathematics vs. Language

Mathematics is language. The word "integer" in arithmetic is equivalent to the word "discreteness" in linguistics –and the same resonating mechanism that generates the integers of arithmetic also generates the discrete speech-sounds, or "phonemes" of language. The phoneme chart (IPA, 1949, p. 10) is a periodic table (Abler, 1989, p. 5; 2019, p. 60).

Mathematics is language. Equations are simple declarative sentences whose Verb is the "equals", and which assert that "A is equal to B", or "I am symmetrical" –an assertion that can be either true or false. Sentences of everyday language exhibit commutative, associative and distributive properties; and expressions in arithmetic exhibit language-like ambiguity and ellipsis (Abler, 2005, pp. 37ff; 2019, pp. 64, 71).

Mathematics is language. Mathematician Colin Pask, who has no reason to convince anyone that mathematics is anything other than what it seems to be –mathematics– informs us, (Pask, 2015, p. 190) that Edmund Halley's equation expressing the cost of annuity is written "in prose rather than in mathematical notation making it hard to follow". Here is Halley's equation, 1693 style. It is prose, and it is language:

If Three Lives are proposed, to find the value of an Annuity during the continuance of any of those three Lives. The Rule is, As the Product of the continual mulitplication of the Three Numbers, in the Table, answering to the Ages proposed, is to the difference of that Product and of the Product of the Three Numbers of the deceased of those Ages, in any given term of Years; So is the present value of a Sum of Money to be paid certainly after so many Years, to the present value of the same / Sum to be paid, provided one of those three Persons be living at the Expiration of that term.

Halley is the Halley of Halley's Comet. The Transactions' original spelling "mulitplication" is preserved here. Pask (2015, p. 190) presents Halley's prose in the form of an equation in conventional mathematical symbols.

Mathematics is language. Thus mathematical symbols, each with its own shape, meaning and pronunciation, are the equivalent of Chinese characters (Abler, 2005, p. 69; 2019, p. 67).

Mathematics is language. Before the introduction of the "equals" symbol and the symbolic equation in 1557 by Robert Recorde, (Boyer & Merzbach, 1991, p. 290; Roberts, 2016, p. 172; Abler, 2019, p. 67), all mathematics was expressed in prose, and there was no reason to see any difference between language and mathematics.

The relationship between arithmetic and language is not one of ancestor-descendant as assumed by Chomsky (1991, p. 50), but one of separate derivation from a common source (Abler, 2019, p. 67). The asymmetrical Subject-Object relation is universal in modern

sentences, modifying them from their original symmetrical form so greatly that no examination of the modern sentence, as found, can lead to a theory of language. See Figure 3. Instead, the key to a theory of language and mind is the observation that equations are sentences; and the symmetrical geometry of the equation is the guide to the archaic sentence. (Abler, 2019, p. 69).

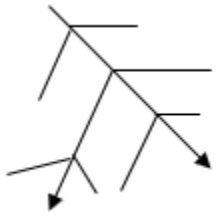

Figure 3 Compound sentence crystal, hypothetical view, showing asymmetrically modified Subject-Object main clause at right, with asymmetrically modified subordinate clause at lower left.

A Theory in Physics

To the extent that it is correct, the theory in physics presented here will inevitably be refined in the future (Neuenschwander, 2010). For now, I will be content if the water-crystal hypothesis (Abler, 2019, p. 68, and present) will serve as a working first approximation: Speech-sounds ("phonemes") and sentences of language draw their properties from the same source in the brain as numbers and equations –in physics, not biology.

A Theory in Simplicity

If the water-crystal hypothesis is not exactly correct, I maintain that it is at minimum the right kind of hypotheses: In other words, it re-directs the study of the brain from chaos and complexity to simplicity and the initiation of an equation or an ordinary sentence starting from an individual cell. The water crystal or its equivalent may be understood as the fundamental mechanism of the brain.

Discussion

The water-crystal hypothesis is one of what may become a growing number of one-cell models (Langille & Gallistel, 2020) for the mechanism that initiates brain action, and may bring into sharper focus un-answered questions that arise for any theory of brain action. Thus we may ask why there are symbols, how symbols are represented in the brain, and how symbols assume meaningful roles in sentences. How is the shape of the water crystal transformed into neural information, and symbols attached to it?

Since words, in themselves, possess no property corresponding to the concept "part of speech", Noun, Verb, Preposition (Abler, 2019, p. 63), but are assigned such a property by

their place in the sentence, an autonomous theory of the sentence is called for. I have supplied such a theory in Newton's "equal and opposite reaction" (Abler, 2019, p. 64). The water-crystal conjecture provides the beginning for what may become a succession of models for the mechanism that manifests such a theory in physiology. Further, a water-crystal mechanism in some form may be quite ancient in the animal kingdom (Abler, 2010, p. 423), possibly extending even to protozoa, and either not used, or used for some other function such as navigation. Only their action in the formation of sentences is unique to human beings.

Sommer et al. demonstration (2008) of water crystals at room temperature was prompted by Albert Szent-Györgyi's 1971 essay, "Biology and pathology of water". Viewed from the perspective of Szent-Györgyi's essay, the water-crystal hypothesis for generating the equation and the sentence is only a simple, even natural extension. Initiated and given structure by a force in physics, the sentence is more than just a Noun and a Verb. The sentence is the engine that generates the properties of assertion, truth and falsity that make the human being and human life possible. It is through the sentence that we generate relationships between concepts, take responsibility for what we do, declare what is good and what is bad, and who will live and who will die. It is the sentence that raises armies, proclaims laws and nations, victory and defeat –and initiates great public works like the pyramids or NASA. The time has come for all of science to take a new look at language.

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