

# Perceptions of Infinite Mathematics in Organic chemistry.

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Human technology has exceeded the individuals' ability to contemplate the imaginable. With little comparative reference to a common home computer, the *Roadrunner*, a supercomputer built by IBM at the Los Alamos National Laboratory in New Mexico, USA is currently the world's fastest computer. The US\$133-million *Roadrunner* is designed for a peak performance of 1.7 petaflops, achieving 1.026 (1.026 x 10<sup>15</sup> or 1,026,000,000,000,000 calculations per second) on May 25, 2008. This sequential computer processing differs in approach to the simultaneous tactic of the roughly 100 billion neurons each linked with up to 10,000 synaptic connections in the Human brain.

Current technology needn't invoke the unfathomable. As of February 2008, *Voyager 1* and *Voyager 2* space probes launched in 1977 were at a distance of 15.7 billion or 15,700,000,000 kilometres and 12.7 billion or 12,700,000,000 kilometres respectively from the Sun. *Voyager 1* and *Voyager 2* are escaping the solar system at a speed of about 6.286 x 10<sup>4</sup> or 62,860 kilometres per hour and 5.789 x 10<sup>4</sup> or 57,890 kilometres per hour respectively. Comparatively, the world land speed record is 1228 km/h made by *Trust SSC*, a British-designed jet-propelled car on 15<sup>th</sup> October 1997 and the world aircraft speed record is 3529 km/h made by U.S.A. *SR-71 Blackbird* aircraft on 28<sup>th</sup> July, 1976.

*Voyager* in the heavens has strained our individual scale of travelled distance and vehicular speed whilst *Roadrunner* has distorted our individual magnitude of computational power and consequentially time. The mind struggles to establish a context for these human-made machine achievements and evaluates them close to the sphere of sacred power whilst acknowledging them as products from the craft of man. The comparisons we utilise define our mental abilities and the definition of a modern mind. Either we resolve to contemplate the limitless and expand our minds in the process or we mindlessly reinforce ego-erected boundaries.

## Infinity (from the Latin *infinitas* - "unboundedness.")

To discover the numinous in Nature is to exceed the conceivable and enter into the realm of The Infinite. Rendering the individual comparative machinery ineffectual and exposing the confines of terrestrial definition. In approaching infinity the mind either attempts to illuminatingly contemplate the Limitless Divine or precipitously progresses toward a bottomless Abyss. Symbolism of the Abyss versus limitless space evokes separate mechanisms to traverse. The Abyss, a symbol of vertical boundlessness, can be horizontally negotiated not necessarily requiring a transformation of the traveller whereas limitless space occupying further dimensions either requires a transformation of the perceptions of the traveller and/or the space itself.

The Infinite has unavoidable spiritual aspects and has impacted on philosophical development, least of which is the meditation on the immeasurable. Aristotle (ca. 384 – 322 BC) contested that it was beyond the human idea to appreciate the dimensions of actual Infinity and thus invoked the *potential* Infinite, defined in terms that any finite number will always have a larger calculation. As no number could represent actual Infinity it was thus without measure, reasoned Saint Thomas Aquinas (ca. 1225 – 1274) in *Summa theologica* (1265-74).

Entwining maths, space and the mind of God captures the Infinite. Lucretius' (ca. 99 - 55 BC) boundary thought experiment in the Atomist *De Rerum Natura* (58BC) was composed: if space was finite then a ball thrown at the limitation would pass through the boundary as any wall to rebound the projectile would be outside of Universe's definition. This argument is incorrect. Yet, four centuries later St. Augustine's argument of a boundless God with infinite thought would have the same confines. The European Catholic Church's insistence that the universe was finite lead Giordano Bruno (ca. 1548 – 1600) to a burning stake in 1600 for vigorously arguing for an infinite universe in '*On the infinite universe and worlds*' (1584).

Galileo Galilei (ca. 1464 – 1642) argued in *Discorsi e dimostrazioni matematiche intorno a due nuove scienze* (1638) that due to our finite minds we restrict our speech to 'greater or less than or equal to' which is the basis of the error. Our inability to conceive the Infinite and restrict thought to the *indefinitely large*, believed Isaac Newton (ca. 1643 – 1717) did not confine the universe being Infinite. Galileo invoked an infinite number of infinitely small gaps added to a small circle to make it larger, just as David Hume (ca. 1711 – 1776) observed in '*of human nature*' (1739) that a distance existed from a ink spot that rendered the spot perfectly indivisible and Immanuel Kant (ca. 1724 – 1804) proposed in *The critique of pure reason* (1781) that due to the lack of perception the actual Infinite cannot exist.

Language is constructed of numbered and unnumbered nouns. English predominately utilises numbered nouns; "Knife" refers to one knife whereas "Water" has no numerical reference until defined by another numbered object such as "Glass" in "Glass of water". "Glass" itself can be unnumbered requiring "pail of glass". However, other languages can be composed entirely of unnumbered nouns such as Vietnamese. "Dao" (knife) has no numerical value, as have all nouns, requiring one of several Classifiers (nhà, đũa, cuón, cây, trái, con & quả) in the case of "Con dao", literally translated in English as "An animate Object (classifier) + Knife (spirit occupying the object)". In so doing Vietnamese creates a system based on the perception of the speaker identifying the Spirits in a Universal animate object. Language defines and sculpts our awareness.

Through utilising geometric argument the Infinite could be understood. Simple formulae tease the mind: a circle's circumference divided by its diameter or a circle's area compared to a square of its radius is pi ( $\pi$ ), a transcendental irrational number that summons the infinite. Studies of Pi has been calculated the constant to 1,241,177,300,000 decimal digits in October, 2005 and in its history have revealed the Infinite Series (c. 287 – 212 BC), Madhava-Leibniz series (c.1350 - 1425), Viète's formula (c. 1540 - 1603), and Wallis' product (1655).

56 years after Giordano Bruno's death John Wallis employed the  $\infty$  symbol in *Arithmetica infinitorum*. He apparently chose it to symbolise the infinite negotiation of the curve. A popular explanation is that the infinity symbol is derived from the ouroboros.

In Nature the infinite is simply achieved in uncomplicated steps. Once the mechanism is discovered the journey to the infinite is not only achievable but can be systematically appreciated. Nature's design exists predominantly in potential infinite whilst not requiring an actual infinite. The profound implication is a simple system creates an incomprehensible result.

### **Isomerism**

In chemistry, different compounds with different properties can exist with the same molecular formula, such that  $C_2H_6O$  can be Ethanol ( $CH_3CH_2OH$ ) with a boiling point (b.p.) of  $78.5^\circ$  or

Dimethyl ether ( $\text{CH}_3\text{OCH}_3$ ) with a  $-23\text{ }^\circ\text{C}$  b.p.. The distinction is the unique structural arrangement called *Isomerism* resulting in select characteristics. Friedrich Woehler, best known for his synthesis of urea and the discoverer of aluminum in clay, first noted isomerism in 1827 with his work in cyanic acid.

Just as *Structural isomers* differ in the ways the molecules are arranged as is the case of ethanol and dimethyl ether, *stereoisomerism* is molecular bonds in identical arrangements that differ in spacial relationships such as the organochloride 1,2-Dichloroethene ( $\text{C}_2\text{H}_2\text{Cl}_2$ ). *Cis* (Latin, on this side) and *trans* (Latin, across) *isomerism* results when stereoisomers cannot rotate bonds in space due to double/triple bonds or ring structures and are inimitable arrangements, ie. *cis*-1,2-Dichloroethene and *trans*-1,2-Dichloroethene are due to the double bond in ethene. *Cis-trans* relationships in Nature are meaningful to living organism conferring biological activity or inactivity owing to enzymes distinguishing between them.

Four carbon with 10 hydrogen have two arrangements or two structural isomers.

Restricting the structures to carbon and hydrogen with single bonds,  $\text{C}_7\text{H}_{16}$  has nine arrangements. Increasing the atomic ingredients accelerates the hypothetical structural isomers, such that  $\text{C}_8\text{H}_{18}$  and  $\text{C}_{15}\text{H}_{32}$  have 35 and 4,317 structural isomers respectively.

If a  $\text{C}_{10}\text{H}_{22}$  molecule with 75 structural isomers has four hydrogen removed the number of isomers is 5568, further reducing the molecule to  $\text{C}_{10}\text{H}_8$  results in 488,125 isomers.

The minute molecular of Omega-3 essential fatty acid ( $\text{C}_{22}\text{H}_{32}\text{O}_2$ ) has over 600 Million potential structural isomers. The profound implication is a simple system in Nature creates an incomprehensible result.

### **Stereoisomerism**

In compounds, stereoisomerism is due to tetrahedral stereogenic centers where the molecular arrangement around the centers are unique such as Carbon (the building blocks of all Life), Sulfur (the chains that bind the block of Life), Nitrogen (Life's energy source) and Phosphorus (Life's energy carrier). In these chiral molecules, the total number of hypothetically possible stereoisomers will approximate  $2^n$ , where  $n$  is the number of stereocenters. For example, Cholesterol, a small cell membrane ingredient, has eight stereocenters from eight asymmetrically bond tetrahedral carbon stereogenic atoms called chiral carbons, thus  $2^8 = 256$  stereoisomers are possible.

In Nature, chiral molecules display a surprising common rotational handedness. Biological stereochemistry is generally uniform for amino acids and sugars. They are systematically left-handed and right-handed respectively.

As the molecular complexity increases the number of hypothetical arrangements increase for the same atomic arrangement; twenty stereocenters may have 1,048,576 stereoisomers and fifty stereocenters may have 1,125,899,906,842,624 or approximately  $1.1 \times 10^{15}$  stereoisomers. Chymotrypsin, a small enzyme accountable for digestion of protein in pancreatic juice, is composed of 241 amino acids. It has 251 stereocentres, thus  $2^{251} = 3.6 \times 10^{75}$  hypothetical stereoisomers are possible.

Metal atoms such as cobalt, molybdenum and chromium with octahedral geometries may also display stereoisomers. As some molecular arrangements are unstable due to steric reasons the symmetry frequently has fewer than the maximum possible number of stereoisomers.

In most chemical reactions stereoisomers will have identical reactions. However, in Nature, enzymes preference one stereoisomer so that in many cases only *one* of the potential stereoisomers will be liable for biological activity! Again, the profound implication is a simple system in Nature creates an incomprehensible result.

### Amino Acid

Just as protein is essential to life, amino acids (*aa*) the building blocks of polypeptides are central to Nature. A protein primary conformation (shape) is a directional chained combination of *aa*. Cellular protein synthesis utilise twenty left-handed standard *aa*, thus the possible permutations are multiplies of the twenty. Three *aa* linked together have a possibility of: 20 possible *aa* in the initial position, 20 possible *aa* in the second position and 20 *aa* for the third resulting in (20x20x20) 8000 amalgamations. This exponential expression has the base 20 with the exponent the number of *aa* in the chain functioning as  $20^3 = 8000$ . A chain of four *aa* has (20<sup>4</sup>) 160,000 combinations.

The potential in this exponential operation quickly creates enormous possibilities with little complexity.

5 *aa* = 20<sup>5</sup> = 3.2 Million

6 *aa* = 20<sup>6</sup> = 64 Million

7 *aa* = 20<sup>7</sup> = 1.28 Billion

8 *aa* = 20<sup>8</sup> = 25.6 Billion

9 *aa* = 20<sup>9</sup> = 512 Billion

Ligase (from the Latin verb *ligāre* — "to bind" or "to glue together") is an enzyme that biochemically combines two molecules together by catalyzing new bonds. In the *Human* model a ligase that forms new carbon-carbon bonds is Pyruvate carboxylase which is an entwined structure of eight *aa* chains in two groups (3bg3+3bg9) that total 1281 *aa*. In the naïve mathematical model of exponential possibilities the number of possible *aa* combinations is  $20^{1281} = 4.16 \times 10^{1666}$ . It is estimated that the human body is composed primarily of 10,000 – 20,000 different proteins, the largest of which isolated is connectin, contains 26,926 amino acids.

### Deoxyribonucleic acid

Four deoxyribonucleotide bases, Adenine (A), Thymine (T), Cytosine (C) and guanine (G) covalently compose a single strand chain of DNA. Two chains coil into a double helix bold by hydrogen bonds between complimentary A=T and C≡G. It is the epigenetic structures and sequence of four nucleotides that express genetic information; therefore the feasible changes are multiples of four. TTAGGG, the telomeric repeat sequence in humans, is one of 4096 possible arrangements of six nucleotides, CGAGATAAG is one of 262,144 constructions and CGCGAGAATGTCATA is one of 1,073,741,824 configurations of 15 bases.

As the length of DNA increases so does the potential structures:

50 bases have  $1.2 \times 10^{30}$  combinations,

100 bases have  $1.6 \times 10^{60}$  organisations, and

150 bases have  $2.3 \times 10^{90}$  arrangements.

Considering that the human genome has 2.85 billion nucleotides, the Nile crocodile has 3.86 billion bases, the Greek tortoise has 5.32 billion and the marbled lungfish has 129.9 billion bases the impossibly mind-bogglingly enormous individual constructs for the genetic code exceed the capacity of the human mind.

### Infinity in Organic Chemistry

Simple architectural principles are observed in the structures of organic chemistry. The multitude of building blocks of Life invokes the near infinite potential in Nature, such as the carbon structures of Omega-3 essential fatty acid (C<sub>22</sub>H<sub>32</sub>O<sub>2</sub>) with its over 600 Million structural isomers and the resulting spectrum of individual characteristics, Chymotrypsin with its  $3.6 \times 10^{75}$  hypothetical stereoisomers of which only one may be functional within the biological system, and an enzyme the size of Pyruvate carboxylase being one of  $4.16 \times 10^{1666}$  possible amino acid arrangements.

Alchemists needn't invoke occult mysteries to overwhelm the mind and awaken the numinous. It is within the observations of modern organic chemistry that we not only find marvels of sacred geometry but also divine mathematics. Just as the four elements were considered in the technology of past millenium so too now the four deoxyribonucleotides fascinate current life science. It is not without profound contemplation that a modern researcher approaches experiments mindful of the vast universe of potential that exists.

Whilst attempting to manipulate the very mechenary of Nature, genetic scientists invoke the sentiment of the alchemist praying to be given an insight into the realm of the Gods. Just as an alchemist may look at his/her hands and ask, "Who am I to be able to perform transmutations?", so to can the geneticist glance at his/her hands and ask, "Who am I to create genetic constructs?"

A profound implication of organic chemistry is that simple design systems actually exist in Nature; that the system has plain foundations; these real designs are capable of creating an incomprehensible continuum of forms; to conceive the infinite and free thought of the confines of the 'indefinitely large' is to confirm the universe being infinite without thought.

A deeper realisation is that Nature utilises only a minute portion of the Infinite. The Conceivable is not necessarily observed in Nature. The human eye is limited to the visual spectrum of electromagnetic radiation. In Reality it is the realm of the Mind that contemplates and constructs imaginary possibilities. It is the mind that ultimately has to concede the actual limitations in Nature. Having meditated upon the mechanics and products of Nature in all the observable Materialism it is only an actual small possibility within the imagined potential. Why?

"No contradiction will arise as long as Finite Man does not mistake the infinite for something fixed, as long as he is not led by an acquired habit of mind to regard the infinite as something bounded," Johann Carl Friedrich Gauss (1831).