Intent from Mindless Mathematical Laws

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It's Coming Right At Us! (*The Illusion of Aim and Intent*)

Last September, I casually watched a tropical system (that eventually became known as Hurricane Matthew[1]) slowly move westward across the Atlantic Ocean and into the Caribbean Sea. Though many people lied in its predicted path, it posed no threat to me until it took an unanticipated sharp right turn in early October and started heading northwestward toward the east coast of the United States. After growing into a major hurricane, Matthew devoured the Bahamas, and headed for landfall on the Florida peninsula at Port St. Lucie, the city I live in.

The forecasters tracked Matthew literally hour-by-hour as it approached, continually attempting to determine what the storm would do next. In the day before expected landfall I prepared for the worst; then hunkered down that evening, not knowing what life would be like the next morning. However, just a couple of hours before what looked surely to be a direct hit, Matthew made a slight turn to the right, causing it to move more northward and parallel to the Florida coast. It spared us what surely would have been a catastrophe.

Throughout the story told in the preceding paragraphs, the mindless tropical system is treated as if it controlled the changes to itself and its path. First, we personified the storm by giving it a name, Matthew. After that, anything the storm did took on the feel of a deliberate action by the storm. It grew, it devoured, it turned and it spared us. In reality, unconscious meteorology and geography[2] dictated everything about the storm and its path, which pursued no goals other than proceeding in time from its current situation as the underlying fundamental laws of science dictated. The accuracy with which meteorologists can predict the tracks and intensities of storms demonstrates this[3]. However, to many people, both educated and uneducated, it felt as if Matthew was coming for us.

It seems we assign aim and intent to systems or situations that are incognizant and thoughtless in order to better understand and cope with them. It is easier to deal with an entity that possesses intent, than with something viewed to be acting indiscriminately. By treating it as if it knows what it is doing, we can study and learn its behavior on our level, and prepare ourselves to deal with its consequences.

My guess is; this subconscious need to give lifeless entities and situations pseudo-consciences likely stems from survival strategies established early in man's existence. The primary threats to people then were predators and rivals, both of which acted with aim and intent to harm them. Developing successful strategies for averting disaster probably involved identifying and assessing those intents and quantifying the actions taken to carry out the attacks. Once this was done, an effective defense could be formulated.

This process is similar to how physical laws were determined in the past; and, to some extent, how they are still determined today. We start by observing the high-level behavior of a system (that we may interpret as pursuing a goal). Then, we successively assess and codify through mathematical expressions the components of the behavior, working our way down from gross, empirical relationships to the most basic tenants. Consequently, the fundamental laws are derivatives of the higher behavior and naturally integrate up to it. These situations may suggest that the lower laws roll up to some kind of cognizance that drives the system to the observed end. However, the end is completely deterministic. The laws generated no intent.

A tropical low-pressure system does not aspire to become a hurricane. It does not intentionally do what is necessary for it to evolve into a tropical storm, or strengthen into a hurricane, or follow a certain track. While its behaviors during its lifetime may resemble those of aim and intent, they are strictly deterministic[4]. It is at the mercy of its environment.

On the other hand, there are physical systems that do appear to act with aim and intent – living systems. These systems actively seek and draw energy from their surroundings. They use that energy to grow. They expel useless and toxic waste products. They produce offspring that mimic this behavioral cycle. Animals consciously stalk their prey. Birds purposely build nests to house and raise their young. Plants deliberately turn their leaves toward the sun to catch its light. Even some bacteria propel themselves toward potential food. So, how can living systems, systems that truly appear goal-oriented, evolve out of a universe of fundamental physical occurrences expressed in terms of mathematics laws? How can they arise from laws that, at their lowest level, usually describe individual, one-time interactions? They can do so because the phenomena that mathematical laws describe build complexity and life represents the highest level of complexity known.

Abracadabra! (*Complexity from Mathematical Laws*)

At the lowest levels, the mathematical laws describing physical behavior involve the interactions of bodies with other bodies or forms of energy. The bodies interacting may be planets orbiting a star, protons attracting an electron, or particles colliding in a gas. However, one must take a giant leap to go from Newton’s laws of motion to cell mitosis. In some ancestral way, Newton’s laws relate to mitosis; but, for mitosis, the family resemblance has long been lost. Yet, we know cells are made of molecules, molecules of atoms, and atoms of protons, neutrons and electrons, and these particles are all constantly experiencing the realities of Newton’s laws.

So, how can the fundamental mathematical expressions of physical behavior take us from subatomic particles to physical systems such as living cells? They can do so because, in concert, they facilitate a critical process within the universe, the process that builds complexity. From this evolving complexity, the products and processes necessary to make outcomes specific to living things, such as cell growth and self-replication, are formed.

In many cases, when physical interactions play out at a given level of complexity, they produce higher levels of complexity. Entropy, a property of the universe, causes systems that have been organized in some way by an external energy source to revert back to their original disorganized state when the external source is removed. However, particle systems in the universe appear to be structured so that, if enough energy is applied to them, they cross a threshold that causes them to assume a higher level of complexity than they had initially. When the application of the energy ceases, they do not fall back to the original configuration they had before the energy was applied. They assume a new configuration that retains a higher level of order than before. The nucleosynthesis of protons[5] in the core of a star provides the subatomic entry point of this phenomenon.

Cooking With Gas (*The Formation of Atoms*)

When stars form, gravity draws the atoms in stellar clouds of hydrogen gas together. As gravity pulls the atoms in, it eventually compresses the hydrogen gas so strongly that its temperature rises, its electrons boil off, and it becomes a hot plasma soup of protons. The extremely high temperature (>10,000,000 °K) causes the protons in the plasma to collide violently with each other. Initially, the collisions are elastic. Buffered by the Coulomb repulsion produced by their like positive charges, the protons bounce off each other. While this occurs, if cooled enough, the plasma will expand causing the protons to spread out, reacquire electrons, and form hydrogen gas again.

However, if the temperature of the plasma gets high enough, during many of the collisions, the two protons get close enough to each other to form a nuclear bond that binds them together. As the temperature persists, those two bound protons may collide with another proton or with another cluster of bound protons to form even larger proton clusters within the plasma. For example:

$$\mathrm{p} + \mathrm{p} \rightarrow 2\mathrm{p} \quad \text{or} \quad \mathrm{p} + 2\mathrm{p} \rightarrow 3\mathrm{p} \quad \text{or} \quad 2\mathrm{p} + 2\mathrm{p} \rightarrow 4\mathrm{p},$$

where p is a proton and the number preceding the p gives the number of protons in the cluster.

When the plasma cools, the clusters do not revert back to the individual protons that existed initially. They retain their organization as clusters and, through processes such as radioactive decay, eventually become the nuclei of atoms more complex than hydrogen. A deuterium nucleus forms from a two-proton cluster, a helium nucleus from a four-proton cluster, a carbon nucleus from a 12-proton cluster, an oxygen nucleus from a 16-proton cluster, all the way up to an iron nucleus from a 56-proton cluster.

This higher level of complexity was born out of particles – the protons – succumbing to a concert of fundamental phenomena we express as mathematical laws including the law of universal gravity[6], Newton's laws of motion[7], the ideal gas law[8], Coulomb's law[9] and nuclear binding laws[10] (see Figure 1). Acting on its own, each law produces a unique effect, not necessarily related to those of the other laws. However, the superposition of the individual laws on each other causes them to form an orchestra of effects, each law playing its individual score of influence, which, in concert, harmonize into the beautiful symphony that is a complex nucleus. Attaining the higher level of complexity allows the new particles – the proton clusters – to configure themselves so that when the opportunity arises, they can acquire an even higher level of complexity.

Mathematical Laws in play during Nucleosynthesis within Stars

$1.\ a = \dfrac{GM}{r^2}$	**Law of Universal Gravity**	**Accelerates hydrogen molecules toward the center of the gas cloud**
$2.\ PV = nRT$	**Ideal Gas Law**	**Causes pressure and temperature of cloud to rise as gravity reduces its volume**
$3a.\ F = ma$	**Newton's Second Law of Motion**	**Establishes the force that the protons have when they collide**
$3b.\ F' = -F$	**Newton's Third Law of Motion**	**Describes the force with which the protons rebound after they collide**
$4.\ F = \dfrac{Qq}{4\pi\varepsilon_0 r^2}$	**Coulomb's Law**	**Creates a force that causes the protons to resist colliding**
$5.\ F = ?$	**Strong Force**	**Causes protons to bind together if close enough when they collide**

Figure 1: The mathematical laws governing nucleosynthesis

The proton clusters formed within the cores of stars cool and acquire electrons. One possible scenario is that as electrons arrive and attempt to form 1s orbitals around the clusters, the strong positive charges of the clusters draw those electrons into them via electron capture. This systematically reduces the charges of the clusters by changing protons into neutrons. At some point, the charges are reduced enough so that the arriving electrons can begin forming the orbitals. Those electrons then configure themselves around the nuclei in accordance with the laws of electrodynamics and quantum mechanics. For example:

$2\mathrm{p} + e \rightarrow {}^{2}\mathrm{H}^{+} + e \rightarrow {}^{2}\mathrm{H}$, or $3\mathrm{p} + e \rightarrow {}^{3}\mathrm{He}^{+2} + 2e \rightarrow {}^{3}\mathrm{He}$
$4\mathrm{p} + 2e \rightarrow {}^{4}\mathrm{He}^{+2} + 2e \rightarrow {}^{4}\mathrm{He}$, or $12\mathrm{p} + 6e \rightarrow {}^{12}\mathrm{C}^{+6} + 6e \rightarrow {}^{12}\mathrm{C}$
$15\mathrm{p} + 8e \rightarrow {}^{15}\mathrm{N}^{+7} + 7e \rightarrow {}^{15}\mathrm{N}$, or $16\mathrm{p} + 8e \rightarrow {}^{16}\mathrm{O}^{+8} + 8e \rightarrow {}^{16}\mathrm{O}$

where *e* is an electron and the number preceding the *e* is the total number of electrons either captured by the cluster before the electron orbitals of the atom start to form, or the number of electrons assembling around the bare nucleus to form the atom. The charge on the intermediate product indicates that the nucleus is bare; it has no electrons in its orbitals. Consequently, atoms including carbon (C), oxygen (O), and nitrogen (N) join the hydrogen (H) atoms as a new class of component particles. With the acquisition of electrons, the new particles – the atoms – are poised to go to the next level of complexity, molecules.

Better Together (*The Formation of Molecules*)

Again, nominal amounts of energy added to mixtures of these atoms will heat them up, but when the energy is removed, the mixture cools and the atoms retain their identities. However, when enough energy is provided to mixtures of these atoms, they cross another threshold and form covalent bonds[11] with each other by sharing electrons.[12] The energy to form covalent bonds is far less than what was needed to form the nuclear bonds of nuclei. It is comparable to energies from temperatures found outside of stars in terrestrial environments.

The covalent bonds produce molecules, which are clusters of atoms. For example:

$$H + H \rightarrow H_2, \text{ (hydrogen)}, \quad N + N \rightarrow N_2, \text{ (nitrogen)}, \quad \text{and} \quad O + O \rightarrow O_2, \text{ (oxygen)}.$$

The molecules are a higher level of complexity than individual atoms. Now, when the mixture cools, instead of reverting back to its original collection of atoms, it retains the molecules, the higher level of complexity. From the atoms discussed above, this process formed molecules such as methane (CH_4), ammonia (NH_3), carbon monoxide (CO) and water (H_2O):

$$2H_2 + O_2 \rightarrow 2H_2O \text{ (water)}, \quad C + 2H_2 \rightarrow CH_4, \text{ (methane)} \quad \text{and} \quad 3H_2 + N_2 \rightarrow 2NH_3 \text{ (ammonia)}.$$

These molecules are the raw materials of the building blocks of life. From them, more complex molecules form including sugars such as glucose ($C_6H_{12}O_6$), ribose ($C_5H_{10}O_5$), and deoxyribose ($C_5H_{10}O_4$); the bases adenine ($C_5H_5N_5$), guanine ($C_5H_5N_5O$), cytosine ($C_4H_5N_3O$), thymine ($C_5H_6N_2O_2$), and uracil ($C_4H_4N_2O_2$); the 20 amino acids found in living cells; and many proteins.[13]

A number of experiments, starting with the Miller/Urey experiment[14] in 1952, have shown that the biomolecules can be synthesized from the simpler molecules discussed above in various conditions thought to have occurred on early Earth[15,16]. Covalent bonds, which can be explained in terms of mathematical laws, and the structure of the carbon atom, make the formation of these biomolecules possible. Together, they raise complexity to the next level.

Team Carbon (*The Formation of Biomolecules*)

The carbon atom has four electrons in its second orbital ($2s^2 2p^2$), which produce four sites for potential covalent bonds. Figure 2 shows some of the configurations the bonds may take.[17] Configuration A is the one that produces elemental carbons like graphite and coal. Bonds 2, 3 and 4 are coplanar, with bond 1 perpendicular to the plane. Configuration B makes the carbon chains found in some organic molecules like glucose. Here, all four bonds are coplanar. The configuration C forms rings such as those found in benzene molecules. Again, the four bonds are coplanar. In a fourth configuration (not shown), the bonds assume a tetrahedral configuration that produces diamonds. The arrangement in configuration C produces a higher level of complexity than A or B, and is found in the biomolecules that make up the nucleic acids.

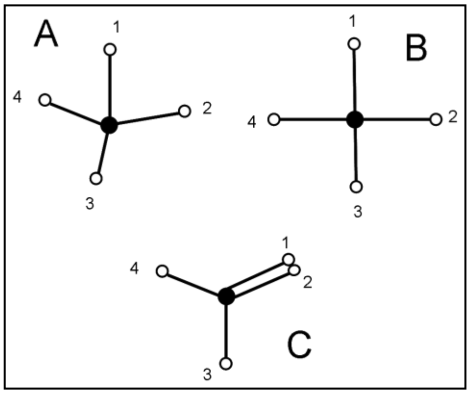

Figure 2: Some arrangements of the four carbon bonds.

The diagrams in Figure 3 show some of the various configurations that the biomolecules form because of the flexibility of the carbon bonds.[18] Alanine, an amino acid that was produced in the Miller/Urey experiment, and glucose, a sugar, are both linear chains of carbons. The five-carbon molecule, deoxyribose, the sugar found in deoxyribonucleic acid (DNA), is a pentagon-shaped ring. Thymine, one of the four bases in DNA, is a six-carbon hexagonal ring, and adenine, another of the DNA bases, is a five-carbon double ring made of a pentagon attached to a hexagon.

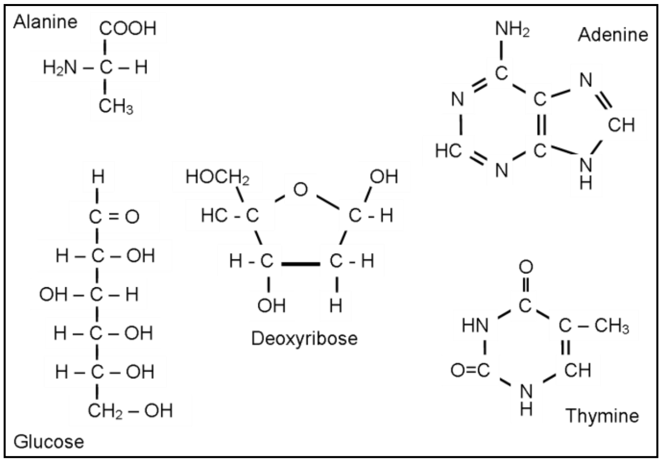

Figure 3 Some examples of hydrocarbons

The sugar ribose, found in ribonucleic acid (RNA), is identical to deoxyribose except that an OH replaces the H in the lower right-hand corner. The DNA base guanine is similar to adenine. Both are derived from the compound purine. The other DNA base, cytosine, and the RNA base uracil, resemble thymine, a pyridimine derivative.

The carbon-ring molecules such as adenine, thymine and deoxyribose are a higher level of complexity than the carbon-chain molecules like alanine and glucose, which are a higher level of complexity than atom-cluster molecules like methane. They raise complexity to the next level by binding collections of simple molecules to their ring of carbon atoms. These carbon rings provide the building blocks for the next level of complexity, that sees them bound together to make nucleotides and nucleic acids.

Adam and Eve (*The Formation of Nucleic Acids*)

The five bases, adenine, cytosine, guanine, thymine and uracil, the two sugars deoxyribose and ribose, along with phosphoric acid are the components of the next level of complexity, nucleotides.[19] Nucleotides are the building blocks of RNA and DNA. They form when one of the bases attaches to a sugar with a covalent bond called a glycosidic bond, and phosphoric acid binds to the sugar via another covalent bond called a phosphoester bond. The reactions that create both bonds produce a molecule of water as a byproduct.

The nucleotides bond two complex carbon rings together, the sugar and the base, and attaches them to a phosphate. There are four nucleotides built from deoxyribose, the one built using adenine, usually designated as A, the one built from thymine, T, the guanine nucleotide, G, and the cytosine nucleotide, C. There are also four nucleotides made from ribose, the one made with adenine, also designated as A, the guanine one, G, the cytosine nucleotide, C and the final one, made from uracil, U. Thymine does not normally bond with the ribose sugar or uracil to deoxyribose.

The nucleotides provide the building blocks for an even higher level of complexity, the nucleic acid.[20] Nucleic acids form when the open ends of the phosphates of nucleotides attach to the sugar of another nucleotide, forming a chain of nucleotides. The connecting bonds are, once again, covalent bonds.

Nucleic acids vary in length ranging from two nucleotides to billions of them. RNA, ribonucleic acid, typically forms in single chains. However, in what is likely the ultimate level of complexity (maybe in the universe), deoxyribonucleic acid, DNA, bonds two chains of nucleic acids together by the free ends of their bases (see Figure 4). The A bases connect only to T bases and T bases only to A bases, and the C bases connect only to G bases and G bases only to C bases. This forms a double chain of nucleotides that resembles a ladder, with each segment of two bases joined together serving as a rung of the ladder. The DNA ladder twists lengthwise to create what is termed a double helix. The bonds joining the bases are hydrogen bonds, which are weaker than covalent bonds. The weaker hydrogen bonds allow the two chains to easily separate.

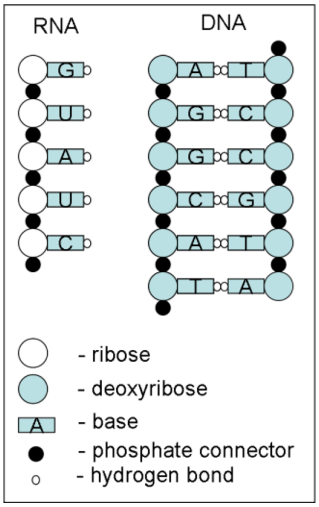

Figure 4: RNA and DNA

Can You Understand It? (*The Complexity of DNA*)

The DNA molecule[21] is at the heart of all cells. Its two long chains of nucleotides,[22] bound together, contain all the information needed to run and reproduce the cell.[23] The two bound chains form the spiral, ladder-like double helix, with a number of "rungs" in the ladder. The DNA found in eukaryotes, the complex cells of higher life forms, is thought to have roughly 3 billion rungs. Prokaryotes, the simpler cells such as those of bacteria, have far fewer, especially the earlier ones. Chemistry dictates the structure and function of this complex molecule, which means that mathematical laws are in play.

The structure of DNA allows it to reproduce itself in a deterministic way. When DNA replicates[24] itself, its two nucleic acid chains progressively separate (unzip) from top to bottom. As the bases of the two nucleic acids become exposed, free nucleotides in the nucleus are attached to them by the enzyme DNA polymerase to replace the one that separated. Since each base can only bond to one type of the others, the new nucleotide attached to a base is always the same type that was there before. This allows each nucleic acid chain (half-DNA) to replace the other chain precisely, resulting in two DNA strands identical to the original one.

In addition to containing the blueprint of the cell, the DNA also directs what, when, where and how everything in the cell happens. It does this through the use of instructions conveyed in the form of proteins. The proteins target and activate or deactivate specific components of the cell, similar to how electrons activate and deactivate components of electronic devices at the direction of a central processor.

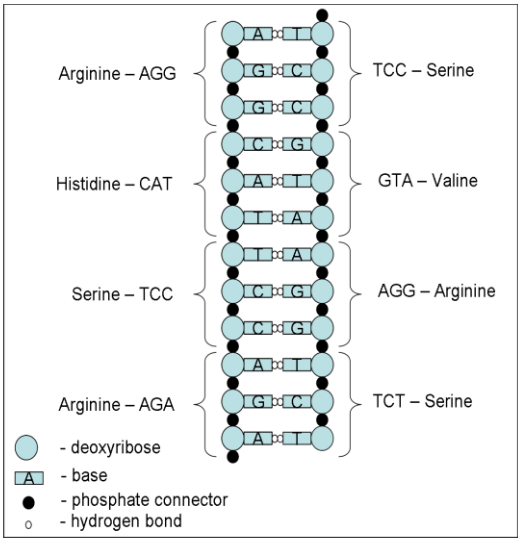

Figure 5: Examples of codons on span of DNA

When the two long sequences of nucleotides in DNA are broken into three-nucleotide segments, they form elements of a code called codons[25]. Each of the 20 amino acids that make up the proteins in living cells is represented by one or more codons. The 20 amino acid codons are similar to the 26 letters of the alphabet. Meaningful sequences of codons form genes, which are synonymous to the words alphabets form. Just as with alphabets to words, codons can be arranged in an infinite number of sequences and numbers to form a gene corresponding to any protein needed to make something happen within the cell.

With four nucleotides available (A, T, C, G) for the code, there are 64 codons possible (4^3). Of the 64 codons, 61 of them code to one of the 20 amino acids, with several redundancies occurring. Three of the codons are used to indicate where a gene stops on the DNA. One of the amino acid codons indicates where the gene starts. Figure 5 shows an example of how codons work and the actual amino acid corresponding to the designated codon.

What's Going On? (*Discovering the Logic in DNA*)

Up to this point, all the advances in complexity appear to have occurred purely by chance. If the right materials were in the right place under the right conditions, the next level of complexity would be realized. However, with the team of DNA and RNA, things changed. Somehow, someway, chemical reactions ceased to occur randomly and began being orchestrated by these two nucleic acids.

With RNA as her drones, queen DNA runs the operations in a cell like a colony of ants or a hive of bees; a single DNA molecule at the center of the cell directing the activities and reproducing, while countless RNA molecules serve her needs, carry out her orders and maintain the cell. In DNA and RNA, the mathematical laws made a leap from producing random events to causing deliberate occurrences. This is where the mathematical laws gave rise to aim and intention.

DNA uses proteins to send and receive information regarding cell operation. Proteins to DNA in a cell are like the electrons dispatched and received by a processor on a printed circuit board; except the variety of proteins generated allows for information to be conveyed without hard-wire connections between components.

The proteins that carry the instructions from DNA to cell components are built within the cell by ribosomes[26] as they are needed by a process called translation. The ribosomes use a type of RNA called ribosomal RNA (rRNA) to prepare proteins from the recipe of amino acids delivered to them by messenger RNA (mRNA). The mRNA decodes the recipe from sequences of nucleotides on the DNA that form a gene by a process called transcription. The amino acids needed to build the protein are procured and delivered to the ribosomes by transfer RNA (tRNA), which gets the amino acid order from the mRNA. The level of organization, coordination and cooperation among the RNA players is striking.

The genes on the DNA have spans called regulatory DNA sequences[27] that act as switches on the gene. When proteins called transcription regulators attach to the regulatory DNA sequences, they either turn the genes on or off. This, in turn, affects the production of proteins that drive one or more processes occurring within the cell and allows the DNA to manage the activities within the cell through a process called gene expression.[28]

A regulatory DNA sequence may span many nucleotides within a gene and require several transcription regulators to engage it. This allows the DNA to employ Boolean logic in initiating or suspending an activity. The DNA can build IF–THEN, AND, OR and other logic into controlling the activity, allowing DNA to make management and operational decisions based on changing information.

A transcription regulator brings information about what is happening for a specific aspect of cell operation to the gene. By requiring several transcription regulators to start up a regulatory DNA sequence, the DNA gets to use inputs from several sources to determine if the activity sponsored by the gene is needed. If one or more of the required transcription regulators is missing, then one of the conditions for initiating the action is not met, and the DNA keeps the gene set in its normal position. The presence of transcription regulators within the cell change over time due to activities occurring within the cell and the influence of the environment outside the cell. Correspondingly, the DNA can adjust the production of the appropriate proteins to respond to these changing conditions.

So, DNA performs a number of deliberate actions that seek goals and display intentions. It collects information from within the cell and the environment surrounding the cell. It analyzes that information to determine the needs of the cell. It makes decisions about what needs to be done to maintain the cell. And it dispatches its RNA workforce to carry out those tasks. All of these actions appear to be deliberate, that is, they are the will of the DNA, and appear to be implemented to achieve specific ends.

Let's Start from the Beginning (*The First Active DNA*)

Living beings appear to be the only true entities on Earth that naturally seek goals and have intentions. There are non-living entities (e.g., artificial intelligence devices) that approach the capacity for expressing aim and intent, but they are not capable of growing and reproducing in the manner that living organisms do. Also, they are usually built by people (living beings) so they are not natural entities, which brings us to the question of how life arose from inert matter?

The origin of life is a hotly debated subject nowadays[29,30] with primarily two factions; the creationists,[31] who insist that God or some divine entity created life; and the evolutionists[32], who ascribe to the idea that life somehow sprang up out of chemicals found on early Earth and gradually evolved into all the plants and animals found today. This essay will not, and is not trying to, settle this debate. However, we can get a feel for what might be how life started; that is, if God did not just create it all in five or six days.

We know, from the earliest fossil records, that prokaryotic creatures, such as bacteria, were probably some of the first life forms on Earth.[33] These single-celled life forms, like bacteria today, had all of their vital organs contained in one membrane. Their DNA was simpler than most animal DNA today, and it was not contained inside a nucleus.

Higher forms of single-celled life, such as amoebas or paramecia, the eukaryotes, still had all their organs in one membrane, but their DNA now resided in a nucleus that separated it from the rest of the cell. If you are in the evolutionists' camp, you suspect that the isolated, protected DNA gives these cells an advantage over the prokaryotes.

The highest forms of life are multi-celled beings ranging from insects all the way up to human beings. Their design includes organs made of many specialized cells that perform the various functions once done in one cell. While each of the cells still contain DNA that control and reproduce the cell, the reproduction and master control of the entire multi-celled entity have been specialized and placed in individual organs. Now, the activities of the whole being are coordinated and controlled by the brain. The entity is still contained in a single membrane, the skin or shell; but it is as if all of the organelles of the single-celled entities were promoted and given a division of subordinates to get their jobs done. In other words, a body is like a large, extremely complex cell.

From all of this, we see that complexity continued to evolve even after biomolecules made the jump to nucleic acids and living systems came into being. Borrowing a page from cosmology,[34] if we start with the higher beings and play the tape backwards, we see the complexity of life rewinding toward what extrapolates to the initiation of life. Assume the reproduction and control center of a living being establishes its life. Then going from the control center being a brain in a head at the top of the body, to DNA in a nucleus near the center of a cell, to DNA being out in the open near the center of the cell, suggests that, before cells, life existed as crude DNA molecules residing in the open environment.

In this open environment, the DNA molecules would be in a communal setting with many DNA molecules sharing the surrounding resources. The pool or blob they resided in would have to have a high concentration of amino acids and proteins, and a host of RNA molecules that randomly serviced all the DNA molecules. In this large "colonial cell", individual DNA molecules could split and make new DNA molecules, growing the DNA population of the pool. It is likely that any DNA not formed in this environment would be inactive and remain dormant as an inert organic molecule like a sugar or a lipid, unless or until it drifted into one of the DNA communities. Perhaps, if the pool also contained phospholipids,[35] which are long amphiphilic molecules that self-assemble[36] into bilayer membranes,[37] they occasionally isolated a DNA molecule with some RNA molecules and a large helping of the protein – amino acid soup and formed the first cells.

What Does It All Mean? (*Conclusion*)

We have taken a journey up the road of complexity from protons to DNA, compliments of mindless mathematical laws. Along the way, we determined that, some things appear to act with intent, but, in reality, are at the mercy of their environments. We saw how the structures of particles allow them to increase their utility when enough energy is applied to them. We also saw that the ultimate complexity transforms a collection of particles into a molecular entity that seeks goals and acts with intent. The evolution from elementary particles to DNA appears to be one of the ways that mindless mathematical laws give rise to aims and intentions.

To revisit our friend Hurricane Matthew before we end, if it had sampled its surroundings to determine in which direction warmer water resided, then changed direction toward it; that would be deliberately seeking a goal. If Matthew had sensed it was headed toward land and turned to avoid it; that, too, would qualify as intent. However, Matthew's life ended in cold water, straddling the east coast of the United States. It had no control over its destiny.

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