

## Origin of Life in Earth in Microbes and Viruses

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Origin of life in our earth is a mystery. Nobody exactly knows when the first life appeared in the earth. But it is sure that the basic constituents of life like Carbon, Hydrogen, Oxygen, Nitrogen and Phosphorous combined in a proportionate way to create first life in earth. We know that for any chemical reaction an optimum temperature, pressure, catalyst and reagents are required which if present in suitable proportion, the reaction can occur and the desired product is formed. Probably the origin of life started from the first production of purine, pyrimidine rings, amino acids and nucleic acid chains and the first life in earth is prokaryotic microbes which probably evolved from the virus like particles but not the exact viruses. Modern day viruses are the defective forms of these primitive particles which cannot replicate independently but only inside the host cells using host cell machinery. But the first living particle probably was the virus like particle with independent replicating capability. So the synthesis of DNA & RNA polymerizing enzymes was the turning point towards the creation of life. Therefore, it is clear that we should search the origin of life in viruses and microbes which are the smallest living particles. Microbes and viruses are the living dusts and probably it was formed even when the earth was hot. Archaeobacteria, thermophiles, methanogens are the proof that living organisms can even survive in high temperature, acidic pH and absence of oxygen. These microbes originated long before the origin of higher plants, as for the production of fertile land suitable for growth of plants, microbes are required. Inorganic substances, water and microbes for many years formed the layer of fertile land on the surface of earth. Structure of viruses which are lacking the cytoplasm and definite cellular structure but containing nucleic acid core and protein covering are the proof that nucleic acid strands were first produced and later on, in presence of water they created the desired products to form cytoplasm and biological membrane to create primitive cell.

To make it logically more comprehensible the origin of life can be divided into several steps discussed below:

- Step I: Formation of basic structural elements or building blocks of life like purine and pyrimidine rings, amino acids, glucose, phosphate energy bonds etc.
- Step II: Formation of more complex structural forms by chain elongation of basic structural molecules.
- Step III: This is the most vital or crucial step where systematic assembling of all these structural elements lead to a structural unit with functional autonomy where all the biochemical reactions can occur automatically, repeatedly in an organized way, making it an autonomic functional unit capable of bio-chemical synthesis, degradation (metabolism), energy production and self-duplication (reproduction).

In this context it is worth mentioning that the above mentioned Step I can be explained by the Miller-Urey Experiment where Stanley Miller in conjunction with fellow scientist Harold Urey, in 1953 first and famously demonstrated the spontaneous synthesis of amino acids, organic compounds that contain carbon and that are required as the basis of life on Earth, from the inorganic precursors and the simplest of organic molecules: methane in a laboratory set-up mimicking primitive atmosphere.

A reducing environment and higher amounts of free energy like lightning storms and high temperatures may have contributed to the origin of life on earth. However, since then, the earth has seen a change of atmosphere from a reducing environment to our present day over-all oxidizing environment. The Miller-Urey experiment strengthened the hypothesis that "spontaneous generation of the first living organisms might reasonably have taken place if large quantities of organic compounds had been present in the oceans of the primitive earth" (Oparin, 1957). Electric discharge of thunder storm and UV radiation from our solar system may have 'played a significant role in the formation of compounds in the primitive atmosphere' (Miller, Science 1953). May be at first there was the development of simple heterotrophic organisms (organisms that obtain their basic constituents from the environment) before autotrophic organisms (like photosynthetic plants) appeared in the earth. The heterotrophic origin of life was proposed by Oparin (1924) and Haldane (1929) who accepted the idea of a primordial protoplasm but proposed that life had been preceded by a lengthy period of abiotic syntheses and accumulation of organic compounds from the "hot primitive soup". However, later on with the developments of Biochemistry & Molecular Biology & the scientific trends towards the understanding biological phenomena at the molecular level led authors like Troland (1914), Muller(1961) and others to propose that single molecules or viruses represented primordial living systems.

As we are trying to unravel the mysteries of origin of life in our planet and as till now the number of planets that have been discovered in our universe, traces of life have not yet been found in any other planet except in earth, so it can be postulated that the creation of life from the nonliving materials is an extremely rare phenomenon and it happened in earth as a chance phenomenon. May be the first development of the basic structural element of life and the systematic organization of them to create the first living form took a long time to happen, just like the evolution of higher animals from the lower animals.

Another question that also strikes our mind is which cell first appeared in our earth? Plant cell or the animal cell? If we follow the rule that simple thing appears first and the complex thing appears later on, then we shall say in favor of plant cell. After the creation of plant kingdom, the huge biomass that was produced in our earth, favored the development of animal kingdom. Here we can say that the creation of the biological membrane with lipid bi-layer of cholesterol and phospholipids was the break- through of evolutionary pathway towards the creation of animal kingdom.

As we have divided the creation of life in earth in three steps and step I can be explained by the Miller-Urey Experiment (1953), but the most difficult part is to explain the Step II and Step III. How the formation of more complex structural form by chain elongation and how the systematic assemblage of these parts occurred to achieve functional autonomy and forming the first living form?

To explain the formation of more complex structural form by chain elongation, it can be said that the purine and pyrimidine ring have some unusual property of organizing and assembling carbon, hydrogen, oxygen and nitrogen molecules in a systematic way. RNA hypothesis of origin of life favors the assumption that uridine (uracil) ring is the most active ring and if we follow the several biochemical reactions in living body it becomes more clear that the uridine ring and the phosphate bond (Uridine mono-phosphate, Uridine-di-phosphate and Uridine-Tri-phosphate) helps in the polymerization of carbohydrate and fatty acid chains and more importantly uridine chain creating the mRNA and tRNA helps in the polymerization of aminoacids creating protein molecules which are the building block of life. So it strengthens the idea that pyrimidine and also purine rings and phosphate bonds are the key structures towards the creation of life.

Though the chain elongation towards the formation of more complex form can be partly explained, the most difficult part is to explain how the systematic assemblage of these parts occurred in such a complex and organized way to achieve the functional autonomy and forming the most incredible and mysterious form of thing in the universe which is life and it can be easily challenged that life as a single cell is several times more complex than a computer CPU!!

Now if we observe the nature’s rules minutely and try to explain things by following the nature’s rule then we can give some light about the origin of life. To explain this more easily we can create a new hypothesis which is called Random Collision and the Association and Rejection with the Acquisition of Added characteristic Hypothesis.

According to this hypothesis it can be said that at the beginning of the creation, just like inorganic molecules randomly come in contact with each other, in the similar way bio-molecules also come in contact with each other at random. As we know that the bio-molecules have some affinity to each other if suitable condition prevails (just like a positively charged compound can be attached to a negatively charged compound), the combination occurred at random following the rules of permutation and combination. Here we can give some simple examples---

“A” combining with “B” forming “AB”, next “B” combining with “C” forming “BC” and so on

- A + B = AB
- B + C = BC
- C + D = CD
- D + A = AD

Now when “A” combines with “B” forming “AB” and if “AB” can acquire some extra property by which it can combine with another molecule “XY” to form “ABXY” then automatically it was selected by nature. On the contrary, if “B” and “C” after combining to form “BC” do not acquire some extra property or added character to combine with “XY”, then it was rejected. So this chain-wise selection and rejection processes can explain how it proceeds further to form more complex molecules. Whenever a new structural form was produced, if it acquired some extra functional capability, it was automatically selected by nature. Whereas the combinations that did not acquired some extra functional capability, that did not proceed further.

AB+ XY ----- ABXY +αβ -----ABXYαβ + γδ -----ABXYαβγδ

(acquired extra characteristic by combining with AB, XY, αβ, γδ and proceeded further in a sequential way to form AB, ABXY, ABXYαβ, ABXYαβγδ and so on )

AB+ XY -----ABXY +  $\gamma\delta$  ----- ABXY $\gamma\delta$

(acquired extra characteristics by combining with AB, XY but not after combining with  $\gamma\delta$ . So it proceeded to form AB, ABXY and ABXY $\gamma\delta$ . But as it did not acquired extra functional characteristics after combining with  $\gamma\delta$ , so it did not proceeded further from ABXY $\gamma\delta$ ).

So in this way, following the nature's rule it can be explained that bio-molecules by random collision and then combination and then acquisition of some functional capability, proceeded towards the more complex form with extra functional capability and ultimately led to the formation of living form with complete functional autonomy. Step by step by random association and rejection, it acquired the step by step functional capability and as microbes are the smallest living cells so it can be assumed that they are the first living cells in earth. From the structures of viruses it can be depicted that before the origin of fully developed unicellular organisms only the RNA or DNA core was developed with limited functional capability of producing few structural proteins and enzymes and in presence of water later the nucleic acid core evolved to form more complex form to produce all the necessary components of cytoplasm, cell membrane and other necessary enzymes to evolve into an independent existing cell. So Darwin's theory of evolution helps in explaining the development of independent primitive cell (prokaryotes) from the core of nucleic acid with limited structure, similar to that of a virus. And the Darwin's theory of evolution can be explained at the molecular level by the fact that during DNA replication some errors can occur during base-pairing, leading to the mutations which can be propagated to the next generation and the accumulation of the favorable mutational changes in a cumulative way led to added characteristics.

Now one thing that strikes the mind is what is meant by the acquisition of new functional capability. We can say that the bio-molecules in a living cell are interconnected in such a way that if one interconnecting pathway is linked with the signal transduction, the effector molecule produced will result in a cleavage of another molecule and that cleaved product may be responsible for stimulating a particular gene to produce a final end product by transcription and translation. So we can say that all the bio-molecules are interconnected with one another in such a finely tuned way or we can say better as a finely programmed way which is responsible for several functional outcomes. Here with the help of this random collision, selection and rejection and acquisition of new functional capability hypothesis, it can be said that overall functional capability and structural organization was achieved step by step with the formation of new molecules where in each step the terminal product produced was one step ahead in functional capability from the preceding one, whether it is the formation of trans-membrane receptor or the formation of cAMP or cGMP molecules or the creation of signal transduction pathway.

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