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A CRITICAL STUDY OF THE THEOLOGICAL AND ETHICAL ASPECTS OF SCIENCE'S ATTEMPT TO SYNTHESIZE LIFE

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ABSTRACT:
Researchers are actively involved in 'creating life' by synthesizing and manipulating the genetic materials and other cell organelles using the tools of synthetic biology. Synthesize of the complete DNA sequence of the bacteria and the creation of synthetic cell with this genome was a milestone in the field of synthetic biology. Some Obvious Questions have come to the fore on the theological and ethical aspects of this discovery. In this study the various beneficial as well as dangers of this marvelous leap in the world of life sciences is analyzed.

Life is an incredibly complex unsolved mystery and the question of life's primordial beginning is one of the existential questions that man have pondered since ancient times. According to Scientists Life is a characteristic physical entity having biological processes. Atheists and religious people have different opinions. The origin of life can be addressed in the platform of interdisciplinary approach that covers chemistry as well as biological, physical and philosophical sciences.

Chemical perspectives of origin of life

While analyzing the origin of life from the chemical perspectives, we need to consider the synthesis of elements as the first step because all living beings are made of atoms and molecules. The key elements involved in the origin of life were formed by complex chemical reactions that might have occurred in the cores of the stars. The enormously high temperature at the core of the stars facilitated the thermonuclear reaction, thereby heavy elements were formed. Many complex chemical reactions involving hydrogen, carbon, oxygen, nitrogen, sulphur and phosphorus eventually led to the formation of bimolecules, the precursors of the orgin of life

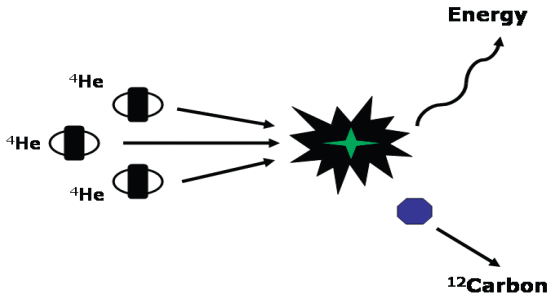
$^{1}H + {}^{1}H \rightarrow {}^{2}H$ (deuterium)

$^{2}H + {}^{2}H \rightarrow {}^{4}He$ (helium)

$^{12}C + {}^{4}He \rightarrow {}^{16}O$ (oxygen)

$^{16}O + {}^{16}O \rightarrow {}^{1}H + {}^{31}P$ (phosphorous)

$3 \times {}^{4}He \rightarrow {}^{12}C$ (carbon)

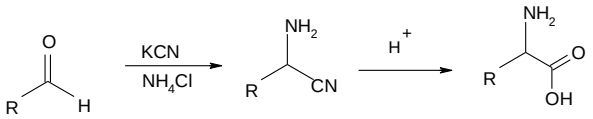


Chemoautotrophic origin of life

Any organism capable of synthesizing own food from inorganic materials using light/chemical energy. According to the Chemoautotrophic origin of life it is suggested that life started autotrophically and that the oxidative formation of pyrite (FeS_2) satisfies all the necessary conditions to be met by an energy source for such an origin. Prebiotic Chemistry suggests that biomolecules are the antecedent of the origin of life and are formed by numerous chemical reactions that might have happened in the primordial earth.

The Strecker reaction for amino acid synthesis and formose reaction for carbohydrate synthesis have been known as the front-runners for the genesis of biomolecules. The Strecker amino-acid synthesis involves the synthesis of amino acid from carbonyl compounds such as aldehyde or ketone in a series of chemical reactions. In the first step, aldehyde condensed with ammonium chloride in the presence of potassium cyanide to form an alpha

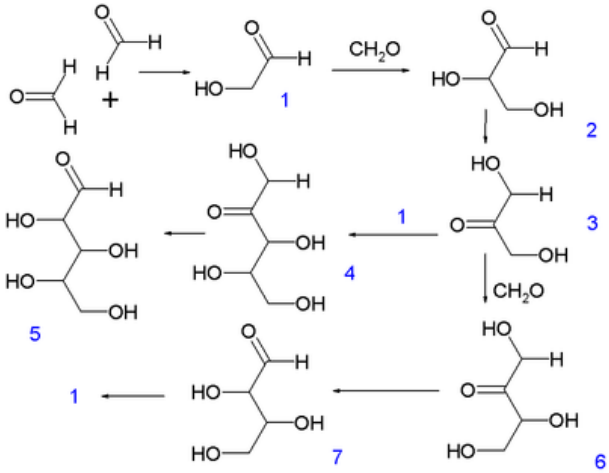
aminonitrile, which is further subjected to hydrolysis to give the desired amino-acid



Aldehyde Amino nitrile Amino acid

The formose reaction involves the synthesis of sugars from formaldehyde and as far as the question on the origin of life is concerned, the formose reaction is of great importance as it explains part of the path from simple formaldehyde to complex sugars like ribose and from there to RNA (Ribo Nucleic Acid).

The reaction starts with the condensation of two molecules of formaldehyde to make glycolaldehyde which further reacts in an aldol reaction with another equivalent of formaldehyde to make glyceraldehydes. This is followed by a series of reactions led leading to the formation of aldotetroses and this reaction is highly useful for the synthesis of ribose sugar, the main constituent of RNA



The reaction begins with two formaldehyde molecules condensing to make glycolaldehyde 1 which further reacts in an aldol reaction with another equivalent of formaldehyde to make glyceraldehyde 2. An aldose-ketose isomerization of 2 forms dihydroxyacetone 3 which can react with 1 to form ribulose 4, and through another isomerization ribose 5. Molecule 3 also can react with formaldehyde to produce tetrulose 6 and then aldoltetrose 7. Molecule 7 can split into 2 in a retro-aldol reaction.

These reactions are credible in the early earth conditions and the molecules formed by these chemical reactions (amino acids, carbohydrates, nucleic acids) might have held together by hydrogen bonding and other electrostatic interactions, eventually leading to the accumulation and formation of more complex molecules.

These complex organic compounds formed on the primitive earth later tended to accumulate and formed cell-like large colloidal aggregates called protobionts, giant molecules containing RNA, protein, polysaccharides, etc.

The modern theory of the origin of life also supports the occurrence of these chemical reactions in the primitive earth.The first life forms were unable to synthesize their own compounds, but were formed from and dependent on pre-existing organic compounds of abiotic origin

It is also proposed that primitive life originated in the water bodies on the primitive earth from non-living organic molecules such as RNA, proteins, etc. by chemical evolution through a series of chemical reactions about 4 billion years ago.

This theory has been experimentally tested by Stanley Miller and Harold Urey and synthesized the organic compounds under primordial earth conditions

Miller's 1953 experiment was followed a few years later, Or´o and Kimball synthesized adenine, the nitrogenous base in DNA, by the polymerization of HCN under basic conditions

These experiments follow a generalization that if this can happen in a lab, it could have occurred in a similar way on the primitive earth atmosphere.

Though researchers synthesized biomolecules (proteins, polysaccharides, RNA, etc), in the lab by establishing the primordial earth conditions, how life 'originates' from these non-living

molecules by chemical processes or any other phenomenon still remains a mystery beyond our comprehension. Nonliving biomolecules do not symbolize life since there is a definite gap existing between non-living molecules and living beings.

There are so many questions before us to be answered, How living organisms came into existence out of non-living matter? How the first living cell could have appeared in the primordial atmosphere on the earth.? The first person to take this matter in hand was the Russian biologist Alexander I. Oparin He says the following in his book *The Origin of Life*, "The problem of the origin of the cell is perhaps the most obscure point in the whole study of the evolution of organisms". Professor Klaus Dose, the president of the Institute of Biochemistry at the University of Johannes Gutenberg, states that "More than 30 years of experimentation on the origin of life in the fields of chemical and molecular evolution have led to a better perception of the immensity of the problem of the origin of life on earth rather than to its solution. At present, all discussions on principal theories and experiments in the field either end in stalemate or in a confession of ignorance

Creating life from the laboratory

Currently, **researchers** are actively involved in 'creating life' by synthesizing and manipulating the genetic materials and other cell organelles. Using the tools of synthetic biology, scientists from the John Craig Venter Institute California created the first "synthetic life" form. Craig Venter and his team synthesized the complete DNA sequence (genome) of the bacteria *Mycoplasma mycoids,* a goat pathogen. With this genome they created a sythetic cell This cell was completely controlled by man-made DNA, This was a milestone in the field of synthetic biology. Some Obvious Questions have come to the fore Has humanity really evolved from creature to creator? What is the impact which such research may have on the community? Who should bear responsibility for the harm caused by the use of such systems? Critics express concerns about "playing God," threatening biodiversity and disrespecting the meaning of life. Even though these questions are very disturbing, there are some positive aspects. This technology can be utilized for the production of biofuels, vaccines and other useful chemicals. For example, NBC news on 19th January, 2015 reported that this kind of technology is utilized by the researchers to develop genetically modified cattle with human DNA for Ebola cure. Escherichia coli cells are programmed to destroy cancer cells In 2006, Jay Keasling at the Lawrence Berkeley National Laboratory in California inserted a group of genes into yeast to produce a precursor (starting molecule) of an anti-malarial drug.Recently, by inserting some extra genes into the harmless strain of *Escherichia coli* bacteria, scientists at the Rensselaer Polytechnic Institute, New York, have produced anthocyanins, the powerful antioxidants that scavenge free radicals produced through metabolic processes.

Creation of synthetic life though beneficial, raises profound ethical as well as theological concerns about the probable misuse of this emergent technology. Nobody knows the consequence of releasing the new organisms into the environment.This technology could be used as a shortcut to creating a harmful pathogen, by terrorists and anti-social groups might otherwise have to find in nature or steal from a government-controlled laboratories for biological weapon for instance the anthrax attack in the US

The controversy pertaining to the creation of life and the consequences of introducing new life form into the environment prompt us to investigate further on this to ensure hope and security in the context of the scientific predictions and mounting apprehensions. For the ethical analysis on the prospect of the creation of synthetic cell by Craig Venter team, the methodology based on the principles of the US Presidential commission for the study of Bioethical issues for assessing synthetic biology and emergent technologies were used. They are Public Beneficence,Responsible Stewardship,Intellectual Freedom and

Responsibility, Democratic Deliberation,Justice and Fairness, Public Beneficence implies maximizing public benefits and minimizing public harm,Improving the public's well-being…food, shelter, transportation, treatmentand ensuring security and safety while pursuing the public good. Responsible Stewardship signifies shared obligation among members of the domestic and global communities to demonstrate concern for those who are not in a position to represent themselves (e.g., children and future generations) and for the environment. Prudent vigilance does call for ongoing evaluation of risks along with benefits. Intellectual Freedom and Responsibility implies using creative potential in morally accountable ways. Applying restrictions on research when the perceived risk is too great to proceed without limit. Democratic Deliberation means collaborative decision making that embraces respectful debate of opposing views and active participation by citizens. Encouraging scientists, policy makers, theologians, and religious, secular, and civil society groups to maintain an ongoing exchange regarding their views on synthetic biology and related emerging technologies. Encouraging participants to adopt a societal perspective over individual interests. Justice and Fairness means Just distribution of benefits and burdens across society.

When we analyse Crag Venter's creation of synthetic cell, based on these ethical principles, it is evident that the technical significance of this feat is substantial. The analysis shows that scientists have created synthetic cell with laudable motives that paves the way for modified bugs that could revolutionize healthcare and fuel production. Scientists are not tampering with the essence of life rather they have been focusing on addressing the societal implications of technology for the benefit of all. The biochemical analysis has revealed that the creation of synthetic cell cannot be regarded as 'creation of life' because only the genome and none of the cytoplasmic structures were synthesized by scientists. Also, Venter's accomplishment was far from an act of creation (bringing into existence something out of nothing), and hence this in no way amounts to "playing God.". Hence no serious moral issue seems to be involved here.

Though Venter's team couldn't completely eliminate the threats associated with 'creating synthetic life' or the abuse of this emerging technology, an ongoing assessment of possible threats along with potential benefits could alleviate the plausible risks. We need to respect intellectual freedom in scientific inquiry and nurture the development of synthetic biology in a way that maximizes its potential benefits while reducing the risks and possibility of direct and indirect harms. While creating the new life forms or modifying the existing ones, we should reveal our concern towards the future generations.

Conclusion

Creation for life and related scientific discoveries need to focus primarily on societal benefit by rendering respectful approach to human dignity. Making decisions about synthetic cells requires our prudence and wisdom. The creation of synthetic cell seems hospitable when it is in accord with God's good and loving purposes rather than serving chaos and destruction

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The Origin of Life,Oparin

Cell bioligy Sheelar and Bianchi

Cell Biology CB Powar

Genetics by Klug and cummings

Genetics by Gardner

Klaus Dose Moleculae evolution and orgin of life

Crag Venter: life decoded my genome mylife