

EVOLUTION - ORIGIN OF LIFE

Some of the most important hypothesis and theories regarding the origin of life are as follows :-

(1) THEORY OF SPECIAL CREATION : One of the foremost advocates of the special creation doctrine during Christian times was Father Suarez (1548-1617). It states that life was created by some supernatural power all of a sudden and out of nothing. According to this theory, this world was made in 6 days. The Earth and Heavens was created on the 1st day, the sky on the 2nd day, and Ancestors of plants and animals were originated on 3rd day. The Sun, moon and stars were created on 4th day; birds, Fishes appeared on 5th day and finally Man and Beasts were created on 6th day. This theory had no scientific backing and hence rejected outrightly.

(2) THEORY OF PANSPERMIA OR COSMOZOIC THEORY :

It states that seeds or spores of living forms might have reached the earth accidentally from some other planet or some source in the Universe. Today we know that life could not have existed in any other planet of the Universe. So, the theory has been rejected.

(3) THEORY OF ETERNITY OF LIFE :

It states that Organisms have unaltered through out their existence and will continue to exist in the same unchanging state till eternity (the state after death).

(4) THEORY OF SPONTANEOUS GENERATION (OR Abiogenesis):

According to this theory, living beings originate repeatedly from non-living organic matter by Spontaneous generation - worms and tadpoles from the mud and flies from dead bodies of animals. This theory was proved wrong by Francesco Redi in 1668.

(5) THEORY OF CATASTROPHISM :

It was proposed by Cuvier which explained the extinction of several forms. It states that plants & animals were not created at the spot but came from distant regions by migrating through temporary bridges between continents.

(6) BIOGENESIS :- Francesco Redi (1621-1691) by conducting simple experiments demonstrated that Abiogenesis cannot exist. Further, the theory of Spontaneous generation was totally discredited by the experiments of Louis Pasteur (1862).

(7) BIOCHEMICAL THEORY :- Several theories have been proposed to account for the origin of life on earth during the period, when the earth was cooling down from its heated condition. Oparin and Urey proposed that there were biochemical reactions which were resulted in the origin of life on earth. Scientists are of the opinion that the life existed billion of years ago as we have got a fossil evidence of life about 500 million years ago.

THEORY OF SPONTANEOUS GENERATION

According to this theory, life has originated from non-living ~~non-living~~ organic matter abiogenetically from time to time.

According to Epicurus, worms and numerous other animals were generated from the soil by the action of moist warmth of Sun and air. According to Aristotle, living creatures ~~were~~ born from life species, but they also arise spontaneously. The common worms, larva of bees, wasps, mites, glow worms and other insects etc. are born from rotting dung and mud, from dry wood, from ^{arise} sweat, from meat etc. Flies, moths, butterflies etc. from field humus, from decaying wood and fruits etc. The highly organised creatures like, ^{crabs} ~~crabs~~ and various molluscs formed from foul earth and mud; ^{eels} ~~eels~~ and other fish from the mud of lakes; frogs from moist earth. This theory was supported by Thales, Anaximander, Plato etc.

However, by conducting ~~simple ex~~ series of experiments Francesco Redi demonstrated that abiogenesis cannot exist. ~~In 18th century~~ The experiments performed by Spallanzani and Pasteur demonstrated that self generation of organism is impossible.

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BIOCHEMICAL ORIGIN OF LIFE (Modern Concepts on the origin of life) :-

The theory of biochemical origin of life was proposed by Haeckel who considered that the most primitive organisms would have been generated spontaneously from some inorganic matter as a result of formative actions of some special external forces like electrical charge, UV light, etc.

The work of Haldane, Oparin, Miller, Urey and others have provided evidences in favour of this hypothesis. The theory can be explained in the following steps -

(1) Origin of earth and its primitive atmosphere :- Our planet earth is a part of the solar system and came into existence about 5-6 billion years ago. Initially it was a ball of hot gases and vapours of various elements. Gradually the gases condense into ~~matter~~^{cond} and different elements got stratified according to their density.

The original temperature of earth was estimated to be 5000-6000 °C. At such a high tempⁿ elements like hydrogen, O₂, C & N could not exist in free state. They combine themselves or with metals forming oxides, carbides and nitrates. These compounds existed in gaseous state due to high tempⁿ of the earth and form the primitive atmosphere of the earth.

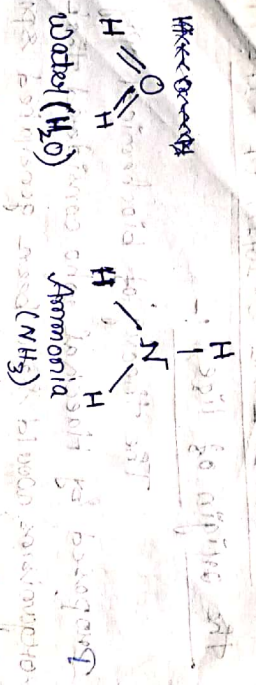
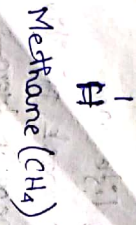
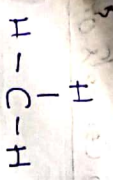


Fig. Simple compounds and the primitive earth.

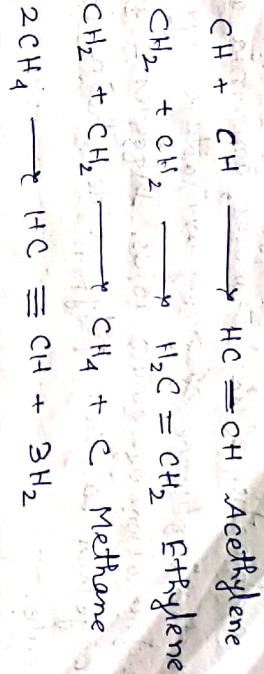
As tempⁿ gradually came down some of this gases liquified and some became solids. Steam condensed into water and resulted in rain forming lagoons, seas and oceans. The Oceanic water contains atmospheric ammonia, methane, dissolved minerals and salts. About 3 million years ago the atmosphere of earth was devoid of free oxygen but ~~rich~~ rich in ammonia, methane and hydrogen. At places the earth surface was filled with hot boiling water. In such a hostile atmosphere there would not be any possibility for existence of life.

(2) Chemical Origin of life :- Opinion for the first time in 1957 suggested that from simple compounds of primitive atmosphere more and more organic compounds were formed under the influence of an electric charge, UV rays etc. as follows -

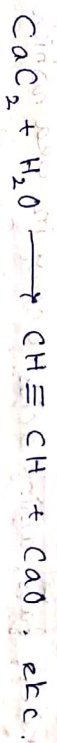
STEP 1 (On Origin of Organic Compounds) :-

(A) Formation of Hydro Carbon :- when the tempⁿ of earth surface cooled down to 1000°C, or even lower, a variety of simple saturated or unsaturated hydrocarbons formed by -

(i) Combining CH & CH₂ :-

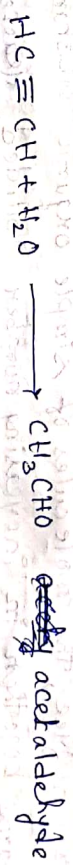


The metal carbides reacts with steam.



(B) Formation of Oxy and Hydroxy derivatives of Hydro Carbon :-

Hydrocarbons reacted with super heated steam to produce oxy and hydroxy derivatives like aldehydes, ketones and acids.

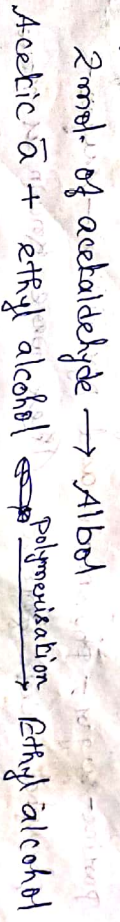


(C) Formation of Carbohydrates :-

Glucose, Fructose must have been formed first from hydroxy derivatives. Glucose and Fructose condensed to form disaccharide and polysaccharides. For e.g. Sugar and starch.

(D) Formation of fatty acids and Glycerol :-

The process of condensation in the polymerisation of aldehydes and ketones and their oxidation resulted in the formation of fatty acids & glycerol.



(E) Formation of amino acid & proteins :-

Combination of hydrocarbons, ammonia and water under the influence of freely available energy resulted the formation of amino acids. Different amino acids unite together to form polypeptide chain i.e., protein molecule.

(1) The Hot dilute soup :- The synthesis of carbonyl states, fats, amino acids occur in sea which have been described by Haldane as "the hot dilute soup".

Step 2: (or) Formation of macromolecules :-

In the "hot dilute soup" which was ~~set~~ sterile and oxygen free, the molecules of simple organic substances came together in increasing number collided, reacted to form new molecules of increasing size and complexity like polysaccharides, fats proteins, purines, pyrimidine, ~~more~~ nucleotides etc. The formation of protein molecules can be considered a landmark in the origin of life. Some of the polypeptide chains acted as primitive enzyme and speeded up the rate of formation of specific molecules.

Step 3: (or) Formation of Nucleic acids :-

Formation of nucleic acids was another important event in the origin of life. In the beginning purine-sugar - phosphate and pyrimidine - sugar - phosphate were formed. These were known as ~~more~~ nucleotides. They linked in different combinations

producing nucleic acids.

Step 4 or Formation of nucleo-proteins :-

Due to aggregation tendency of molecules, giant molecules of nucleoside-proteins were formed by the union of nucleic acid and protein.

The first living forms :-

It is thought that nucleoside-proteins must have had certain characteristics of a free living gene. A number of such genes together might have formed a single layer unit and were named "~~proto~~ "protovirus".

Biological

Step 5 or formation of primary organisms :-

Different types of protovirus, nucleoside-proteins, organic and inorganic molecules in various combinations formed colloidal particles which were termed as coacervates. In the mean time some of the fatty acids like cephaline and lecithin became organised around the coacervates to form plasma-membrane, which resulted in the differential accumulation of various substances inside the coacervates. At this stage, some proteins, deforelaid into enzymes and were able to complete some chemical reactions. Such ~~changes~~ changes might have resulted in the formation of even first cell.

The first living cell :-

The concentrated with nucleoproteins surrounded by nutrient cells and limiting membrane are supposed to be the first living cell. The Monerans and the prokaryotic cells were regarded as the early cell types.

Other early cell types :-

(1) Monerian type :- In these cells the nucleoproteins aggregated loosely and directly embedded in the cell substances. These are regarded to be a ancestors of bacteria and blue green algae.

(2) Prokaryotic type :- In these cells the nucleoproteins were condensed and surrounded by fine membrane. These nucleoproteins were separated from the cell substance. Early complex chemicals

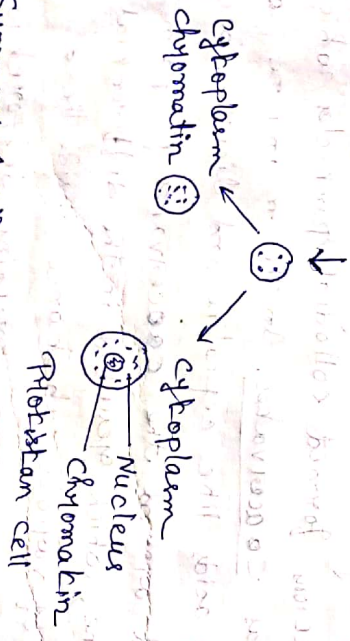


Fig: Summary of 5th round of reaction showing the origin of Monerian and Prokaryotic cell.

Step 6 :- (on Problem of energy sources) :-

The early cell types might have been similar to the present day microbes. They evolved different methods of obtaining food which are —

Parasites: which started living in the bodies of other cells. e.g. - monerian viruses.

Saprophytes: which stand ~~as~~ nutrishment from dead and decaying cells. e.g. - Bacteria.

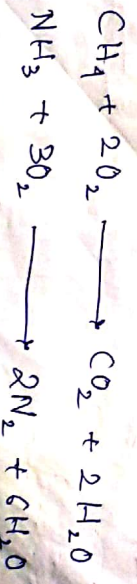
Predators: where ~~as~~ one organism eats another.

Chemosynthesis: - It includes utilization of energy from inorganic molecules. This energy is used for synthesis of organic molecules.

Photosynthesis: - In this process solar energy is trapped on the organic compounds by chlorophyll organisms which develop these process were first plant like types and stay form plant Kingdom.

Step 7 :- (on O₂ reduction) :-

With the increases in photosynthesis organisms, O₂ was liberated in the sea and then in the atmosphere. This free oxygen then reacted with methane and NH₃ present in the primitive atmosphere and transformed them into CO₂ and free N₂.



These events ultimately transform the ancient atmosphere into modern atmosphere with plenty of free O_2 . Free O_2 finally led which yielded more energy from the stuff when anaerobic respiration or fermentation.