Origin of life

Evolutionary Biology is the study of history of life forms on earth. The origin of life is considered a unique event in the history of universe.

The **Big Bang theory** and the **Nebular Hypothesis** are the most acceptable explanation of the origin of universe and solar system. It talks of a rapid expansion of singular mass having immense density, temperature and energy. The universe expanded and hence, the temperature came down. The gases which are called as Nebula condensed under gravitation and formed the galaxies, stars and planets of the present day universe.

Earth formed around 4.54 billion (4.54×10^9) years ago by accretion from the **solar nebula**. There was no atmosphere on early earth. Earth may have been chemically reducing in nature, composed primarily of Methane (CH_4), Ammonia (NH_3), Hydrogen sulphide (H_2S), Carbon dioxide (CO_2) or Carbon monoxide (CO), phosphate (PO_4^{3-}) and Water (H_2O). The molecular oxygen (O_2) and ozone (O_3) were absent. Thus **early atmosphere of earth was reducing and anoxygenic**

As earth cooled, the water vapour fell as rain and filled all the depressions to form oceans after 200 million years of origin of earth. Oceans may have been formed in a hot and reducing environment of 100 °C (212 °F) with a pH of about 5.8

Abiogenic or Biochemical origin of Life

Oparin and Haldane proposed this concept in 1938**.** It explains that it took one billion years for origin of life. During this period various organic molecules evolved, aggregated and formed protocells which developed into first living being.

The compounds present in the early oceans got accumulated in the form of a "**primordial soup**."In such a reducing atmosphere, electrical activity catalyzed the creation of certain basic small molecules (monomers) of life. These were called as **coacervates** and **microspheres**. More and more transformations of organic polymers ultimately resulted in the origin of first form of life.

The first form of life originated from pre-existing non-living organic molecules (e.g.DNA, RNA and protein, etc.). So, formation of life was originated by **chemical evolution**, i.e., formation of diverse organic molecules from inorganic constituents. The origin of life can be summarised as below:

Life appeared almost **4 billion years ago.**

§ Life originated from the **protocell type (virus like)** organisms termed as **Prokaryotes.** They inhabited the Earth from approximately 3–4 billion years ago.

H. O: 25/8, Old Rajender Nagar Market, Delhi-60. B. O.: 105-106, Top Floor, Mukherjee Tower, Mukherjee Nagar, Delhi-9
Website:www.vvrias.com || Email:vvrias@gmail.com Ph:.011-45629987, 09999329111, 09999197625

- **Bacteria** and archaea were the dominant form of life. The first prokaryotic types of organisms were **Chemohetrotroph and anaerobic** that is they absorbed organic molecules from outside for body building and metabolism.
- In later stages**, Chemo-autotrophic organisms were** formed. They obtained their **nutrition from inorganic substances in anaerobic conditions.** Some present day examples of chemoautotrophs are nitrifying bacteria, iron bacteria and sulphur bacteria**.**
- **The first photosynthetic organisms were Cyanobacteria (Blue Green Algae)**.
- The origin of Oxygenic photosynthesis and breakdown of water into Hydrogen and Oxygen by the UV rays from the sun lead to formation of Oxygen in the atomosphere.
- The earliest complex cellular structures originated as **single eukaryotic cells** at around 1.85 billion years ago. Their diversification accelerated when they started using oxygen in their metabolism.
- At around 1.7 billion years ago multicellular organisms began to appear, with differentiated cells performing specialised functions. The evolution of multicellularity occurred in multiple independent events, in organisms such as sponges, brown algae, cyanobacteria, slime moulds and myxobacteria etc.
- About 500 million years ago, **plants and fungi** colonised the land and were soon followed by **arthropods** and other animals.
- **Amphibians** first appeared around 364 million years ago, followed by **birds** around 155 million years ago (both from "reptile" like lineages).
- **Mammals** appeared around 129 million years ago, human ancestors appeared around 10 million years ago and modern humans around 0.25 million years ago.

The experimental proof of chemical evolution of life was given by **Urey and Miller** in 1953. It was an experiment that replicated the conditions thought to be present at the time of the early Earth and tested for the occurrence of chemical origins of life. Through this experiment at least 15 amino acids were formed from the gases present in the early atmosphere of the earth, in lab which supported the basic idea of **Oparin and Haldane**.

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