CHAPTER 2

# Origin and Evolution of Life

## The Origin of Life

These are important theories of origin of life which have been proposed.

### Theory of Spontaneous Generation

- Organism formed automatically from non-living matter.
- **Van Helmont** (1652) stated that young mice could arise from wheat grains when these are put in the dark along with a moist shirt.

### Theory of Biogenesis

- Theory of spontaneous generation (life) was not accepted by **Francesco Redi** (1668), **Lazzaro Spallanzani** (1765) and **Louis Pasteur** (1861).
- Spontaneous generation of flies from rotting meat was disproved by F Redi.
- Spallanzani stated that air carried microorganisms.
- Pasteur is famous for 'Germ Theory of Diseases.'
- Theory of biogenesis states that the living things can only arise from previously existing living things.

### Modern Theory (Oparin's Hypothesis)

- The most important condition for the origin of life is presence of water. There is no life on moon due to absence of water.
- Hydrogen atoms were most numerous and most active in primitive atmosphere, may be a plant product.
- It was hypothesized by **Al Oparin**. Oparin wrote "The Origin of Life" in 1936
- The first experiment support to Oparin-Haldane's theory of origin of life came from Urey and Miller's simulation experiment in 1853.

## Evolution

- The term 'evolution' means to reveal hidden potentialities.

## Evidences of Organic Evolution

- Homologous structures organs are similar in basic structure and origin but dissimilar in functions.
- Wings of bat, cat's paw, front foot of horse, human hands and wings of birds are homologous organs.
- Analogous organs are the organs similar in shape and function but their origin, basic development plan are dissimilar.
- Wings of insects, birds and bats are analogous organs.
- Analogous organs are also called as **homoplastic organs**.
- Vestigial organs are degenerate, non-functional organs which were functional earlier.
- Human body has been discribed to possess about 90 vestigial organs. Some of these are muscles of ear pinna, canine teeth and third molar teeth, body hairs, vermiform appendix (degenerated terminal part of Caecum) nictitating membrane of eye, caudal vertebral (coccyx or tail bone), etc.

| Organism | Connecting Link Between |
|---|---|
| Virus | Living and non-living |
| *Euglena* (Protozoa) | Plants and animals |
| *Proterospongia* (Protozoa) | Protozoa and Porifera |
| *Peripatus* (Arthropoda) | Annelida and Arthropoda |
| *Neopilina* (Mollusca) | Annelida and Mollusca |
| *Balanoglossus* (Chordata) | Non-chordata and Chordata |
| Dipnoi (Lung fish) | Pisces and Amphibia |
| *Archaeopteryx* (Aves) | Reptiles and Aves |
| *Prototheria* (Mammalia) | Reptiles and Mammalia |

- Atavism or reversion is the sudden reappearance of some ancestral features.
- Appearance of thick body hair, large canines, monstral face, short temporary tails, additional pairs of nipples, etc., are examples of atavism.

## Theories of Evolution

- Evolution is generally progressive and variation is most important requirement for it.
- The ultimate source of organic variation is mutation (sudden change in genes).

### Lamarckism

- The French biologist Jean Baptiste de Lamarck (1744-1829) suggested a complete theory of evolution.
- Lamarckian theory is also known as 'Theory of inheritance of acquired characters' or 'Theory of use and disuse of organs.'
- Lamarck's theory was published in Philosophie Zoologique in 1809.
- Lamarck arranged his theory in four postulates.
  (a) Internal forces tend to increase size of the body.
  (b) Formation of new organs is the result of the need.
  (c) Development of organs is based on the continuous use and disuse.
  (d) All changes acquired by the organism are transmitted to offspring by the process of inheritance.
- Some examples of uses and disuses of organs are
  (a) Webbed feet of swimming birds.
  (b) Rudimentary eyes of cave dwellers.
  (c) Elongated limbless body of snake.
  (d) Long thin neck in giraffe.
  (e) Vestigial organs of living animals.

### Darwinism

- Charles Darwin (1809-1882) and Alfred Russel Wallace (1823-1913) proposed, the "Theory of Natural Selection."

  Darwin's theory is based on the five principles.
  (a) Over production is shown by every organism.
  (b) Organism shows struggle for existence.
  (c) Struggle for existence leads to variations and their inheritance.
  (d) The variations in the organisms leads to the survival of the fittest.
  (e) Natural selection and species formation is due to variations.
- One major criticism against Darwin's theory was his failure to give an explanation for variations.

### Mutation Theory

- Hugo de Vries proposed the theory of mutation.
- Mutations are discontinuous variation.
- Mutations are due to changes in chromosomes, genes and DNA.
- Mutations are the changes which may or may not be inherited.

### Synthetic Theory

- Initial basis of synthetic theory was given by **Dobzohansky** (1937).
- Modern synthetic theory of evolution was designated by **Huxley** in 1942.
- According to it the five basic factors are :
  (a) Gene mutation
  (b) Changes in chromosome structure and number
  (c) Genetic recombinations
  (d) Natural selection
  (e) Reproductive isolation
- First three factors are responsible for genetic variability.

# Modern Views of Evolution

## Hardy-Weinberg Equilibrium

- Mutation, introduce new genes into a species resulting a change in gene frequencies.
- If certain conditions existed gene frequencies would remain constant.
- Conditions necessary for gene frequencies would remain constant.
- Conditions necessary for gene frequency to remain constant are :
  (a) Mating must be completely random.
  (b) Mutation must not occur.
  (c) The population must be very large.
  (d) All genes must have an equal chance of being passed to the next generations.
- Constant gene frequencies over several generations indicate that natural selection and evolution are not taking place.
- Changing gene frequencies would indicate that evolution is in progress.

### Points to be Remember

- First cell (Prokaryotic cell) came into existence in Precambrian Age of mammals and birds — Coenozoic era
- Age of man or epoch of human civilization — Holocene
- Age of reptiles or dinosaurs — Jurassic Period (Mesozoic era.)
- *Archaeopteryx* —Jurassic period.
- Dominance of Dinosaures — Jurassic period
- Extinction of Dinosaurs — Cretaceous
- Age of invertebrates — Early Palaeozoic era
- Age of fish — Devonian period of mid Palaeozoic era
- Age of amphibians — Late Palaeozoic era
- The nearest relative of manare apes.

# Exercise

1. Arrange the following in the order of their evolution.
   I. Amphibians II. Fish
   III. Reptiles IV. Birds
   (a) I, II, IV and III (b) II, I, IV and III
   (c) II, I, III and IV (d) IV, I, III and II

2. Which of the following were first formed?
   (a) Genes (b) Cells
   (c) Eobionts (d) Coacervates

3. Genetic variation arises by
   (a) recombination (b) mutation
   (c) chromosomal aberrations (d) All of these

4. Which of the following theories was not proposed by Charles Darwin?
   (a) Natural selection
   (b) Survival of the fittest
   (c) Struggle for existence
   (d) Inheritance of acquired characters

5. The theory of 'survival of the fittest' was propounded by
   (a) Lamarck (b) Mendel
   (c) Charles Darwin (d) Karl Landsteiner

6. The evolution of human species took place mainly in
   (a) Asia (b) Africa
   (c) Europe (d) China

7. The organs which are morphologically different but perform the same function are called
   (a) homologous organs (b) analogous organs
   (c) vestigial organs (d) None of these

8. Vermiform appendix is vestigial in man due to
   (a) cellulose digestion (b) omnivorous diet
   (c) heterodont condition (d) cooking habbit

9. *Archeopteryx* is a fossil which provides an evidence of evolution of
   (a) reptiles from amphibians (b) birds from reptiles
   (c) mammals from birds (d) None of these

10. Which of the following have not undergone much of a change during the process of evolution over millions of years?
    I. Crocodile II. Cockroach
    III. Horse
    (a) I and II (b) II and III
    (c) I and III (d) I, II and III

11. Which of the following is the correct sequence in which the given animal groups appeared on the earth during the course of evolution?
    (a) Porifera – Annelida – Coelenterata – Protozoa
    (b) Protozoa – Coelenterata – Porifera – Annelida
    (c) Annelida – Porifera – Protozoa – Coelenterata
    (d) Protozoa – Porifera – Coelenterata – Annelida

12. Mutation theory was proposed by
    (a) Morgan (b) Muller
    (c) Darwin (d) Hugo de Vries

13. The nearest relative of man are
    (a) lemurs (b) apes
    (c) new world monkeys (d) old world monkeys

14. Life originated in
    (a) air (b) land
    (c) water (d) All of these

15. Match list I (Theory) with list II (Scientist) and select the correct answer using the codes given below in the lists.

| List I | List II |
|---|---|
| A. Theory of nuclear fission | 1. George Gamoro |
| B. Big-bang theory | 2. W Heisenberg |
| C. Quantum theory of matter | 3. Bohr and Wheeler |
| D. Wave theory of light | 4. C Huygens |

Codes

| | A | B | C | D | | A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|
| (a) | 1 | 2 | 3 | 4 | (b) | 3 | 1 | 2 | 4 |
| (c) | 4 | 3 | 2 | 1 | (d) | 3 | 2 | 1 | 4 |

16. Who proposed the mutation theory of evolution?
    (a) Huxley (b) Darwin
    (c) Lamarck (d) Hugo de Vries

17. Which is correct sequence in order of chronology?
    I. Mendel's law of inheritance.
    II. Darwin's theory of evolution.
    III. Blood circulation by Harvey.
    IV. de Vries theory of mutation.
    (a) I II III IV (b) II IV I III
    (c) III II I IV (d) IV II III I

18. Which one of the following characteristics is common among parrot, platypus and kangaroo? **(CDS 2009 I)**
    (a) Oviparity
    (b) Toothless jaws
    (c) Homothermy
    (d) Functional postanal tail

19. Which one of the following is an example of vestigial organ in man? **(CDS 2009 I)**
    (a) Jaw apparatus (b) Ear muscles
    (c) Canine teeth (d) Humerus

20. Which colour of heat radiation represents the highest temperature? **(CDS 2008 II)**
    (a) Blood red (b) Dark cherry
    (c) Salmon (d) White

## Answers

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. (c) | 2. (d) | 3. (d) | 4. (d) | 5. (c) | 6. (b) | 7. (b) | 8. (d) | 9. (b) | 10. (a) |
| 11. (d) | 12. (d) | 13. (b) | 14. (c) | 15. (a) | 16. (d) | 17. (b) | 18. (c) | 19. (b) | 20. (d) |