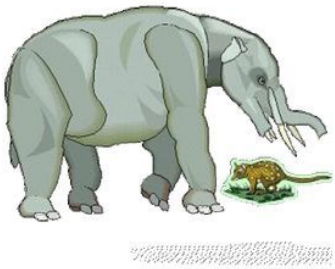


TOPIC: Evolution

AIM: What are the theories about Evolution?





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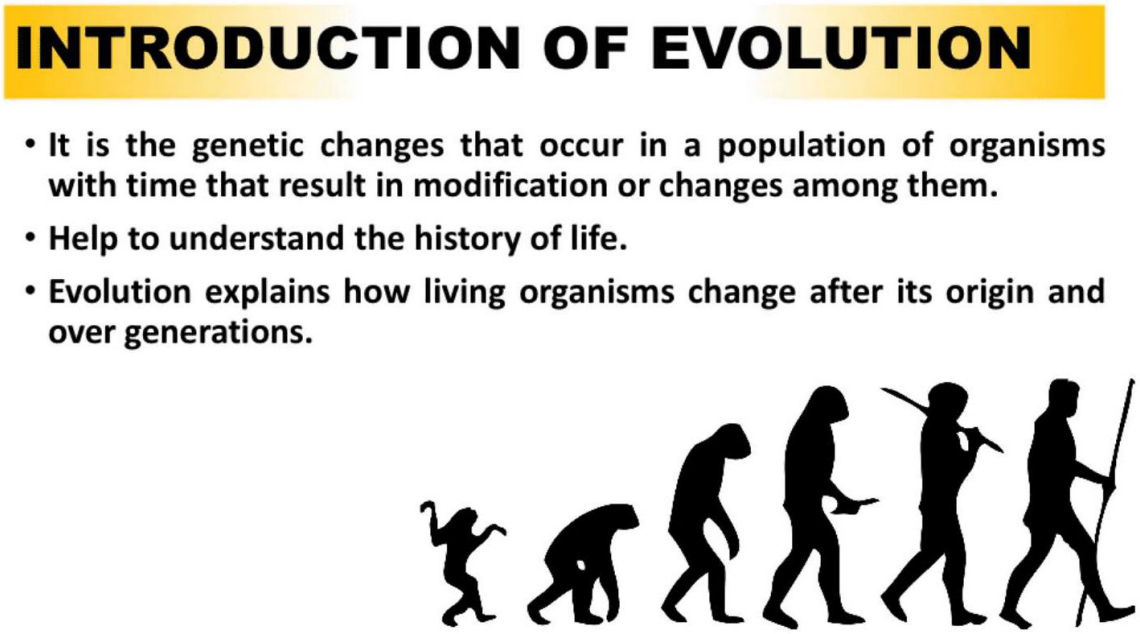


theories of evolution are:

(I) Lamarckism or Theory of Inheritance of Acquired characters.

(II) Darwinism or Theory of Natural Selection.

(III) Mutation theory of De Vries.

(IV) Neo-Darwinism or Modern concept or Synthetic theory of evolution.

I. Lamarckism:

It is also called “Theory of inheritance of acquired characters” and was proposed by a great French naturalist, Jean Baptiste de Lamarck (Fig. 7.34) in 1809 A.D. in his famous book “Philosphic Zoologique”. This theory is based on the comparison between the contemporary species of his time to fossil records.

Fig. 7.34. Jean Baptiste de Lamarck (1744–1829 A.D.).

His theory is based on the inheritance of acquired characters which are defined as the changes (variations) developed in the body of an organism from normal characters, in response to the changes in environment, or in the functioning (use and disuse) of organs, in their

own life time, to fulfill their new needs. Thus Lamarck stressed on adaptation as means of evolutionary modification.

A. Postulates of Lamarckism:

Lamarckism is based on following four postulates:

1. New needs:

Every living organism is found in some kind of environment. The changes in the environmental factors like light, temperature, medium, food, air etc. or migration of animal lead to the origin of new needs in the living organisms, especially animals. To fulfill these new needs, the living organisms have to exert special efforts like the changes in habits or behaviour.

2. Use and disuse of organs:

The new habits involve the greater use of certain organs to meet new needs, and the disuse or lesser use of certain other organs which are of no use in new conditions. This use and disuse of organs greatly affect the form, structure and functioning of the organs.

Continuous and extra use of organs make them more efficient while the continued disuse of some other organs lead to their degeneration

and ultimate disappearance. So, Lamarckism is also called “Theory of use and disuse of organs.”

So the organism acquires certain new characters due to direct or indirect environmental effects during its own life span and are called Acquired or adaptive characters.

3. Inheritance of acquired characters:

Lamarck believed that acquired characters are inheritable and are transmitted to the offsprings so that these are born fit to face the changed environmental conditions and the chances of their survival are increased.

4. Speciation:

Lamarck believed that in every generation, new characters are acquired and transmitted to next generation, so that new characters accumulate generation after generation. After a number of generations, a new species is forSo according to Lamarck, an existing individual is the sum total of the characters acquired by a number of previous generations and the speciation is a gradual process.

Summary of four postulates of Lamarckism:

1. Living organisms or their component parts tend to increase in size.

2. Production of new organ is resulted from a new need.

3. Continued use of an organ makes it more developed, while disuse of an organ results in degeneration.

4. Acquired characters (or modifications) developed by individuals during their own lifetime are inheritable and accumulate over a period of time resulting a new species.

B. Evidences in favour of Lamarckism:

1. Phylogenetic studies of horse, elephant and other animals show that all these increase in their evolution from simple to complex forms.

2. Giraffe

Development of present day long-necked and long fore-necked giraffe from deer-like ancestor by the gradual elongation of neck and forelimbs in response to deficiency of food on the barren ground in dry deserts of Africa. These body parts were elongated so as to eat the leaves on the tree branches. This is an example of effect of extra use and elongation of certain organs.

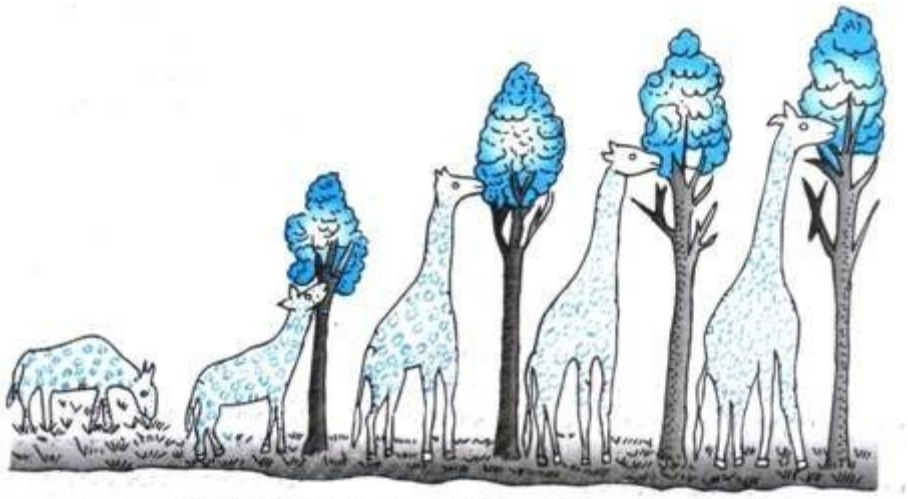


Fig. 7.35. Stages in the evolution of present-day giraffe.

3. Snakes:

Development of present day limbless snakes with long slender body from the limbed ancestors due to continued disuse of limbs and stretching of their body to suit their creeping mode of locomotion and fossorial mode of living out of fear of larger and more powerful mammals. It is an example of disuse and degeneration of certain organs.

4. Aquatic birds:

Development of aquatic birds like ducks, geese etc. from their terrestrial ancestors by the acquired characters like reduction of wings

due to their continued disuse, development of webs between their toes for wading purposes.

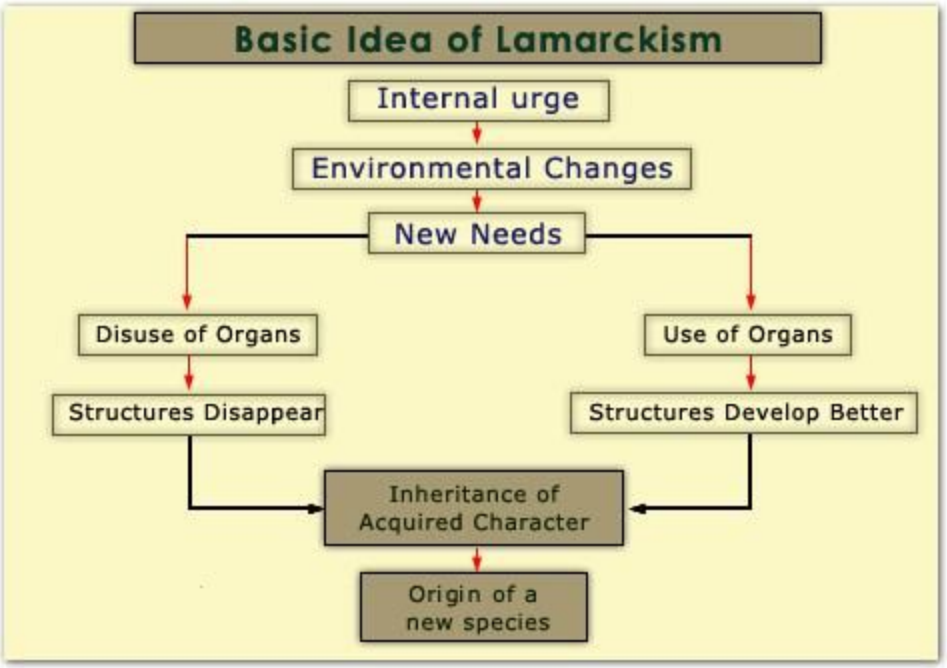
These changes were induced due to deficiency of food on land and severe competition. It is an example of both extra use (skin between the toes) and disuse (wings) of organs.

5. Flightless birds:

Development of flightless birds like ostrich from flying ancestors due to continued disuse of wings as these were found in well protected areas with plenty of food.

6. Horse:

The ancestors of modem horse (Equus caballus) used to live in the areas with soft ground and were short legged with more number of functional digits (e.g. 4 functional fingers and 3 functional toes in Dawn horse-Eohippus). These gradually took to live in areas with dry ground. This change in habit was accompanied by increase in length of legs and decrease in functional digits for fast running over hard ground.



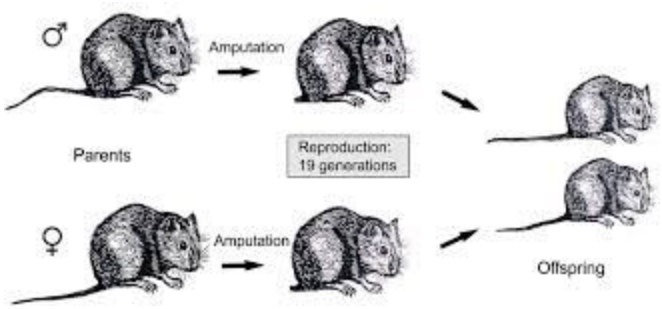
Criticism of Lamarckism:

(Evidences against the Inheritance of Acquired Characters):

The first proposition of the theory does not have any ground because there is no vital force in organisms which increases their body parts. As regards the second proposition, the environment can affect the animal but it is doubtful that a new need forms new structures. The third proposition, the use and disuse of the organs is correct up to some extent. The fourth proposition regarding the inheritance of acquired characters is disputed.

Mendel's Laws of Inheritance and Weismann's Theory of Continuity of Germplasm (1892) discarded Lamarck's concept of inheritance of acquired characters.

(i) Theory of Continuity of Germplasm. August Weismann (1834-1914), a German biologist, was the main opposer of the inheritance-of acquired characters. He put forward the theory of continuity of germplasm. According to Weismann, the characters influencing the germ cells are only inherited. There is a continuity of germplasm (protoplasm of germ cells) but the somato-plasm (protoplasm of somatic cells) is not transmitted to the next generation hence it does not carry characters to next generation. Weismann cut off the tails of rats for as many as 22 generations and allowed them to breed, but tailless rats were never born.



(ii) Boring of pinna (external ear) and nose of Indian women is never inherited to the next generations.

(iii) The wrestler's powerful muscles are not transmitted to the offspring.

(iv) European ladies wear tight waist garments in order to keep their waist slender but their offspring at the time of birth have normal waists.

(v) Chinese women used to wear iron shoes in order to have small feet, but their children at the time of birth have always normal feet.

not be explained by Lamarckism.

Evidences in Favour of the Inheritance of Acquired Characters:

(i) Formation of Germ Cells from Somatic Cells:

In certain cases somatic cells can produce the germ cells, which is against Weismann's theory of continuity of germ-plasm. This occurs in vegetative propagation in plants and regeneration in animals.

(ii) Effect of Environment directly on Germ Cells:

Tower exposed the young developing Potato Beetles to extremes of temperature and humidity at the time of the development of their reproductive organs. This did not produce any change in the beetles themselves. Their offspring, however, had colour variations, which were passed on to the succeeding generations. Tower's observations indicate direct effect of environment on germ cells.

(iii) Effect of Radiation:

Exposure of organisms to high energy radiations (ultra-violet rays, X-rays, gamma rays, etc.) or feeding them with mutagenic chemicals, produces sudden inheritable variations or mutations. For example, Auerbach et al obtained a number of mutations and chromosome aberrations in Drosophila with the help of mustard gas.

(iv) Agar:

Agar reared water fleas in a culture of green flagellates and found that some abnormalities were developed in their structures. The parthenogenetic eggs of such individuals when kept in ordinary water and allowed to hatch produced individuals with the same abnormalities.

D. Significance:

1. It was first comprehensive theory of biological evolution.

2. It stressed on adaptation to the environment as a primary product of evolution.

Neo-Lamarckism:

Long forgotten Lamarckism has been revived as Neo-Lamarckism, in the light of recent findings in the field of genetics which confirm that environment does affect the form, structure; colour, size etc. and these characters are inheritable.

Main scientists who contributed in the evolution of Neo-Lamarckism are: French Giard, American Cope, T.H. Morgan, Spencer, Packard, Bonner, Tower, Naegali, Mc Dougal, etc. Term neo-Lamarckism was coined by Alphaeus S. Packard.

Neo-Lamarckism states:

1. Germ cells may be formed from the somatic cells indicating similar nature of chromosomes and gene make up in two cell lines e.g.

(a) Regeneration in earthworms.

(b) Vegetative propagation in plants like Bryophyllum (with foliar buds).

(c) A part of zygote (equipotential egg) of human female can develop into a complete baby (Driesch).

2. Effect of environment on germ cells through the somatic cells e.g. Heslop Harrison found that a pale variety of moth, Selenia bilunaria, when fed on manganese coated food, a true breeding melanic variety of moth is produced.

3. Effect of environment directly on germ cells. Tower exposed the young ones of some potato beetles to temperature fluctuation and found that though beetles remained unaffected with no somatic change but next generation had marked changes in body

Muller confirmed the mutagenic role of X-rays on Drosophila while C. Auerbach et., al. confirmed the chemical mutagens (mustard gas vapours) causing mutation in Drosophila melanogaster, so neo-Lamarckism proved:

(a) Germ cells are not immune from the effect of environment.

(b) Germ cells can carry somatic changes to next progeny (Harrison's experiment).

(c) Germ cells may be directly affected by the environmental factors (Tower's experiment).

Difference between LAMARCKISM AND NEO-LAMARCKISM

CHARACTERS	LAMARCKISM	NEO-LAMARCKISM
NATURE OF THEORY	Original theory of Lamarck	Modified in the light of modern theory
FACTORS INCLUDING VARIATIONS	Certain internal forces, change in environmental factors, and use and disuse of organs	Changes in environment, but not leading to development of vestigial organs
CELLS INVOLVED	Only somatic cells are affected to cause changes	Both somatic and gametic cells are affected to cause changes
NATURE OF INHERITED TRAITS	Acquired characters are inherited	Only germinal variations are inherited where germ cells are produced from somatic cells