SEM 4 CORE COURSE: Genetics & Evolutionary Biology
ZOOG-CC4-4-TH

Lamarck and Lamarckism

In the Pre-Darwinian period the well-known evolutionist was LAMARCK JEAN BAPTISTE PIERCE ANTOINE DE MONET LAMARCK (1744-1829) was a French naturalist, well-known for his theory of evolution.
LAMARCK's name is inseparably linked with the theory of evolution. But he had attributed to biology in a number of other ways. He was the person who introduced the word **'biology'** to emphasize the kinship between living beings (i.e. plants and animals).

Lamarckism or Inheritance of Acquired Characteristics

Propositions of Lamarckism

LAMARCK's theory of evolution was published in '*Philosophie Zoologique*' in the year 1809. It is popularly known as "The Inheritance of Acquired characteristics in Organisms", and comprises of four propositions or assumptions-
1. Living organisms and their parts tend to increase in size continuously due to internal forces of life.
2. Formation of a new organ in the body of organisms is the result of a new need and new movement which this need initiates and maintains in the body.
3. If an organ is used continuously and constantly, it will tend to become highly developed, whereas disuse results in its degeneration.
4. Modifications which are acquired during the life time of an individual are inherited by its offsprings. It means changes are cumulative over a period of time.

1. Reaction to the environment - LAMARCK believed that environment plays an important role in influencing the form of living organisms. The influence leads to change in their habits. The change in habits results in unusual activity of an organ or structure.

For example, changes in the environment, soil, food, temperature etc. were supposed to act directly in the case of plants and indirectly in case of animals. LAMARCK demonstrated several cases where individuals of the same species, grown under different environmental conditions exhibited marked differences. He noted smaller and weaker plants in poor soil but healthy and luxuriant plants on rich soil. The leaves of beech tree present on the sunny side have two layers of palisade cells, whereas leaves that are present in the shade have only one layer. Several amphibious plants exhibited heterophylly, i.e. possess two types of leaves. LAMARCK from such observations, assumed that living organisms react to external conditions and become modified.

2. The effects of needs-LAMARCK thought that change of habits may initiate the formation of a new organ or may bring about the modification of the existing organ or structure.

3. Use and disuse-The constant use of an organ enhances its efficiency and size and leads to its better development. On the contrary if any organ is not used for a long time it leads to the reduction in efficiency and size of the organ and ultimately leads to its degeneration. Citing an example of elongation of neck and front legs in Giraffe, he presumed that the ancestors of Giraffe lived in grassy plain and had short neck and their fore and hind-limbs were equal in size. When these ancestors were transferred to an area where there were

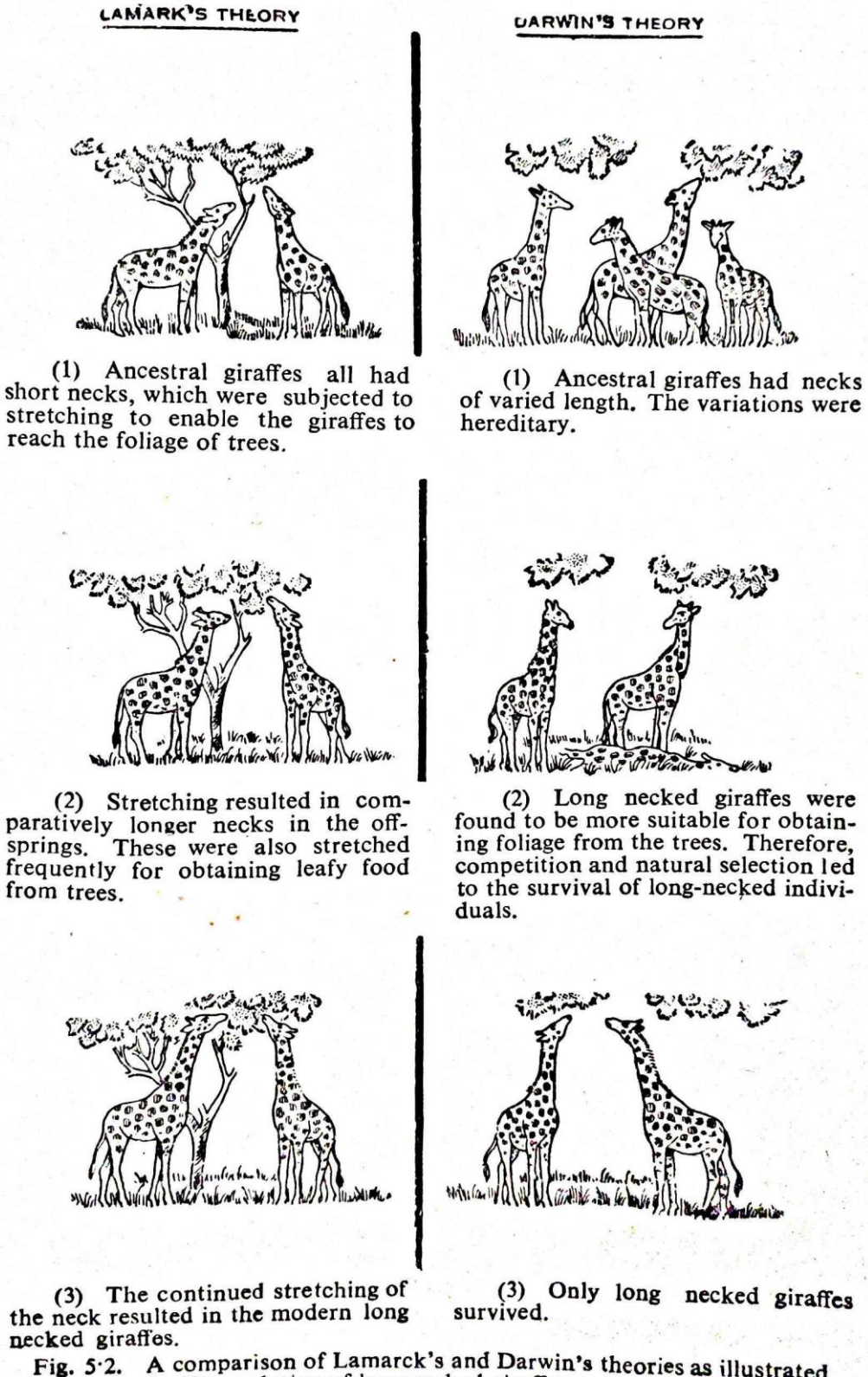

Fig. 5·2. A comparison of Lamarck's and Darwin's theories as illustrated by the evolution of long necked giraffes.

only trees and no grass, they had to stretch their neck to reach the leaves of the trees (their food) high above the ground. The continuous stretching of neck for several generations resulted in elongation of neck, which was the result of gradual incorporation of length for several generations.

Similarly, presence of vestigeal organs in animals was explained by LAMARCK due to their continuous disuse,

4. Inheritance of acquired characters-All that has been acquired by the organism during its life time due to direct or indirect environmental effects is preserved by the generation and is transmitted to the offsprings. In the offsprings these modifications become more and more pronounced if they are exposed to similar stress of the environment as was faced by their parents or ancestors. Such cumulative effects will ultimately result in the appearance of new species.

Examples

LAMARCK's propositions were based on direct observation of the nature. Some of the examples are briefed here:

1. Ancestors of modern horse lived in soft ground in jungles. These were browsers and had plantigrade foot posture. When thick Jungles were replaced by dry grassy plains these had to graze on hard grass and to walk on dry land. These changes in habit were accompanied by changes in the molars and premolars, reduction in the number of digits and lengthening of the legs. The foot posture gradually changed to unguligrade which was suited for swift running over hard ground.
2. Giraffe obtained its long neck by stretching it upwards to reach the available food in the form of leaves from tall trees.
3. Water birds (duck etc.) developed their webbed feet by constant stretching of the skin of their feet in skimming the water surface and in swimming.
4. Clasping birds through constant perching of the twigs or branches of the trees have developed sharp and curved digits.
5. Eyes are reduced in Moles because they live underground.
6. Muscles of pinna are reduced in man but are well developed and functional in rabbit, dog and elephant, etc. because these live in Jungles and use their pinna to collect sound waves from the surroundings.
7. The limbs are absent in snakes, *Proteus* and other burrowing animals because these are of no use in crawling and burrowing and rather produced a hindrance. So these became gradually reduced and finally disappeared.

The evolutionary theory of LAMARCK was warmly supported by ETIENNE GEOFFROY (1772-1844), Professor of Geology at the Faculty of Sciences at Paris.

Criticism of Lamarckism

Lamarckian theory was exposed to severe criticism and LAMARCK had to defend it throughout his life. It failed to meet the tests of observations. Even our day to day observations indicate its futility. CUVIER and WEISMANN were the great critics of LAMARCKISM.

Some objections which LAMARCK could not answer are as follows:-

1. The first principle, the tendency to increase in size, has been noted in many forms, but many times evolution shows reduction in size. Moreover, persons constantly busy in reading and writing and using their eyes more than others often develop impaired sight.

Why their eyes do not become more efficient ?

2. The second principle that new organs develop where the organisms feel their need is also not true. If the development of new organ or structure depends upon the desire why man who has long desired to fly like birds has not developed the wings?

3. LAMARCK explains the improvement of a character or change, but does not explain its utility in its initial stage.
4. His third principle, reaction to the environment may have some weight, since organisms do react to the environment but environment causes temporary changes in their organization and these changes can not be inherited to the offsprings. Similarly, it could not be understood that how use or disuse of an organ will produce a change in its size and how this change will be inherited to the off-Springs.
5. Experiments have discarded his law of inheritance of acquired characteristics. For example, if any of the parent becomes blind or deaf or lame before producing the offsprings, they do not produce blind, deaf or lame offsprings. Mutilations and wounds of parents do not appear in the offsprings. The adaptive characters of plants and animals which superficially appear to be the direct result of use or disuse or effect of environment are actually of germinal origin.
6. Chinese woman use iron shoes to keep their feet short but young ones at birth have normal size. A child always learns the language which his parents taught him, but never acquires it.
7. The deadliest blow to LAMARCKISM came from experiments conducted by WEISMANN. WEISMANN removed the tail of mice continuously for about 22 generations and even the offsprings of 22nd generation had a tail as long as in the original parents.

WEISMANN differentiated between changes occurring in the soma and the changes which occur in the germplasm. He established that somatic changes acquired during the life time of the organisms are non-heritable, whereas the changes occurring in the germplasm are all inherited by the offsprings.