Micro, Macro & Megaevolution

Based on the degree of change and speed of evolution three stages in evolutionary process can be identified:

1) Origin of small evolutionary differences at subspecific level.

2) Modifications in larger groups of animals, producing species and genera by adaptive radiation.

3) Evolution of new types from their predecessors by large genetic changes, often producing families, orders, classes and phyla.

Microevolution

This is also called **Sequential evolution,** which involves a continuous and gradual change in an interbreeding population, usually giving rise to new subspecies and geographical races. Basic process involves changes in gene frequencies in a population from one generation to the next. Microevolution is produced by stabilizing or normalizing natural selections that operate in stable environmental conditions and in short time span.

Examples: Rowe has discovered several lines of descent in sea urchin, *Micraster,* where he found gradual change in characters from *M. corbovis* to that of *M. cor-anguinum,* mainly in the shape of the test, structure of oral opening and the form of ambulacra. The changes took place in a more or less stable environment. Similarly Fenton has described gradual replacement of one species by another in brachiopod, *Spirifer.*

Macroevolution

This may also be called **Adaptive radiation,** which includes evolutionary changes above the species level that may result in the production of new adaptive types through genetic divergence. The changes are on account of large gene mutations or macromutations and result in the establishment of new genera, families and orders. Macroevolution takes place in individuals that have entered a new environmental zone, which is free of competition. Darwin called such directional changes **Orthogenesis.**

Examples: Evolution of horse is a perfect example of macroevolution, in which there was an increase in the size of body and legs and in the enlargement of teeth. All body changes were related to life in open grasslands, fast running and feeding on harsh grasses, eventually leading to new adaptive types. Other examples of macroevolution are: adaptive radiation in Darwin's finches, divergence of reptiles and evolution of camel and elephant.

Megaevolution

This includes formation of new groups, classes or phyla due to evolution of new types from its predecessors by general adaptation. Megaevolutionary changes are rare and have occurred rarely in the evolutionary history. During megaevolution, organisms of the ancestral stalk attempt to enter a new and very different environmental zone where they face strong natural selection, for which they must possess certain pre-adaptations to enable them to survive in the new zone. Megaevolution is brought about by large genetic changes that are capable of producing different types and disruptive or divergent natural selection that makes the population occupy different types of environmental zones.

Examples: Amphibians were preadapted to live on land for short periods since as fish they already possessed lungs for air breathing and limbs to support body on land.

Origin of birds from reptiles included growth of feathers and sudden change in the fore limb to produce wing, which enabled them to invade air and then developed beak, sternal keel and loss of tail as postadaptations.

Origin of mammals can be traced back from a series of fossil reptiles (Synapsida) of Triassic period. During evolution, a false palate was formed, teeth became thecodont, and limbs moved under the body for better locomotion. Emergence of bats (Order Chiroptera) from the primitive insectivores has been a sudden event in the beginning of Coenozoic era. Skeletons of early Eocene bats show fully developed wings, much like our modern day species possess. No transitional forms are known, suggesting that bats emerged by a megaevolutionary event.