Factors Affecting Neoteny and Types of Neoteny

Extrinsic factors

According to Gadow (1903): Abundance of food and other favourable conditions in the life of amphibian larva may be the cause of retention of larval features.

According to Shufeldt: Deep-water and coldness inhibits the secretio of thyroxin.

According to Weismann: Saline nature of water is responsible neoteny.

According to Huxley (1929): Low temperature is responsible for the acre of metamorphosis.

Though extensive researches have been carried out on the role extrinsic factors on metamorphosis, but it is still unclear that whether extrinsic factors are exclusively responsible for arrest of metamorphosis or not. So the existence of internal factors at physiological becomes inherent.

Intrinsic factors

Different investigators have advanced several experimental evidences. Gressner (1928) opined that insulin hormone inhibi metamorphosis. But recent researches reveal that metamorphosis is primarily influenced by

(i) varying threshold levels of thyroxin and its analogues and

(ii) by the degree of responsiveness of the larval tissues to the hormones.

During early premetamorphic stage in amphibian development, the level of thyroxin kept very low in the body by genetic mechanism (Etkin, 1968). Etkin, et al. have also established the role of prolactin on metamorphosis. They

showed that the level of prolactin acting as an inhibitor in the overall control of metamorphosis remains high at this time.

In the light of modern genetics it may be suggested that the structural genes guiding the synthesis of thyroxin are 'switched off' by some operator genes, whereas, the genes guiding the formation of prolactin are 'switched on'. In such condition, hypothalamus becomes sensitive to the available level of thyroid hormone in the blood stream. The neurosecretory apparatus of the hypothalamus produces a substance called **thyrotropin releasing factor** (TRF). TRF stimulates the anterior lobe of pituitary to produce thyroid stimulating hormone (TSH), which in turn enhances the rate of thyroid secretion. As the level of TSH rises during prometamorphosis, the level of prolactin suddenly falls, so the metamorphosis starts. Poor secretion of thyroid glands and the irresponsiveness of the larval tissues to the hormone are responsible for neoteny.

In amphibian development, the tadpole larva undergoes progressive metamorphosis and transforms into an adult. This is a normal occurrence in amphibians. However, deviation from the normal pathway of development is found in the life cycle of many urodeles. Such deviated pathways of development in axolotls due to extrinsic as well as intrinsic environmental factors may be regarded as 'canalisation', i.e., buffering of development against environmental change. Neoteny is looked upon as a consequence of adaptations to neighbouring environments where retention of larval gills and other larval features may be advantageous.

G.K. Noble (1954) regarded that neoteny has nothing to do in the phylogeny of the amphibians. This is quite evident from the heterogenous characters of

the Perennibranchiata where all the neotenous species are included. Neoteny as such may have some importance in the individual groups.

Types of neoteny

Partial Neoteny: It is partial when metamorphosis is delayed due to temporary ecological or physiological changes in environment. It is shown by tadpoles and larvae tiding over winter.

Intermediate neoteny: It is shown by axolotls which also reproduce sexually but undergo metamorphosis in suitable conditions. Under experimental conditions in laboratories, it is possible to produce either axolotls or transformed individuals.

The extreme or total neoteny: It is shown by several perennibranchiate salamanders such as Necturus, Siren and Proteus. They remain larval throughout. Even treatment with thyroxine fails to induce metamorphosis; the tissue response is absent.

Significance of neoteny

Weismann (1875) thought neoteny to be a case of retarded evolution or atavism, that is, reversion to ancestral condition. However, this is now regarded to be of secondary specialization, a physiological adaptation of advantage. This is also proved by the great heterogeneity of all neotenous perennibranchiate forms.