METAMERISM

Metamerism is segmentation of body into somites or metameres. **Pseudometamerism** occurs in cestodes in which every segment is independent of the other and contains complete set of organs that have no connection with organs in other segments. During growth new segments are added in front, in the neck region and hence the posterior-most body segment is the oldest one and the anterior segments are younger.

In true **metamerism**, there is a serial repetition of homologous organs, like nephridia, nerves, muscles, reproductive organs, appendages etc. in each segment but these organs function in coordination with the others. All segments are integrated into a single functional unit. In true metamerism new segments are added in front of the last segment called pygidium. Hence posterior segments are younger as compared to the anterior ones. Coelom is divided by intersegmental septa into compartments, each of which can be regulated independently of the others.

Truly segmented animals typically have an anterior **acron** and posterior **pygidium** and various intermediate segments called **metameres** or **somites.** In higher invertebrates, such as arthropods, metamerism provided an opportunity for specialization of segments into head, thorax and abdomen and serially repeated organs could be specialised resulting in rapid evolution.

EVOLUTION OF METAMERISM

It is believed that during the course of evolution metamerism evolved three times independently for different purposes as mentioned below.

EVOLUTION OF PSEUDOMETAMERISM

Pseudometamerism occurs in cestodes such as tapeworms. There are two theories to explain its origin.

FISSION THEORY

Proposed by Perrier 1882, this theory postulates that pseudometamerism evolved in flat worms by strobilation of body as happens in strobila of scyphozoa. Strobilation is aimed to increase the rate of reproduction. Proglottids of helminths are serially arranged segments but in reverse order and they increase reproductive capacity many times.

PSEUDOMETAMERISM THEORY

Hymen (1951) proposed that pseudometamerism evolved in turbellarians and nemertians first by serial repetition of organs, particularly the reproductive organs for increasing fecundity. Later, these organs were separated by cross-partitioning of body producing metamerism. Turbellarians are not segmented but some have serially repeated organs. Nemertians are intermediate between turbellarians and annelids and possess a specialized coelom called rhynchocoel in which organs are serially repeated but not separated by septa. Ancestors of metameric animals were perhaps similar to nemertians and archiannelids such as *Polygordius,* which are also not clearly segmented animals.

EVOLUTION OF TRUE METAMERISM

True metamerism evolved in animals twice independently, once in Annelida and Arthropoda and again in chordates.

METAMERISM IN ANNELIDA

R.B. Clark (1964) proposed the LOCOMOTION THEORY to explain the origin of metamerism in annelids. According to this theory metamerism evolved in annelids as an adaptation to peristaltic locomotion and for burrowing. Annelids possess what is called peristaltic locomotion which involves shortening and lengthening of body by circular and longitudinal muscles. As the coelom is filled with coelomic fluid peristaltic locomotion will not be possible unless the coelom is divided by septa, so that high pressure produced by contraction of muscles can be confined to a particular region and it does not affect the whole body. By having metamerism annelids not only can save energy by keeping high pressure areas in selected regions but also can control and regulate locomotory movements in different directions.

For burrowing in sand and mud annelids require a hard skeleton which they do not possess. Hence they produce what is known as **hydraulic skeleton** with the help of coelomic fluid and intersegmental septa.

Arthropods inherited metamerism from annelids in which body organs and appendages were serially repeated in each segment. Arthropods used this condition to specialise body organs and reduce their number (Williston's rule of serial homology). Therefore, arthropods specialised segmented body into **tagma**, such as cephalothorax and abdomen in crustaceans or into head, thorax and abdomen in insects. Appendages were modified to produce antennae, mouth parts, walking and swimming appendages, wings etc. Such specialization of body segments in arthropods is called **tagmatization** or **tagmosis,** which led to rapid evolution that made arthropods the most abundant and diversified of all animals on earth.

METAMERISM IN CHORDATES

CLARK'S LOCOMOTION THEORY

R.B. Clark's (1964) theory postulates that metamerism evolved independently in chordates also for locomotion which was carried out by lateral undulation of body in primitive aquatic vertebrates. Metamerism allowed myotomes or muscle bundles and nerves to be arranged segmentally for better co-ordination of undulatory movement of body.

CYCLOMERISM THEORY

This theory, proposed by Sedgwick in 1884, says that metamerism in chordates evolved for better arrangement of organs in coelom. True coelom or enterocoel evolves by outpouching of coelenteron in three places to produce protocoel, mesoscoel and metacoele, which further partitioned later to produce somites. This provided septa and compartments in coelom in which organs could be arranged in a better way.