B.Sc. Part II Paper IV A

Development in Amphioxus

(Part-I)

Introduction – In Amphioxus, fertilization is external and occurs in sea water. The fertilized egg or zygote of Amphioxus has well-marked polarity, bilateral symmetry and well-established cytoplasmic organisation. The cleavage of the eggs of Amphioxus is of holoblastic and of almost equal type. Hence, the development of Amphioxus is of Indeterminate type. The first set of cleavage is meridional which cuts through the egg along the median axis, starting at the posto. vestal side of egg. The blastomeres are of equal size and establish the bilateral symmetry of the adult animal.

After fertilization, development of Amphioxus occurs in various stages. These are

I Cleavage & Blastulation –

II Gastrulation

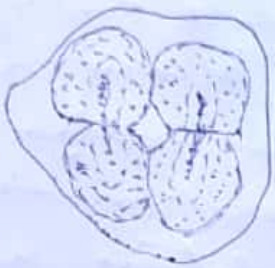
III Tubulation and Organogenesis.

I **Cleavage & Blastulation** – As mentioned above, first cleavage is meridional cutting the zygote along the median axis resulting two equal blastomeres. The second set of cleavage is also meridional but at the right angle to the first and forming four equal blastomeres.

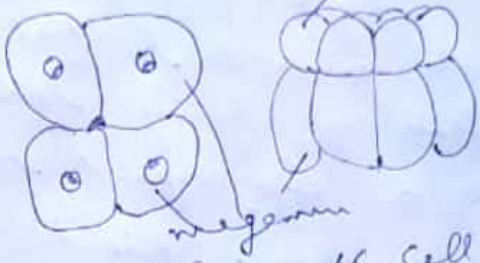
Third set of cleavage is transverse, dividing four blastomeres into a smaller micromere at the animal pole and a larger macromere at the vegetal pole. Fourth Cleavage is also meridional and all the blastomeres devide synchronously. They result in a sixteen cells stage having eight micromeres and eight macromeres. The fifth cleavage plane is an latitudinal and synchronous. They result is thirty-two cells arranged in four tiers and with a modest gradation in size. The sixth set of cleavage planes are approximately meridional and synchronous producing sixty-four blastomeres. But beginning with the Seventh set of cleavage, the synchronous character of the divisions decline so that the progression in nos. of blastomeres become arithmetical. Upto this stage, the blastomeres remain loosely packed and called morula. Meanwhile, a semifluid material accumulates in the centre of the mass of cells (blastomeres) of morula. This pushes all the blastomeres outward, so that they become arranged in single layer called blastoderm, enclosing a central-liquid filled cavity, blastocoel. To form the blastoderm, each blastomere of morula performs some morphogenetic movement and each assumes a columnar shape resulting blastula. A fully developed blastula of Amphioxus is called coeloblastula.

Fertilized Egg

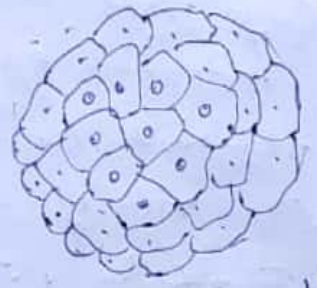
Mitosis of First cleavage



Four Cell stage



8 celled stage 16 cell stage

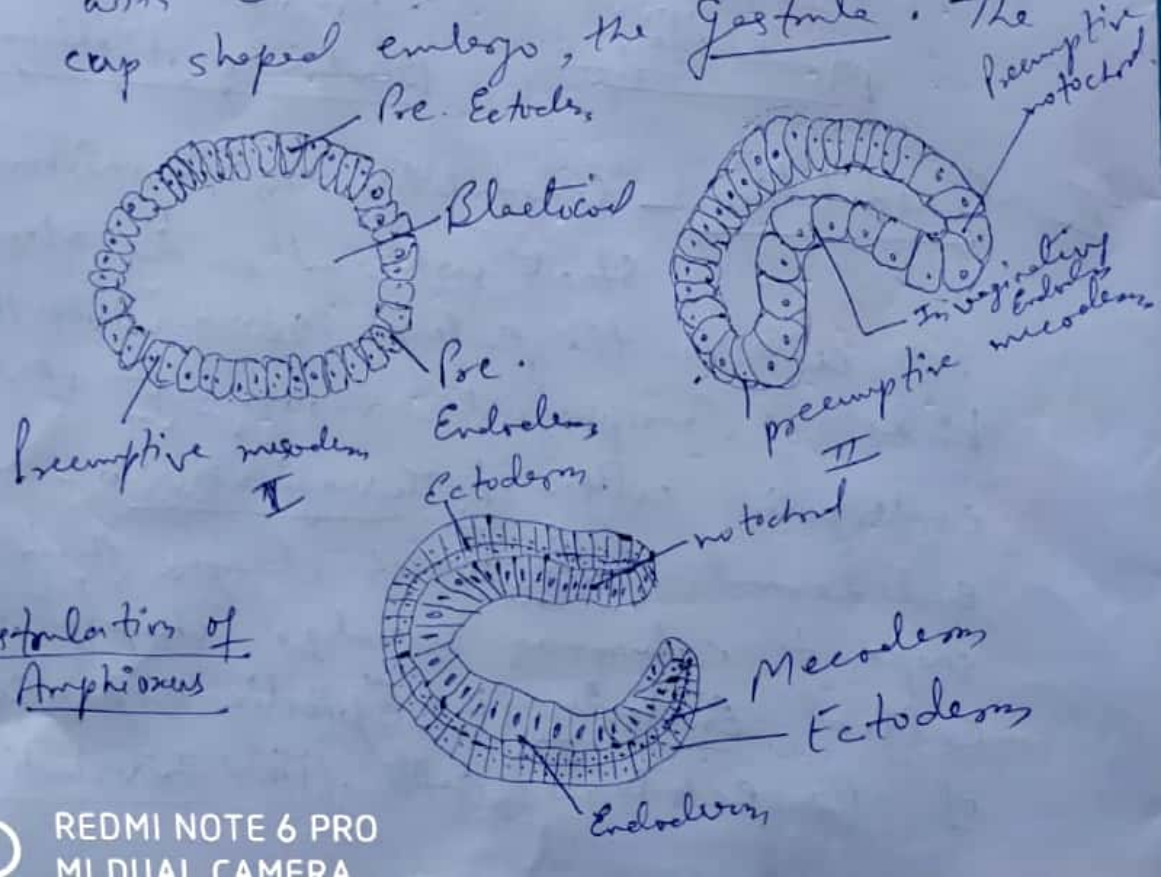


Morula stage

Blastula of Amphioxus

II Gastrulation – Gastrulation in Amphioxus start when there are about 800 cells in the embryo. It involves three kinds of morphogenetic movements of the embryonic cells – (i) Invagination of endodermal cells which changes their shape to columnar wedge shaped, also called Emboly (ii) Epibolic expansion of the ectodermal cells. (iii) Involution of

of notochordal and mesodermal cells. Gastrulation also involves obliteration of blastocoel and formation of a new cavity, called gastrocoel or archenteron which remains communicated to the exterior by blastopore. In Amphioxus, the process of gastrulation is initiated when the blastoderm at the vegetal pole becomes flat and subsequently bends inwards so that whole embryo, instead of being spherical becomes converted into a cup shaped structure called archenteron. This is in open communication with the exterior by the blastopore, on the side that was originally the vegetal pole of embryo. The cup has double walls, an external and internal epithelial layer, both of which remains continuous with each other over the rim of the cup shaped embryo, the Gastrula. The



Gastrulation of Amphioxus

circular rim of the blastopore is termed the lip, thus, with reference to the future orientation of the embryo, the prospective mesoderm lies in the ventral lip of the blastopore and the prospective notochordal line in the dorsal lip of the blastopore.

As the endodermal plate continues to move inward, notochordal cells in the mid-dorsal region of the blastopore involute, move inward along with the endoderm. This serves to bring the prospective notochordal material to the interior and beneath the prospective neural ectoderm. Due to continued invagination of endoderm, the prospective mesoderm in the ventral lip of the blastopore is brought in to interior. The blastopore is very broad in the initial stage of gastrulation, but soon the lips of the blastopore begin to contract, so that the opening which leads into the archenteron become smaller and is eventually reduced to an insignificant fraction of the original orifice. The notochordal got reoriented from a transverse to a longitudinal bend in the steady pulling of the mesoderm from the other side in a dorso-anterior direction. Thus, germinal layers [illegible] are the source of development of organs in adult Amphioxus. (Contd