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Sem-6

LSPT 614

- Development — [ontogenic : Development of an embryo
  phylogenic : Evolutionary development

Approaches to study development :-

1. Anatomical approach
2. Genetic approach
3. Experimental approach

- Anatomical — [Comparative
  Evolutionary
  Teratology [study abt birth defects]
  Mathematical modelling

- Comparative — Aristotle (4th century BC) father of comparative embryology.

→ Give the concept of oviparous, viviparous, ovoviviparous.

→ He saw a no of eggs and said egg can undergo holoblastic [when cell completely divided into two] cleavage and meroblastic cleavage.

undergo cleavage [Partial cleavage]

Yolk

Meroblastic cleavage [Birds]

→ Also studied the functions of placenta and umbilical cord.

⇒ William Harvey in the year 1651

- All animals arise from eggs — He said this
- He also said ~~the~~ or give the function of amniotic fluid → amniotic fluid acts shock absorber.

⇒ Marcello Malpighi

- He gave the first microscopic account of ~~chy~~ chick development.

EPIGENESIS AND PREFORMATION ?—

- Aristotle Harvey said development is de novo
- Epigenesis is supported by Aristotle Harvey. they said embryos are formed de novo. Preformation was proposed by marcello malpighi. He said that the organs of the adult were present in miniature form in eggs and sometimes sperm. when the embryo begins to develop~~ed~~, these parts grow or unfold. The Ovists were peopce who believed that the embryo was formed in the egg and the animalculists believe that the embryo was present in the spermat-ozoa. However, the discovery of parthenogenetic development in insects gave support to the Ovists.

Epigenesis is revived by ~~Fedrick~~ Kasper Freiderich Wolff who observed the formation of chick embryo and noticed no pre-formed structure in the egg only granule substances were present. He concluded that the eggs contain material from which material is built. Also epigenesis gained strength with the development of improved microscope, better staining technique and the German universities.

- Christian Pander → He discovered the germ layers. He saw the tissue interactions.

- Heinrich Rathke → He saw the development of frog, Salamander, Fish, birds and mammals. He concluded there are similarities in development in all Vertebrates

- Karl Ernst Von Baer → Von Baer's laws

→ First law :- General features appear earlier in development. (notochord)

→ Second law :- The less general characters appear from the more general characters.

→ Third law :- Embryo of a given species instead of passing to the adult stages of lower animal departs more from them

→ Forth law :- Early embryo of higher animal is never like a lower animal. It only resembles its embryo.

Biogenetic law :

Biogenetic law muller-Haeckel

Muller propounded the law and supported it based on the development of crustaceans [Arthropods] Haeckel (1868) named it the biogenetic law. It is basically the Baer's law re-interpreted in the light of evolutionary theory.

Evolutionary theory - It states ontogeny recapitulates phylogeny, i.e ontogenic development presents the various features of animal organisation in the same sequence in which they develop phylogenetically.

Biogenetic law states that ontogeny is a shortened and modified recapitulation of phylogeny. while phylogeny takes years, ontology is a matter of days and weeks. Also many stages are omitted in ontology.

6 Jan

Fate maps

Fate maps are the map that trace larval or adult structure onto the region of embryo it e from which it arose. It forms the bases of experimental embryology. They can be generated in several ways:

1. By observing living embryos.

In some invertebrates the embryos are transparent and have few cells. In this we can observe and trace the descendants of particular cells into organs they generate. Edwein G. Conklin took eggs of tunicate Styla Partita, a sea squirts squads and followed the fate of each cell. This was possible bcoz in styla different cells contain different pigment. Eg muscle forming cell had yellow pigment. The exp. was confirmed by cell-removal experiment It was seen that removal of these yellow cell resulted in absence of tailed muscles.

(2) Vital dye staining : (Those stain live cells)
Vogt in 1929, dyed particular cells with vital dies. For this he prepared agar on slide and mixed it with the dye. The ends of the dyed agar were placed on the frog embryo. After the dye stained the cells, agar chips were removed; the cells movement could be observed.

(3) Radioactive ~~movement~~ labelling and flouroscent dye :
For this the donor embryo is grown in radioactive medium. The region of interest is cut from the host embryo and replaced by radioactive graft of the donor then sections are cut for the microscopy. The descents of interest are radioactive. The problem with vital dye and radioactive dye is that with each division it becomes diluted and difficult to detect.

Fluorescent dyes like fluorescent conjugated dextran can be used to stain cell and the embryo can be observed under UV.

(4) Genetic marking :-
Mosaic embryos can be created. Best e.g is the construction of chimeric embryos consisting of graft of Quail cells inside chick embryo [both have similar early embryonic devel.] Quail cells have diff. nucleus i.e heterochromatin and also these are cell specific antigens that are quail specific. Quail cells are substituted for chick cells while embryo is still inside the egg and the chick, that hatches will have quail cells at particular sites.

- Fate maps are instrumental in demonstrating the extensive cell migration during development
- Mary Rawls in 1940 showed that melanocytes of chick originates in the neural ~~crest~~ crest using the same technique, Ris (1941) demonstrated that while external pigment cells in chicken originate from neural crest, the retinal pigment cells are formed in the retina itself. By using radioactive marking, Weston in 1963 demonstrated that neural crest cells give rise to melanocytes, peripheral neurons and adrenal medulla.

Evolutionary Embryology

Based on the Muller's interpretation of Baer's law Charles Darwin suggested that embryonic resemblances show genetic connectiveness of different animals.
Based on larval forms, barnacles were placed in Arthropods and tunicate larvae in chordates. bcoz they have notochord and pharyngeal pouches. Also Darwin noted that embryonic organisms make structures in appropriate for their adult form but they show their relatidness to other animals.

Homology : Homology structure which are similar as they are derived from common anscetral structure. Eg forearm of human and wings of bird, Gill cartilage of fish - Reptalian Jaw and mammalian middle ear.

Analog : They are similas as they perform the similar function. eg wings of insect and wings of birds.

10/Jan

Teratology

medical Embryology and tetratology

- Defect
  - Genetic - (defect in genes)
  - Tetratology

Some birth defects are due to mutant genes or chromosomes. Others are produced by environmental factors, abnormalities caused by genetic events are called as malformation and those & the study of embryological defect caused by environ. [chemicals, radiations] are known as ~~teratology~~ teratology.

Integration of malformation with the knowledge of genes responsible for the development has helped us identify steps in development.

Mathematical modelling and Depelopment :-

Pattern formation and growth are two areas in which mathematical modelling has helped.

Unicellular to multicellular - 2 Principle -
① Staying together ② Differentiation

Evolution of multicellular organism :-

Orderly division of cells and subsequent differentat^n e.g volvocians mostly they are group of cells resembling unicellular chlamydomonas. The group of cell some form flat-plate of cells (4-16 cells) e.g Gonium. In Pandorina, the 16 cells form a sphere. Thus in this, we see the orderly cell division followed by arrangement in a predictable manner, Process basically resembles the cleavage. In 2 genera of volvocian, another imp. principle is seen, i.e differentiation of cell type. In Pleodorina and Volvox there is differentiat^n of reproductive cell and somatic cell.

In pleodorina, only anterior cells perform somatic function and posterior cells take place in reproduction.

In volvox, reproductive cells never develop flagella and do not help in motility or any other somatic function.

Differentiation and morphogenesis :
↳ movement of cell during gastruation.

- It can be seen in unicellular org. Dictiostelium discoidium.

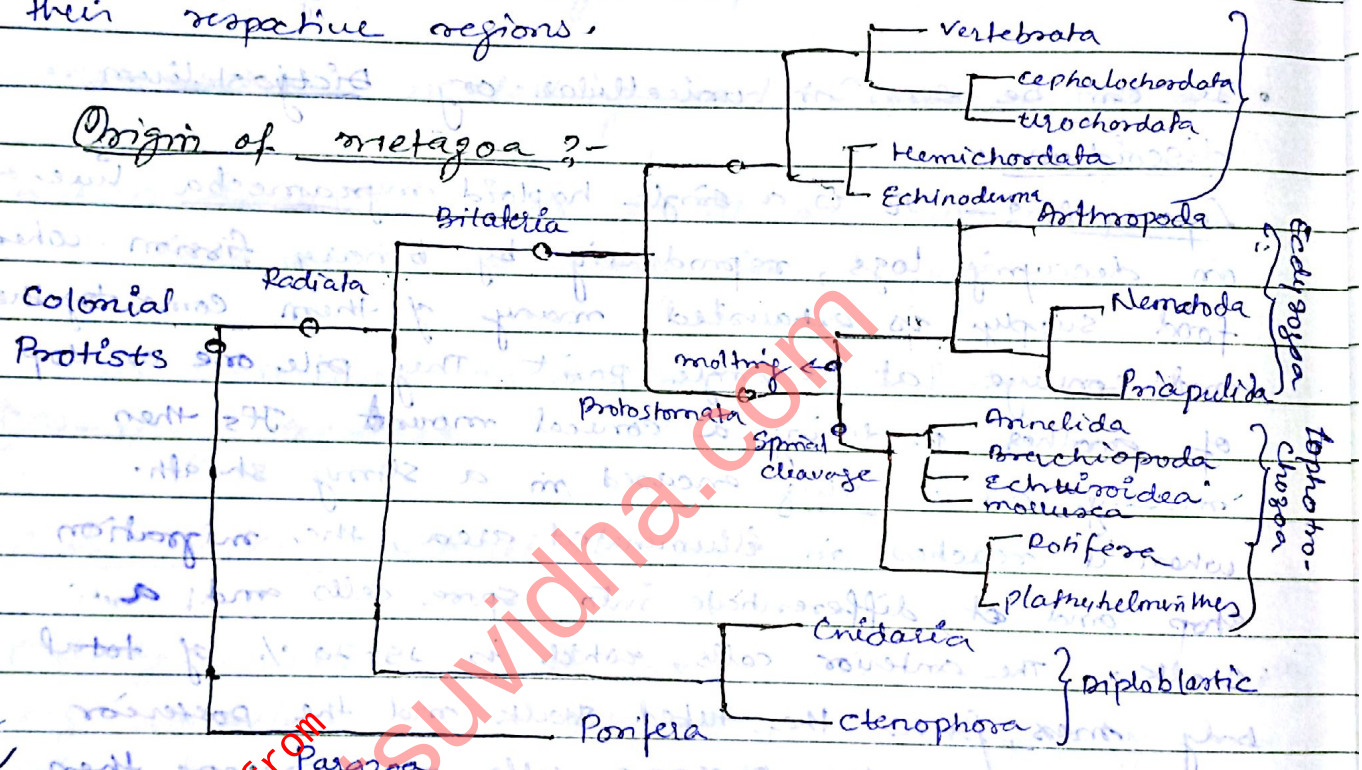
Life cycle :- It is a single haploid myxamoeba live on decaying logs, reproducing by binary fission. When food supply is exhausted many of them come together and converge at a single point. They pile one on top of another producing a conical mound. It's then moving as a slug encased in a slimy sheath. When it reaches in illuminated area, the migration stop and it differentiate into spore cells and a stalk. The anterior cells, which is 15-20 % of total body mass forms the tubed stalk and the posterior 4/5th cell forms the prespore cells. The prespore then becomes the new spore cells, disperse and again become new myxamoeba. In this we see cell differentiation and also cell morphogenesis to form complex organism.

How this aggregation takes place :- aggregation takes place due to chemotaxis. Cyclic AMP is released by the cells. The neighbouring cells move towards the cyclic AMP pulse and also in turn release more cyclic AMP.

How adhesion takes place :- Adhesion takes place with the help of adhesion molecules. The initial cell-cell adhesion is initiated by 24 KDa glycoproteins (gp24). The second adhesion molecule is of 80 KDa (gp 80). This helps in stabilization of adhesion. There is a third adhesion molecule gp150 (150 KDa).

If this protein is absent due to gene mutation, then the prespore and prestalk fail to sort out into their respective regions.

Origin of metazoa :-



Amniote egg — (1) Presence of Amnion
(2) " Yolk sac
(3) " Cohesion [gas exchange]
(4) " Allantois [helps in excretion]