TOPIC: EOLUTION OF METAZOA

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ZOOLOGY(HONS.)-PAPER I-GROUP A
CHAPTER 3
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Diploblastic and Triploblastic Organization

In Metazoa, special regions of the body are set aside for dealing with different functions.

The Metazoa produce gametes of two types, the male gametes are spermatozoa and female gametes are ova.
A spermatozoon fertilizes an ovum to from a zygote which undergoes a series of mitotic cell division to from a hollow ball of cells called blastula it has a cavity known as blastocoel.
Further increase of the cells of the blastula causes an invagination of the wall on one side, and by different processes the cells eventually come to lie in two layers, an outer layer of ectoderm and an inner layer of endoderm, the blastocoel is obliterated; the mouth of the invagination is a blastopore which leads into a new cavity, the archenteron; this two layered bag is a gastrula.
The development of some Metazoa stops at gastrula stage, these two –layered Metazoa are diploblastic, such as Cnidaria and Ctenophora.
In all other metazoan phyla, a third layer of cells called mesoderm arises between the ectoderm and endoderm.

The phyla which possess three layers are triploblastic, and their mesoderm opens up further possibilities of increase in size and complexity.

In triploblastic phyla, the ectoderm and endoderm retain most of the function which they perform in diploblastic animals.

The ectoderm forms the outer protective epidermis, external sense organs, nephridia and the nervous system, but in Echinodermata, part of the nervous system is mesodermal in origin.

The endoderm gives rise to the lining of alimentary canal and organs associated with digestion and respiration.

The mesoderm is not single entity but has parts which originate in two ways; the cells which migrate from the ectoderm or endoderm form a loose cellular tissue called mesenchyme which fills the spaces between the other layers, and it is comparable to the cells which are found in the mesogloea of Cnidaria.

The second type of cells which from the wall of the body cavity are known as mesothelium or real mesoderm which gives rise to connective tissue, muscles, skeleton, blood, circulatory system, excretory system and reproductive system.

In lower triploblastic phyla (Platyhelminthes and Aschelminthes), there is no mesothelium, in Chaetognatha there is no mesenchyme, but the other phyla possess both kinds of mesoderm.

The triploblastic acoelomate animals may attain a degree of complexity not seen in diploblastic animals. (Fig.5).

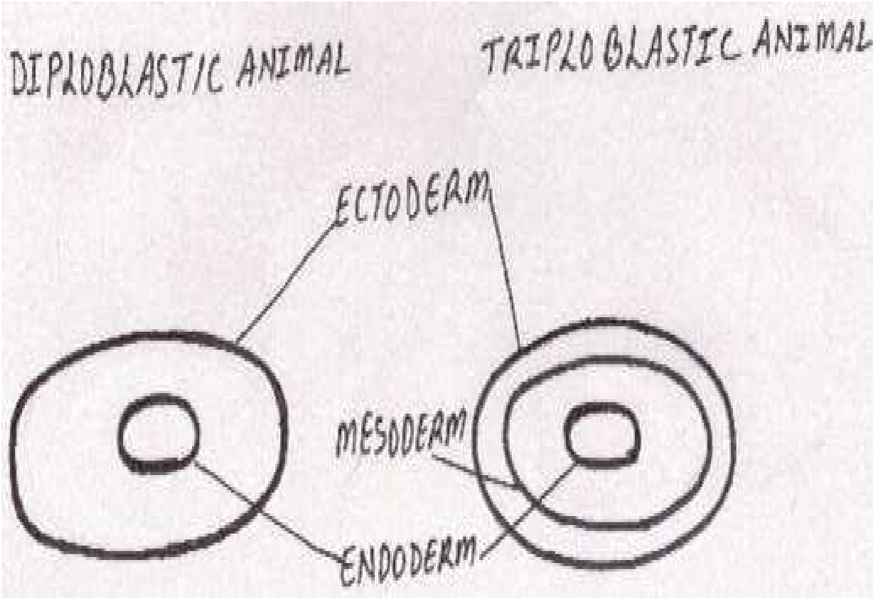

Fig 5. Diploblastic & Triploblastic Animal

Eg. Diploblasts (e.g. *Hydra, Nematostella-)* - Only two germ layers Radial Symmetry. Triploblasts or Bilateria (the rest) **-** Three germ layers Bilateral Symmetry

Theories on the origin of metazoans:

Cnidarians have been regarded as the most primitive eumetazoan and the possession of radial symmetry has been regarded as a primitive character of cnidarians. The origin of metazoa is based on this assumption.

(1) COLONIAL THEORY:

Most widely accepted theory was first conceived by Haeckel (1874). Later, the theory was modified by Metschnikoff (1887) and Hyman (1940). According to this theory the ancestors of the metazoans are the flagellates. The ancestral metazoan probably arose from a spherical, hollow, colonial flagellate. The colony possessed a distinct anterior-posterior axis with monoflagellate cells on the outer surface. It moved with its anterior axis forward. The somatic cells were differentiated from the reproductive ones. This hypothetical stage was called **blastaea**. It is believed to reflect, the blastula stage which occurs in the development of all animals. The blastaea invaginated to produce a double-walled **gastrea** which was regarded as the hypothetical metazoan ancestor by Haeckel. This gastrea was equivalent to the gastrula stage in the embryonic development of living metazoans. Division of labor of the somatic cells probably led to increasing interdependence of cells and finally an original colony of unicellular individuals became a multicellular organism.

Metschnikoff argued that the originally hollow blastaea became transformed into an organism having a solid structure (gastraea) by the proliferation of the cells from the blastula wall into the blastocoel. This hypothetical ancestral metazoan is believed to be radially symmetrical, ovoid, with no definite mouth. The outer flagellated cells assumed a locomotory function while the inner ones were nutritive and reproductive in function.

This hypothetical ancestral metazoan resembled the planula larva of cnidarians and has been called as the planuloid ancestor who has given rise to the lower metazoans .Thus, this theory clearly suggests that the cnidarians have been derived from the planuloid ancestor and that the radial symmetry is primary one and that the bilateral symmetry is a later modification.

(2) CELLULARISATION / SYNCYTIAL THEORY:

Hadzi (1953) and Hanson (1977) are the chief proponents of this theory. They suggested that the metazoans have evolved by the cellularization of a syncytial protistan. According to them most primitive acoelous turbellarians e.g. *Convoluta* were derived from multinucleate ciliated protistans by the process of cellularisation. Since many ciliates tend towards bilateral symmetry they argued that the ancestral metazoans were bilaterally symmetrical and gave rise to the acoels which were regarded as the primitive living metazoans.

POINTS IN FAVOUR:

Size of the acoels is comparable to the ciliates.

Acoels are also ciliated.

(c).Bilaterally symmetrical.

(d).Both lack a hollow digestive cavity.

(e).Imperfect cellularisation is found in the acoels. Syncytial aggregates have been found in the central region of the parenchyma of the acoels.

However, Hadzis theory also suggests that the Cnidarians, more specifically the anthozoans were derived from the turbellarians and that their radial symmetry is because of their sessile mode of existence. These cnidarians retained some of their ancestral bilateral symmetry internally in the stomodaeum, mesentries and muscle bands. Thus, according to this view, the Hydrozoans are advanced rather than being primitive and that their simple structure is a secondary adaptation to its mode of existence.

CRITICISM:

This theory is based on the adult structure and disregards the embryological evidences.

The development of turbellarians, nemerteans, annelids, molluscs and some other groups show spiral cleavage which is not found in cnidarians or ctenophora.

The cnidarians show a wide variety of cleavage patterns suggesting a primitive nature of this group.

The mere fact that cnidarians have evolved from the turbellarians would mean the abandonment of spiral cleavage which seems improbable.

The primitive groups are generally more variable with a simple body plan than the highly evolved ones.

Hydrozoans are more variable than either Anthozoa or Scyphozoa or Turbellaria and therefore Hydrozoa should be considered most primitive. However, according to Hadzi, hydrozoans are regarded as advanced and their structural simplicity is a secondary development.

According to this theory, the acoels are the most primitive living metazoans. Thus, the bilateral symmetry becomes primitive for the metazoans. This would mean that the radial symmetry of the cnidarians has been secondarily derived from the flatworms. Many zoologists now doubt that the acoels are the most primitive flatworms.

A ciliate ancestry does not explain the occurrence of flagellated sperm in metazoans.

Most sessile animals are hermaphrodite. With a few exceptions, anthozoans are not hermaphrodites. Thus, it seems dubious to consider anthozoans as the descendants of hermaphroditic turbellarian

Summary

All are Multicellular/Specialized cells.

All are Eukaryotic Heterotrophs.

No cell wall or Chloroplasts Dominant diploid (2n) organism.

Store glucose as Glycogen**.**

Most mobile at some point in life cycle.

Larva (free living sexually immature form) may be only time in some

Development of Zygote undergoes cleavage (Mitosis) to make Blastula (hollow ball of cells).

Gastrulation: Cells in blastula move inward over lip of Blastopore Form digestive system (tube within a tube) .

Germ layers form some animals only two germ layers form (Diploblastic). Eg: Sponges and cnidarians

Most animals -Three germ layers form (Triploblastic). Germ Layers i.e. :

Endoderm-forms lining of digestive tract, digestive (Liver and Pancreas) and respiratory organs (Lungs).

Mesoderm- forms muscle, skeletal, circulatory, excretory, reproductive systems.

Ectoderm- forms outer covering (epidermis), brain, central nervous system.

Glossary

Acoelomate: Animals without coelom.

Archenteron: Primary digestive tract of the metazoan embyo, formed during gastrulation.

Asymmetry: Condition in which opposite sides of an animal are not alike, without symmetry.

Bilateral symmetry: The arrangement of the body parts so that the right and left haflves are mirror images of each other.

Bilateria: The metazoans with bilateral symmetry.

Biradial symmetry: Condition in which an animal has radially arranged parts that lay half on one side and half on other side of a median longitudinal plane. E.g. Ctenophora.

Blastocoel: cavity of the blastula.

Blastula: The early embryo in which the cells form a hollow ball.

Coelom: The body cavity lined with the tissue of mesodermal origin in which the digestive and other organs lie.

Diploblastic: Derived from two embryonic germ layers, ectoderm and endoderm.

Ectoderm: outer Layer of cells in the gastrula. This layer gives rise to the epidermis, sense organs and nervous

	system.
Endoderm:	Innermost layer of the early embryo which gives rise to the lining of the digestive tract.
Gastrula:|	An embryonic stage with two germ layers: ectoderm and endoderm.