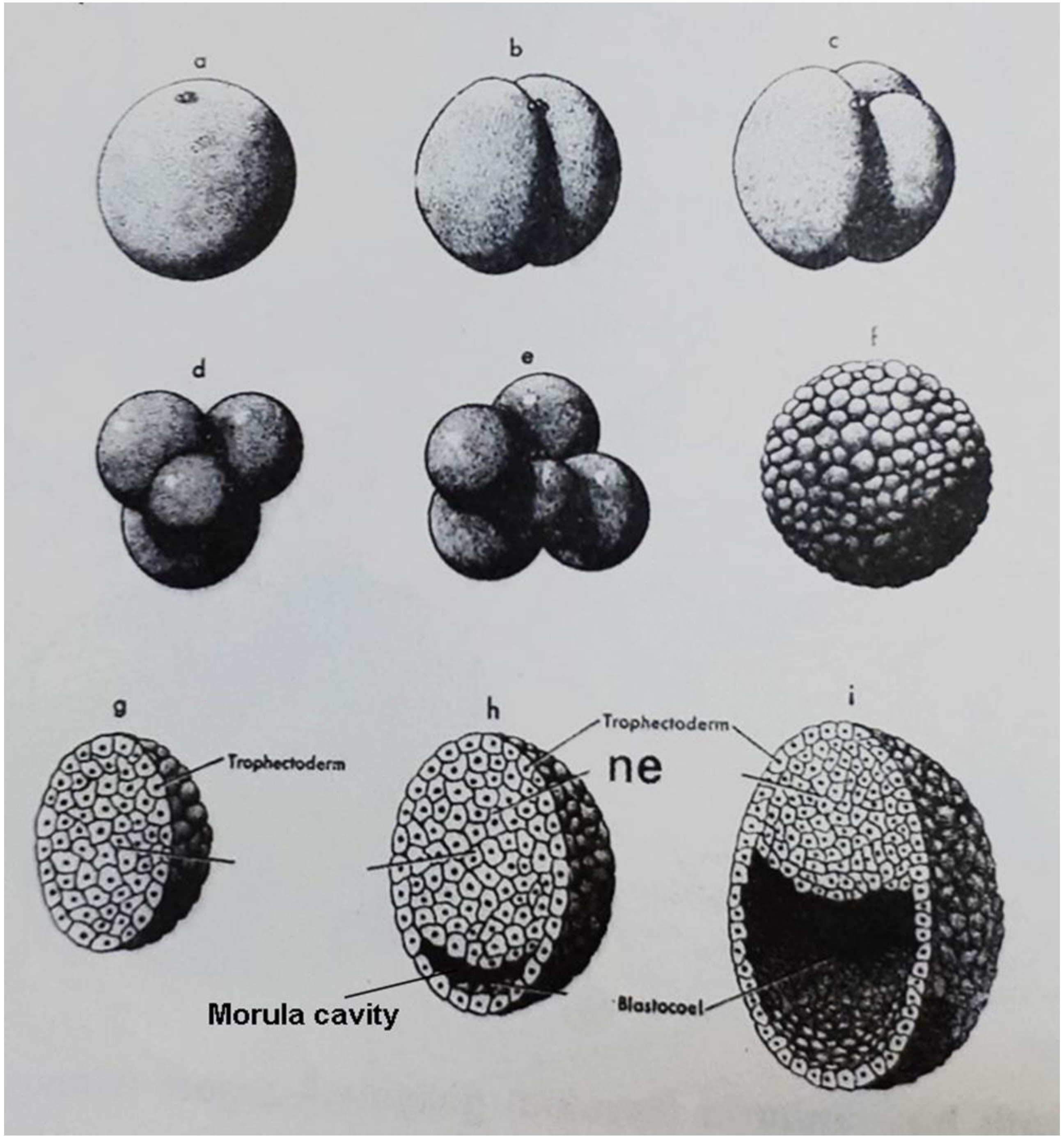
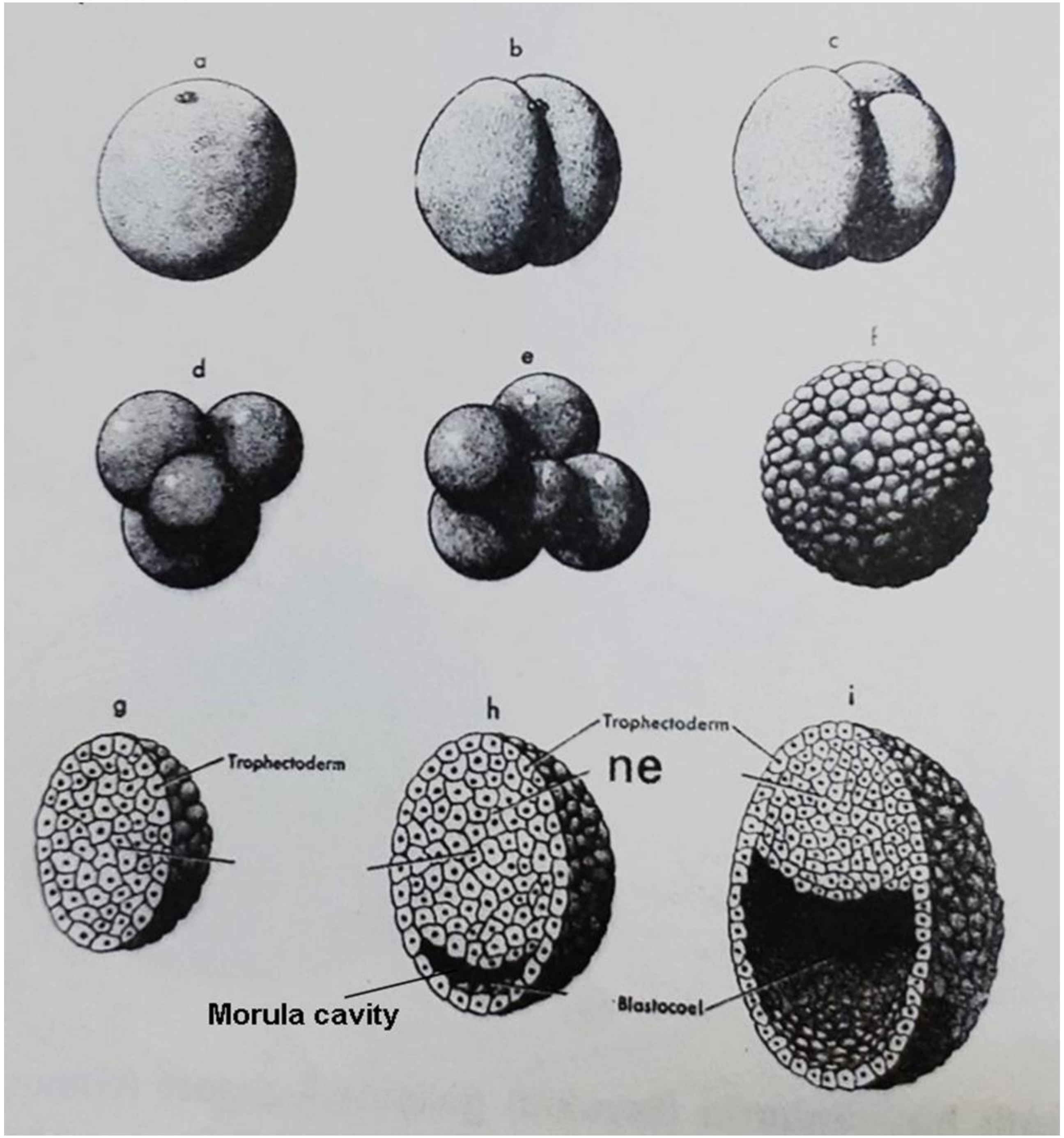
Developments in the mammals after zygote

- After fertilization of the ovum and occur zygote, with the first meridional division, two sister cells occur.
- These two cells referred to as blastomeres.
- These blastomeres are of equal size.
- At the end of the second meridional division consists of three blastomeres, not four.
- Because the second meridional division is atypical and does not occur at the same time in both sister cells (blastomeres).
- First, one of these blastomeres divide and two small cells form.
- The other blastomer is still undivided.



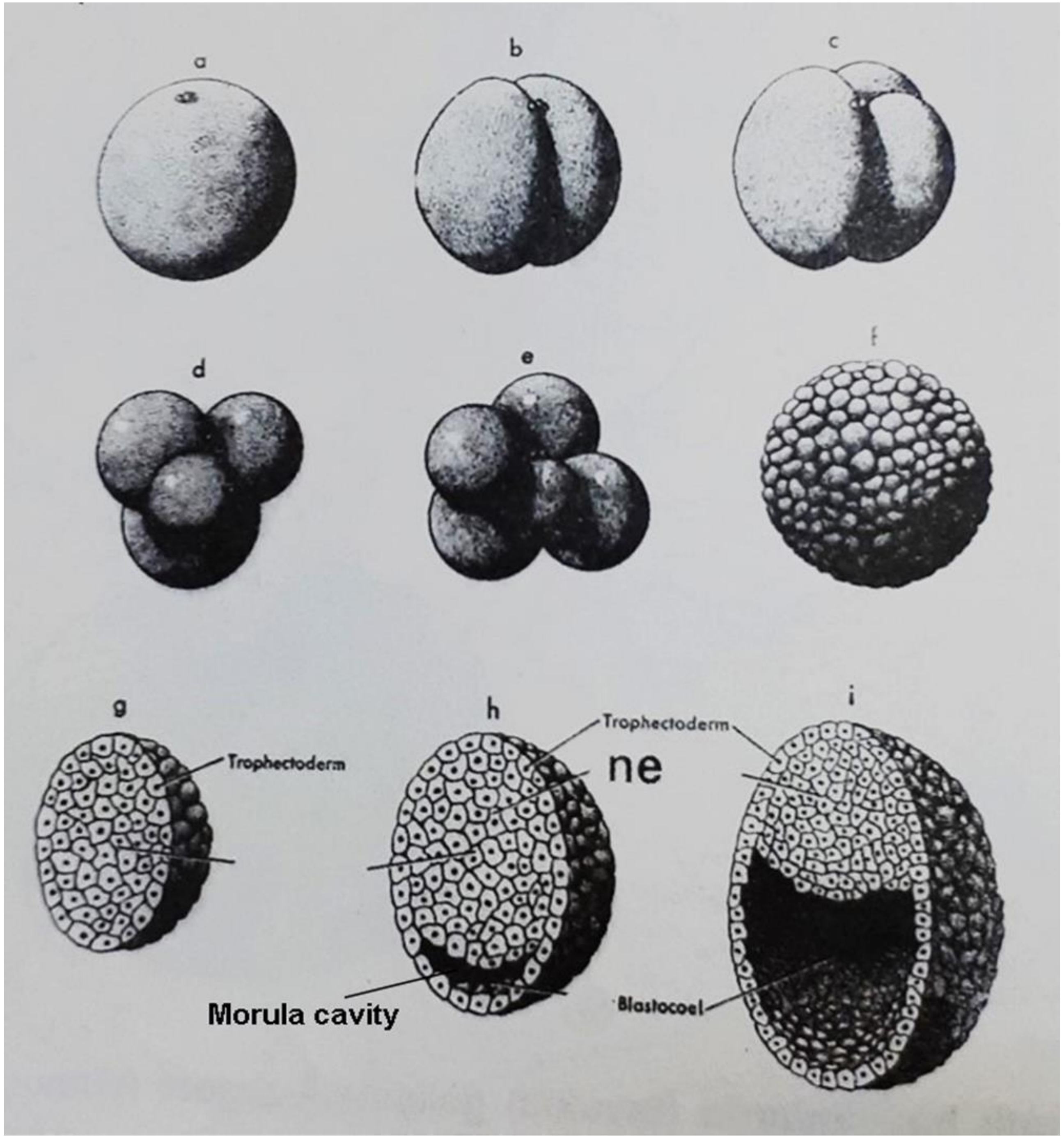
- At this stage, there are 3 blastomeres, but one of which is large and the other two blastomeres are small.

- With a third meridional cleavage, the undivided blastomere is also divided. Thus, the number of blastomere increases to four.



- As a result, three meridional cleavages occur in place of two meridionals.

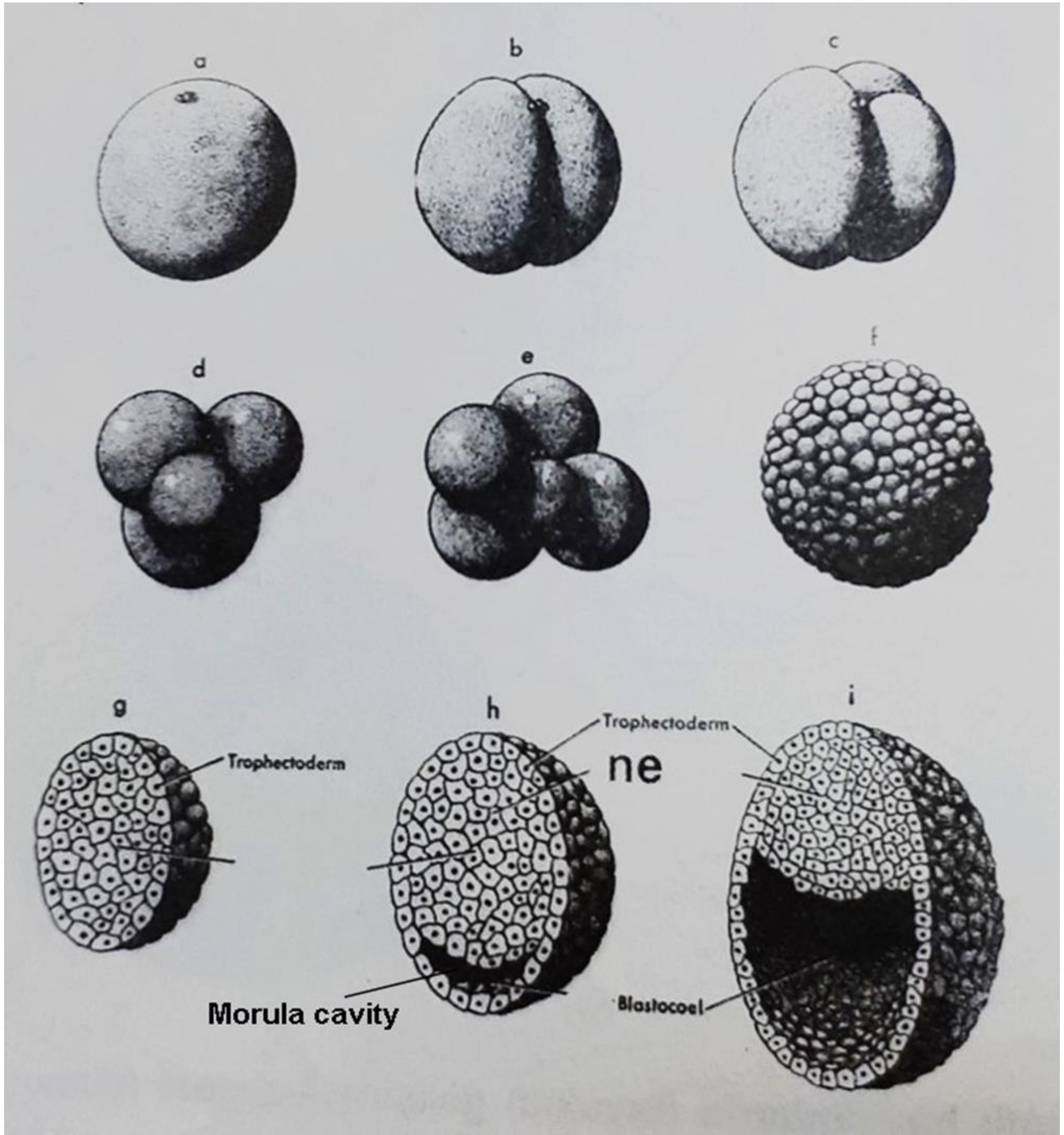
- Subsequent to these equatorial and meridional divisions, a **morula** composed of equal sized blastomeres unique to oligolechital eggs occurs.



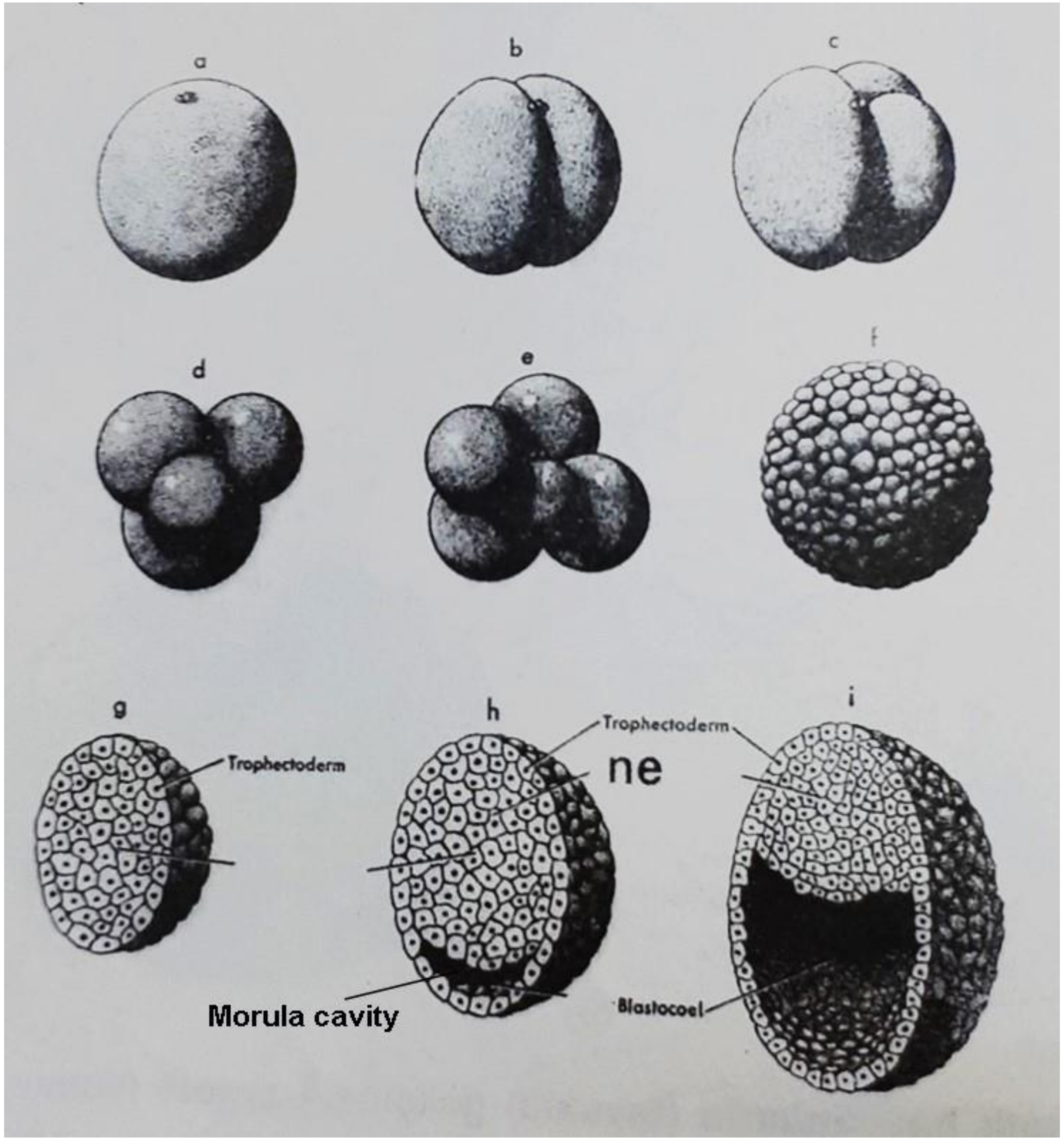
Morula occurs with total-aequal cleavages.

In the morula stage, the embryo is yet surrounded by the **zona pellucida**.

The polocytes maintain their existence for a while.

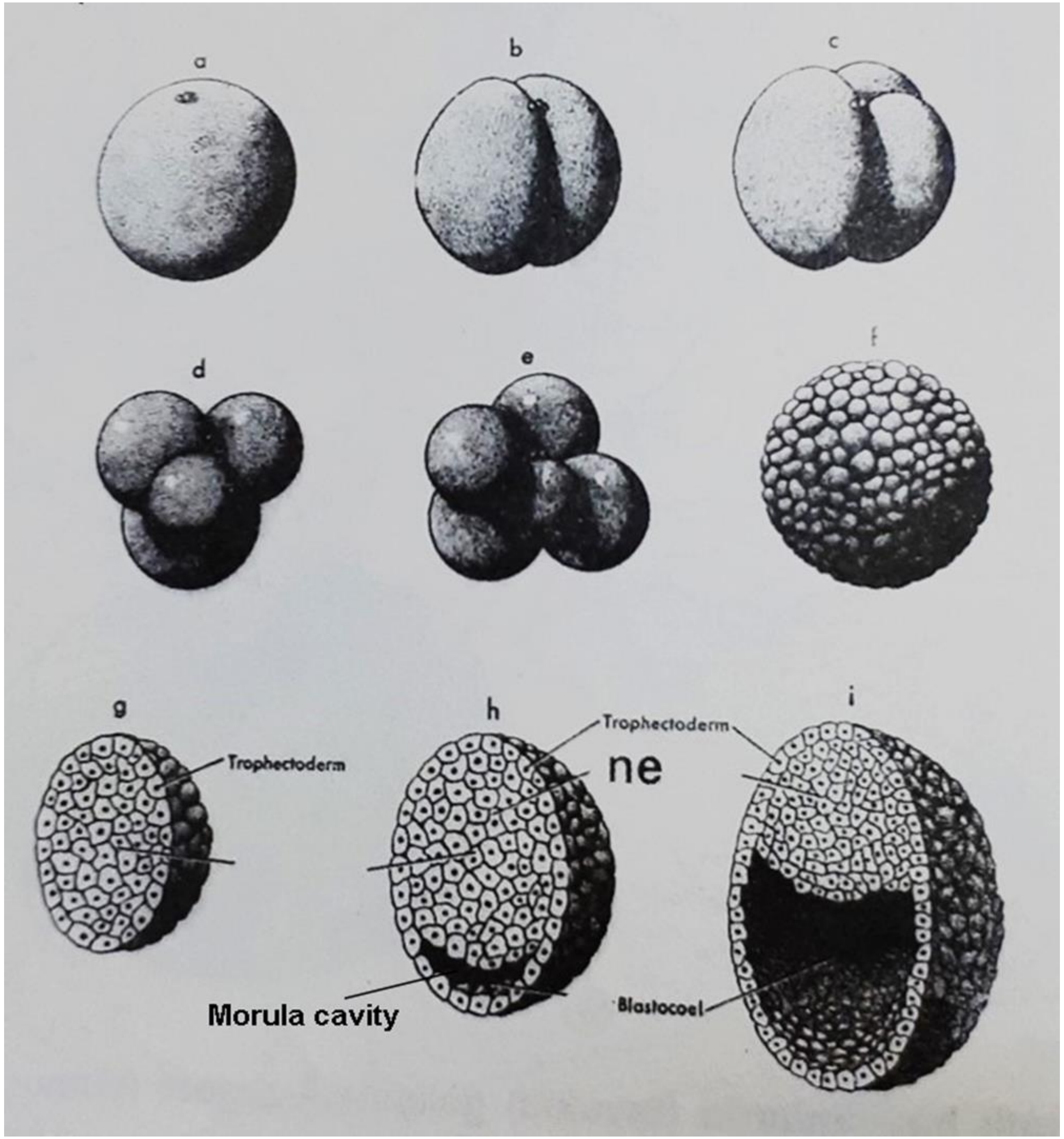


The cells in the inner part of the morula, near the vegetative pole, slowly melt away, and space occurs, referred to as morula cavity.



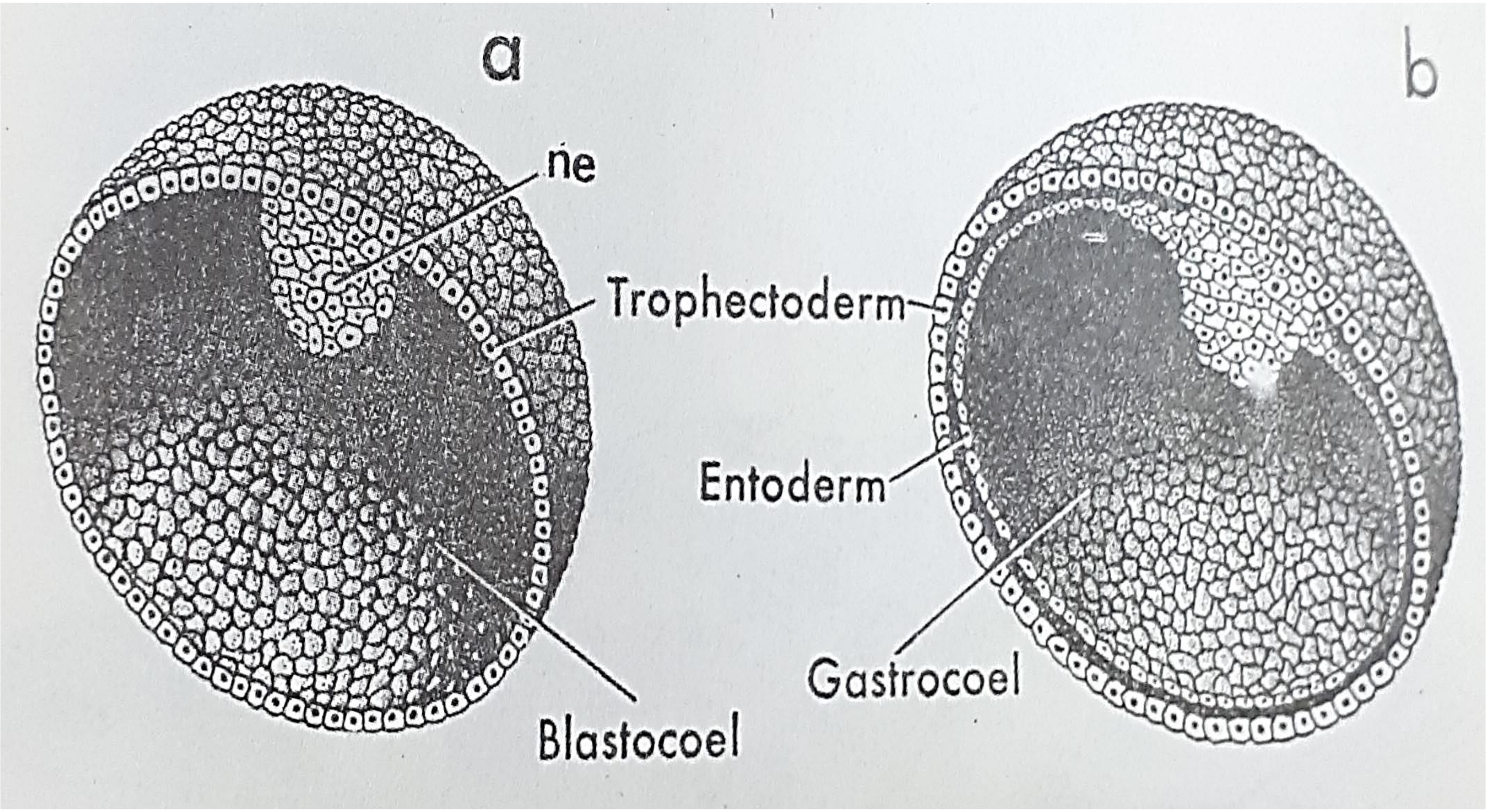
The blastula is formed by the expansion of the morula cavity, and morula cavity transforms into blastocoel.

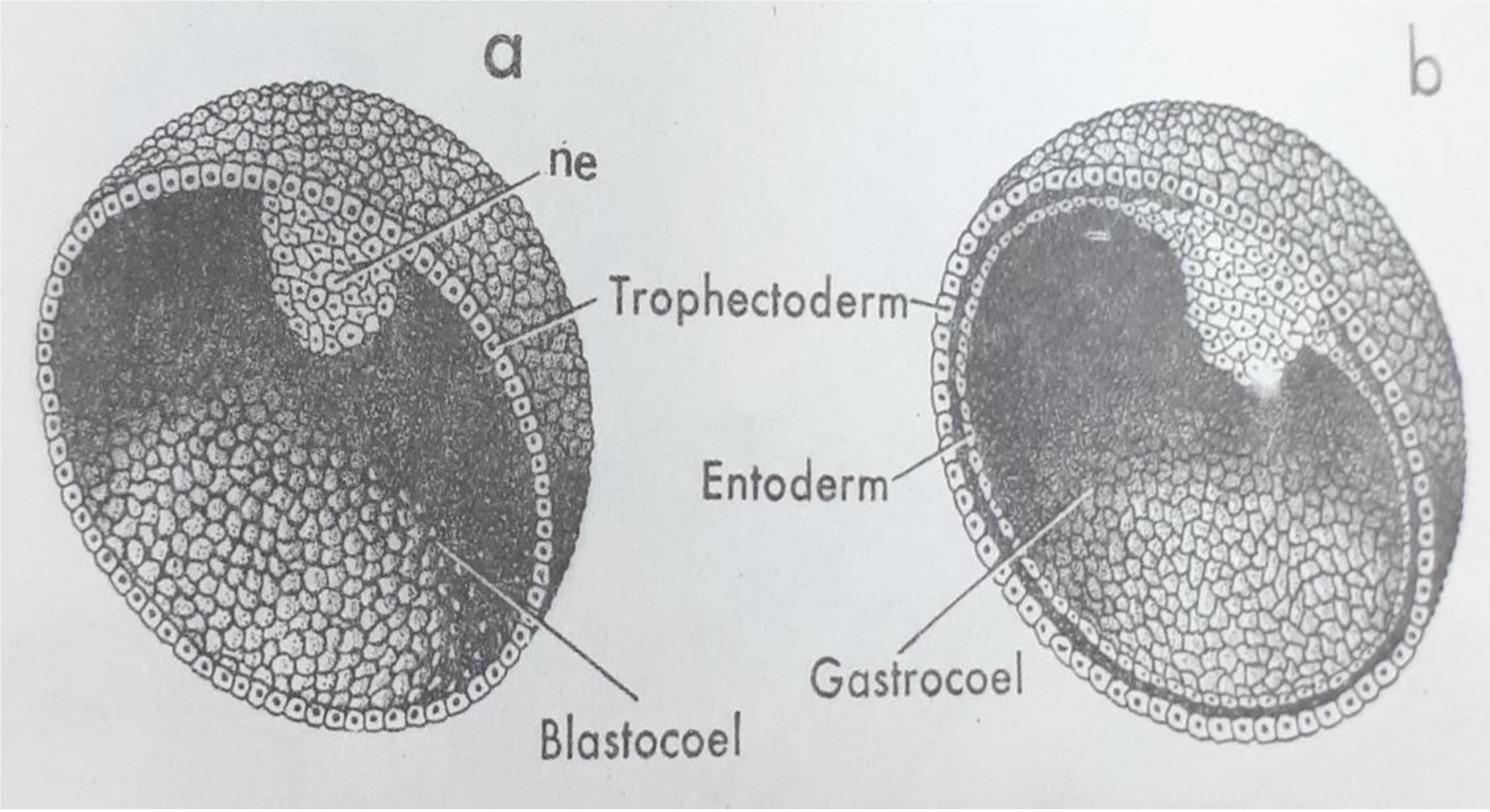
Mammalian blastula is a different appearance from amphioxus and chicks blastula.



Because from the animal pole to the blastocoel, in the form of a bump (inner cell mass), a blastomere assemblage hang down.

This bump (inner cell mass), which consists of ectoderm cells, is called **nodus embryonalis (embryoblast)**.



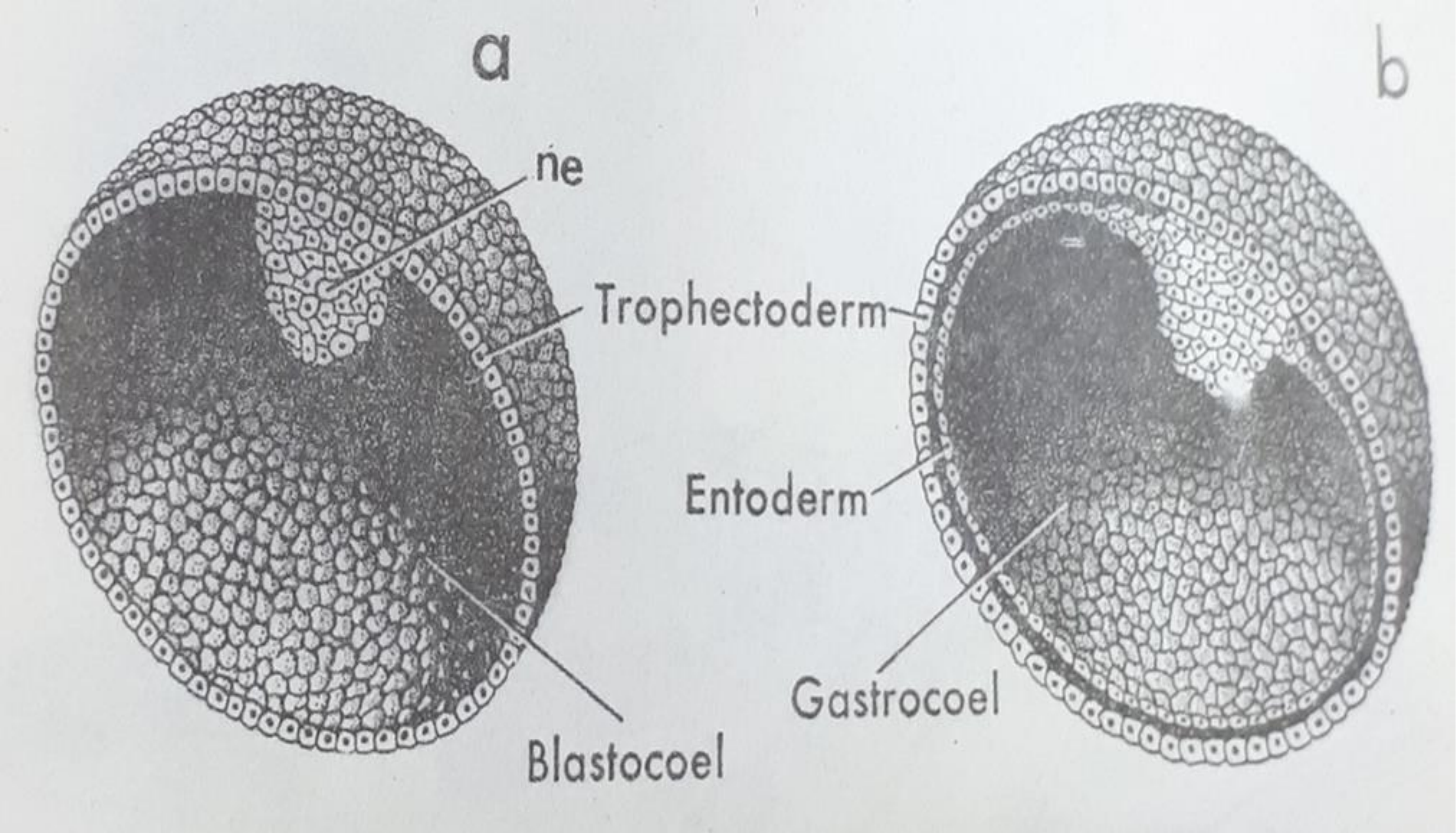


The ectoderm cells surrounding the blastocoel form a simple squamous layer.

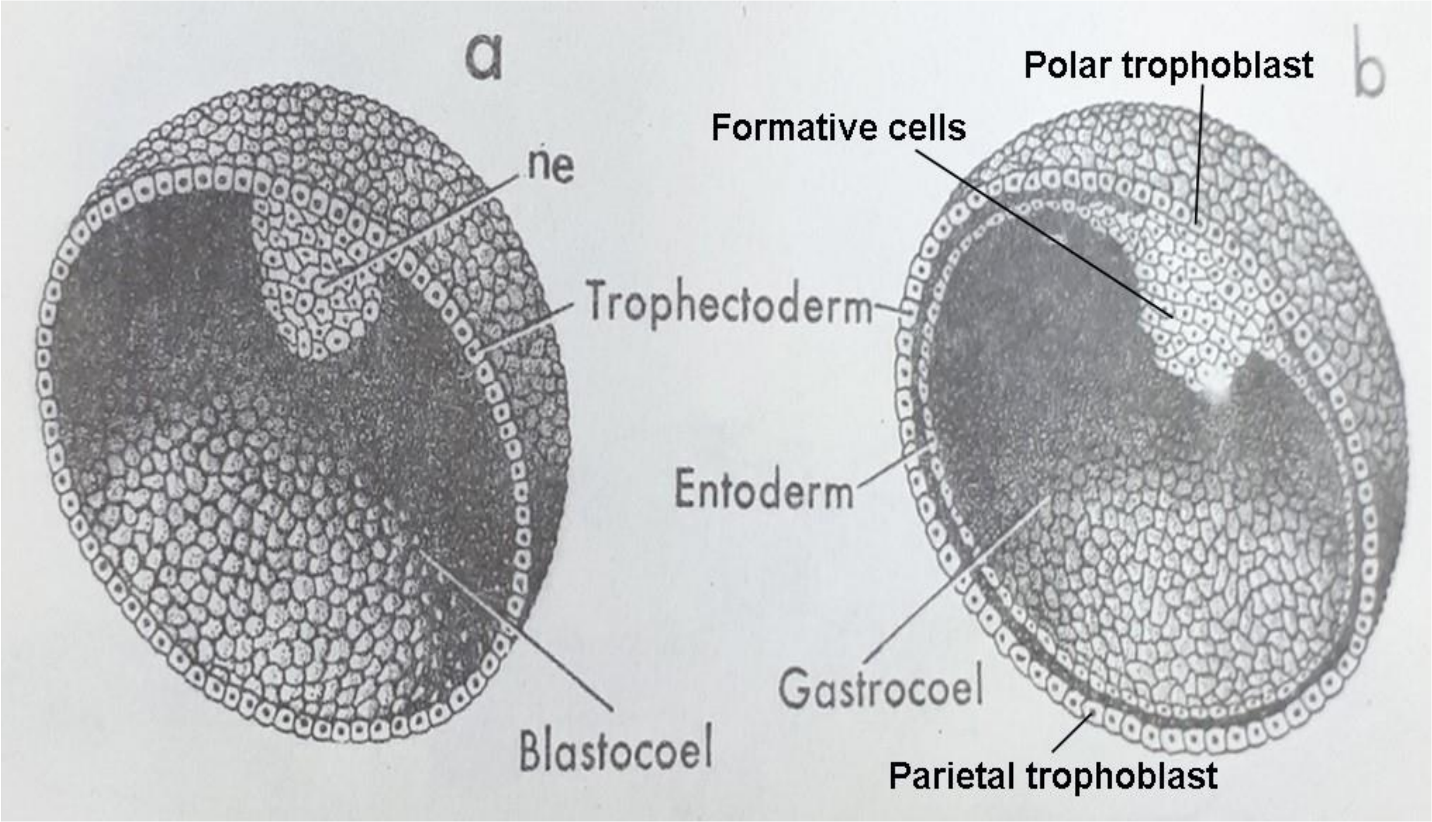
The mammalian blastula which is composed of blastocoel, ectoderm and nodus embriyonalis is called **cystoblastula** (**blastocyst**).

This structure is similar to a single stone ring.

Here, the ectoderm layer is called **trophoblast**, because it takes on the task of feeding.



The trophoblast covering to the nodus embryonalis is called the **polar trophoblast** (Rauber's layer), and the trophoblast surrounding to the blastocoel is called the **parietal trophoblast**.

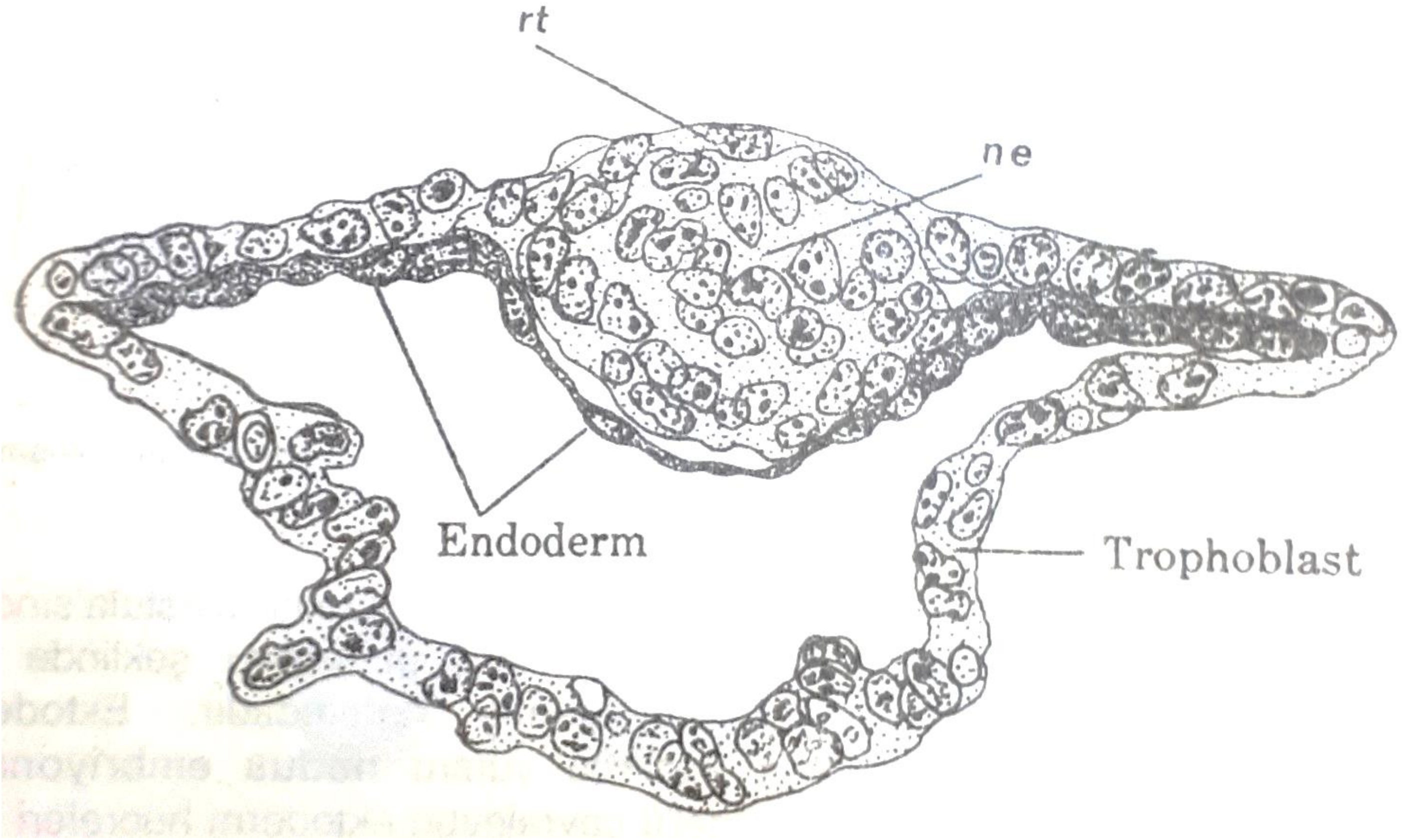


Cells that form nodus embryonalis are called **formative cells**.

Human blastula is the same type and shows the same structure.

FORMATION OF ENDODERM

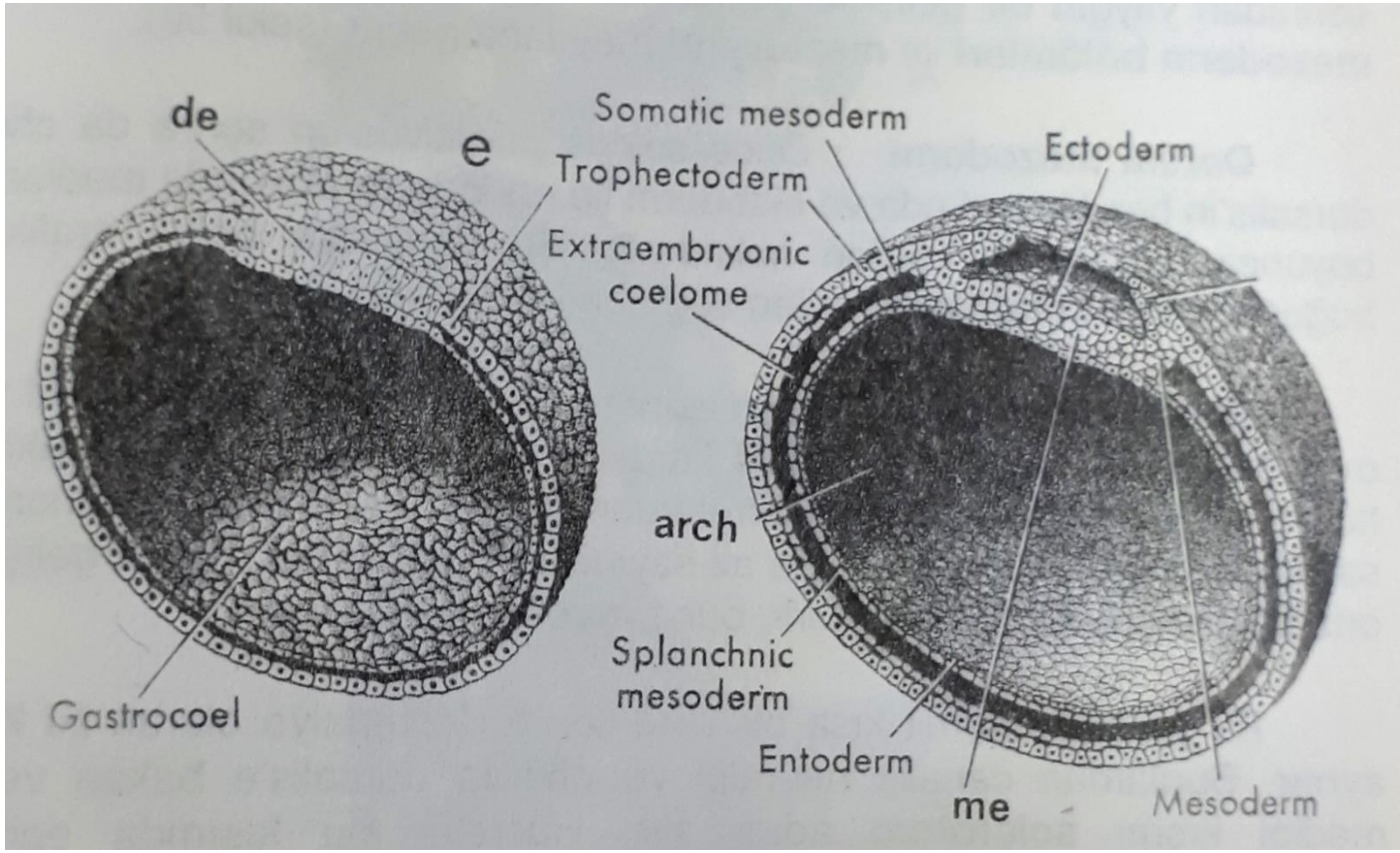
In mammals, not by invagination or polyinvagination as in endoderm, amphioxus, and poultry, but occurs by **differentiation of ectoderm** (**formative cells**) in the **nodus embryonalis**.



As the development progresses, it is seen that the cells facing the blastocoel are flattened in the **nodus embryonalis**.

Subsequently, these flat cells proceed downwardly under the ectoderm in a single row and compose **endoderm**.

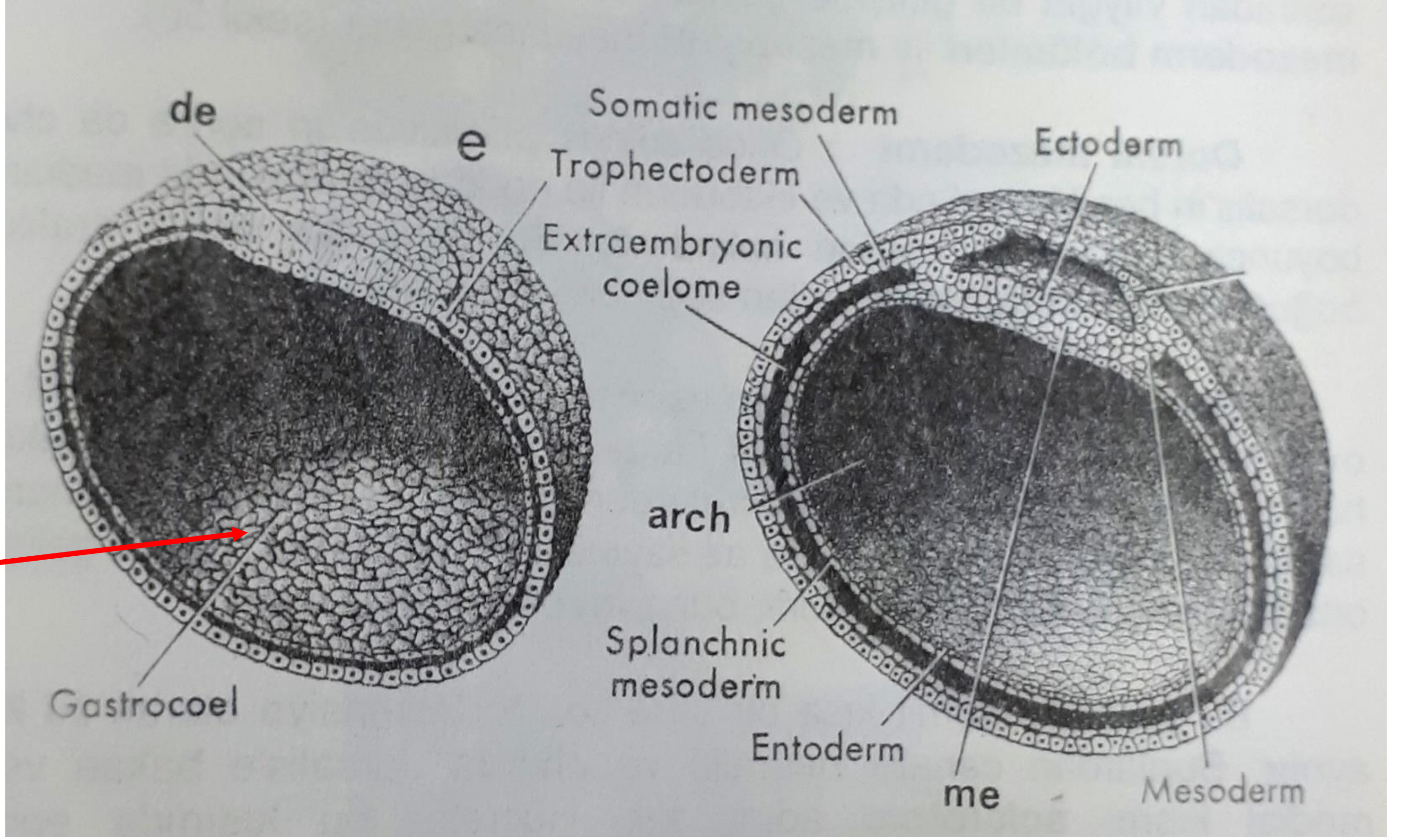
This event corresponds to **gastrulation**.



No typical gastrulation is observed here.

However, until the development of the endoderm is completed, the inner space is called **gastrocoel**.

When the development of endoderm is completed, this space is called the **vitellus sac**.



After the endoderm has been formed, this time, the other cells in the nodus embryonalis multiply and spread to form a disc-shaped area.

During the formation of this field, which takes the name **discus embryonalis**, the top face of the disc becomes free as the polar trophoblasts melt.

All developments after the formation of the embryonic disc are similar to those of the birds.

Sulcus primitivus, **nodus primitivus**, **fossa primitivus** and **canalis neuro-entericus** develop in the same way.

The formation of **chorda dorsalis** and **mesoderm**, expansion of **mesocoelom** and formation of **endocoelom** and **exocoelom** are also the same.

Somatopleura and **splanchniopleura** occur in the same way.

After the formation of **mesoderm** and **chorda dorsalis**, the disappearance of **sulcus primitivus**, **fossa primitivus** and **nodus primitivus**, the closure of **sulcus neuralis** and the formation of **canalis neuralis**, and the transformation of **dorsal mesoderm** into **somites** are also the same.

As the development progresses, a groove (sulcus primitivus) appears in the ectoderm at the caudal edge of the discus embryonalis.

This groove (sulcus primitivus), which extends in the cranial direction, ends in a pit near the middle of the disc.

This pit is called the fossa primitivus.

A mass is formed by the proliferation of ectodermal cells occurring in front of the fossa primitivus.

This is called **nodus primitivus (Hensen nodus).**

In later developments, a second groove in the cranial direction begins to form in the anterior part of the **nodus primitivus**.

This groove is **sulcus neuralis**, the origin of the nervous system.

FORMATIONS OF THE CHORDA DORSALIS AND MESODERM:

In mammals, **chorda dorsalis** and **mesoderm** consist of a group of indifferent cells that originate from ectoderm such as in poultry.

At the base of the **sulcus primitivus** and at the **nodus primitivus** (**Hensen's nodus**) the ectoderm cells proliferate towards the endoderm and form a group of cells.

Chorda dorsalis develops from nodus primitivus (Hensen nodus), and mesoderm develops from sulcus primitivus.

After chorda dorsalis and mesoderm formed, sulcus primitivus, fossa primitivus and, nodus primitivus, which are originated indifferent cell mass of ectoderm, show a regression and they gradually disappear.

Already their function is to create chorda dorsalis and mesoderm.

CHORDA DORSALIS:

In poultry and mammals, chorda dorsalis, which is regressed with the development of the spine, form the middle parts of the intervertebral discs called the nucleus pulposus.

As the chorda dorsalis develops, the anterior end of it ends in a tuber at the cranial end of the embryonal disc.

This tuber stops the excessive extension of the chorda dorsalis and takes the name **prechordal nodus.**

MESODERM:

The mesoderm, consisting of an indifferent cell group, creates dorsal mesoderm (paraxial mesoderm), intermediate mesoderm, lateral mesoderm, and mesenchyme.

Dorsal Mesoderm:

Dorsal mesoderm (paraxial mesoderm-somitic mesoderm), in both side of the sulcus primitivus and then in both side of the chorda dorsalis (notochord) and between the ectoderm and the endoderm, extending along the median line in two cords.

STRUCTURE OF SOMİTES:

The cross section of somit (3), which has completed its development, is oval.

Its structure is of epitheloid character and it is in the form of a cell cluster.

As somit develops, a gap appears in the middle region, called myocoelom.

Somit, after a short period of time, is divided into two parts.

The ventromedial portion of the somit, that overlooks canalis neuralis and chorda dorsalis is called **sclerotome**.

Cells lose their epithelioid character in this part and take the star shape and then migrate to the chorda dorsalis and canalis neuralis to form mesenchymal tissue.

Mesenchymal tissue will make smooth muscles, cartilage drafts of the vertebrae, and connective tissue in further developments.

The dorso-lateral part of the somite looks at the ectoderme.

This part is called dermamyotome.

Dermamyotome has two halves. The outer half is located just below the ectoderm and is called a dermatome, made of mesenchymal cells, spreading under the ectoderm and adhering to it, forming subcutis with the dermis of the skin.

The inner half of the dermamyotome is called myotome.

Myotome forms the trunk muscles and the muscles of the arms, legs, and neck, ie the dorsal and lateral skeletal muscles.

Intermediate mesoderm:

It is located between the dorsal mesoderm (paraxial mesoderm-somit) and the lateral mesoderm. This section develops the urogenital system (kidneys and internal genital organs).

Lateral mesoderm:

Lateral mesoderm (1) occurs when the intermediate mesoderm is spread out sideways. Subsequently, the lateral mesoderm is divided into two layers in the form of a slit-shaped in the inner part and create space.

This space, called mesocoelom, expands and is divided into intraembryonic and extraembryonic areas.

The part of the cavity within the embryonal area is called endocoelom (intraembryonic coelom) and the part outside the embryonal field is called exocoelom (extraembryonic coelom).

Endocoelom is the first body cavity and forms the cavities of the abdomen, chest and heart sac.

Exocoelom is a large cavity containing extraembryonic sacs (vitellus, allantois and amnion sacs). With the birth, the mission of the exocoelom and sacs are completed.

Endocoelom and exocoelom are interconnected by a narrow passage.

The outer leaf of the endocoelom is called somitic mesoderm (the parietal leaf of the lateral mesoderm), and the inner leaf is called the splanchnic mesoderm (the visceral leaf of the lateral mesoderm).

The somatic mesoderm merges with the ectoderm covering itself and makes somatopleure.

The splanchnic mesoderm merges with the endoderm and makes splanchniopleure.

The lateral and ventral portions of the embryo, including the extremities, develop from somatopleure.

Digestive and respiratory tract, connective tissue, smooth muscles, and serous membranes develop from splanchnopleure.

Mesenchyme:

Mesenchyme, in vertebrate embryology, is a type of connective tissue found mostly during the development of the embryo.

Mesenchyme is an important mesoderm that makes connective tissues, cartilage, and bones, blood, heart, and veins.

The mesenchyme, derived from the sclerotome and dermatome of the somites, is spread all over the embryo and into the walls of extraembryonic sacs.

Therefore, it is possible to divide the mesenchyme into two main groups as sclerotomic mesenchyme and dermatomic mesenchyme.

The mesenchymal cells that develop from sclerotome spread first around the canalis neuralis and chorda dorsalis, and make connective tissues, and cartilage drafts of the vertebrae.

The smooth muscles and other layers of the vessels in this region also consist of these mesenchymal cells.

Sclerotomic mesenchymal cells that migrate to the digestive tract spread on the endoderm and make the connective tissue of the canal smooth muscles, blood and lymph vessels, and lymph follicles.

Sclerotomic mesenchyme (splanchnopleura mesenchyme) also forms the blood cells and vessels of the vitellus sac.

Some sclerotomic mesenchymal cells in the heart region also differentiate into the heart muscle.

Dermatomic mesenchyme, spreading under the ectoderm, constitute dermis of the skin covering the body and subcutis.

The somitic mesoderm of somatopleure, mesenchyme of amnion and chorion sacs is also of dermatomic origin.

Peritoneum, pleura, pericardium (serous membranes) also develop from mesenchyme.

Dermatomic mesenchyme and sclerotomic mesenchyme are involved in the formation of these serous membranes.

The striated muscles of the head area, like the head bones, develop from the head region mesenchyme.

Mesenchyme also plays an important role in the formation of lymph nodes and spleen, the formation of respiratory and urogenital systems.

In summary, mesenchyme is a mesoderm portion that forms all the supporting tissues of the body (connective tissues, cartilage, bone, and blood) and smooth muscles.

However, the two muscles (M.sphincter pupilae and M. dilatator pupilae) in the iris layer of the eye were composed of ectoderm although they were smooth muscle.

TISSUES FORMED FROM THE MESENCHYME:

If connective tissue will develop :

First, the mesenchymal cells send the cytoplasmic extensions to form star-shaped cells and then bind to each other to form a syncytium.

Subsequently, in these syncytium cavities, a gel matter is collected and embryonic connective tissue occurs.

This tissue, with the forming of the fibers, constitute the various connective tissues.

<u>If cartilage tissue will develop:</u>

The embryonic connective tissue cells that form the syncytium lose their extensions and take the oval or shuttle form and clump together to form the cartilage draft tissue.

These cells in the draft, later move away from each other by releasing the intermediate material and shape the fibers (collagen fibers, elastic fibers) and form embryonic cartilages.

If bone tissue will develop:

As in cartilage tissue, first embryonal connective tissue occurs. Then, flat, short and long bones are formed by intramembranous or chondral type ossification.

The flat bones of the skull develop intramembraneously from the head region mesenchyme.

In this type of ossification, first, the embryonic connective tissue and then the membrane models of bone lamellae occur.

The ossification event begins thereafter, and the bone tissue develops from the embryonic connective tissue that forms these membrane models; Here, the cartilage draft does not occur.

With the transformation of embryonic connective tissue into cartilage tissue, long and short bones begin to form and the resulting cartilage draft is then completed by chondral bone formation.

The resulting bone tissue is still flexible (osteoid character), then hardened by the precipitation of calcium salts.

<u>If blood cell will develop:</u>

Blood cells form by differentiating from the mesenchymal cells on the splanchnopleura, which close to the intestine of the vitellus sac.

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