DEVELOPMENT OF THE CNS

BY

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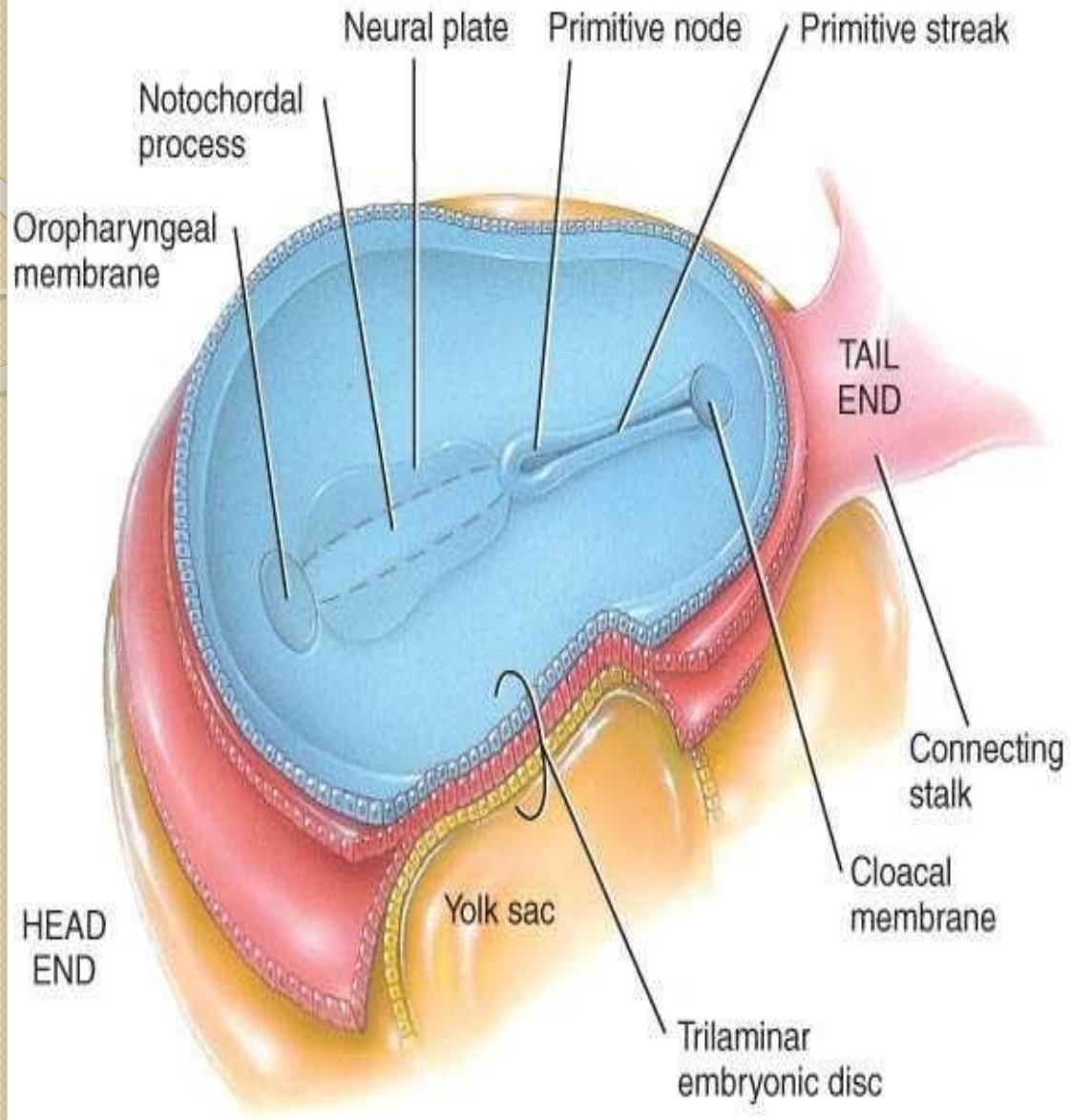
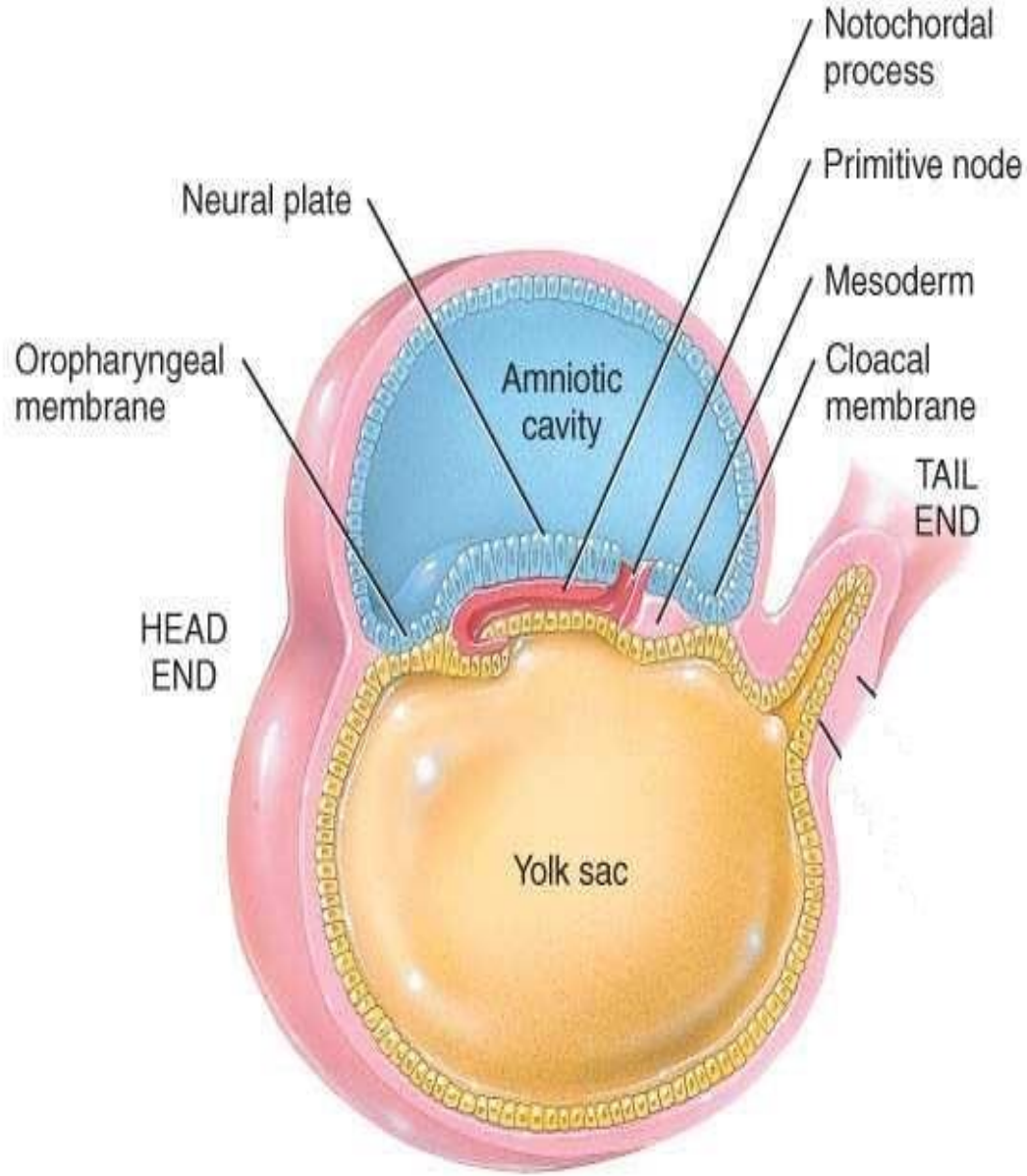


(a) Dorsal and partial sectional views of trilaminar embryonic disc, about 16 days after fertilization



(b) Sagittal section of trilaminar embryonic disc about 16 days after fertilization

DEVELOPMENT OF THE NERVOUS SYSTEM

Time:- 3rd week

Source:- ectoderm

Formation of the neural tube:-

1-formation of neural plate

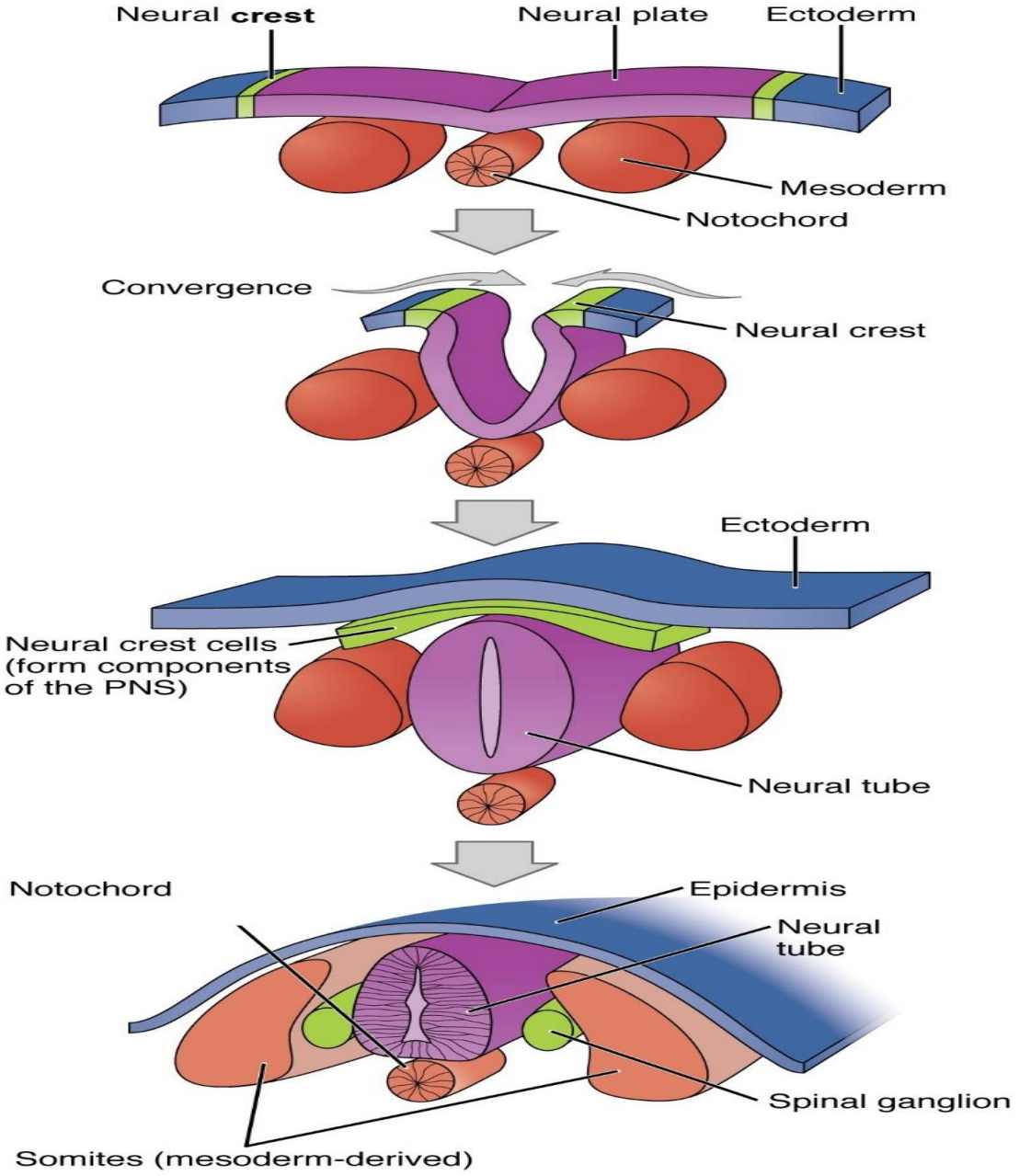
the ectoderm overlying the notochord increase in height and transformed into neural plate

2-formation of neural crest

Which is a thin longitudinal band of ectodermal cells on sides of neural plate

3-formation of neural folds

Lateral edges of neural plate are elevated to form neural folds



DEVELOPMENT OF THE NERVOUS SYSTEM

Formation of the neural tube

4- Fusion of the neural folds to form neural tube

Neural folds approach each other in midline
then fuse together to form the neural tube.
This fusion begins in the cervical region
then extends cranially & caudally
except the most cranial & caudal parts
forming cranial & caudal neuropores respectively

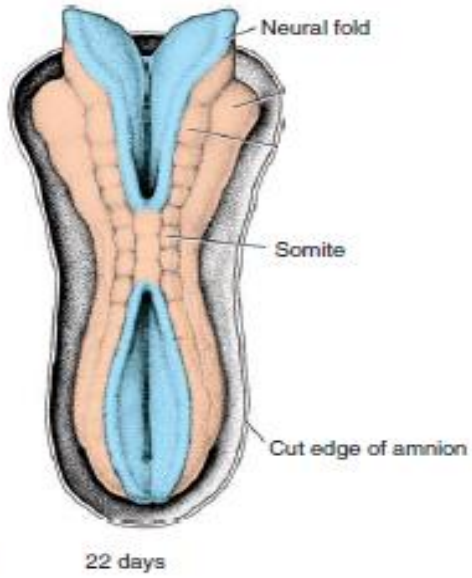
5- Closure of cranial Neuropore at 25th day & Caudal Neuropore at 27th day

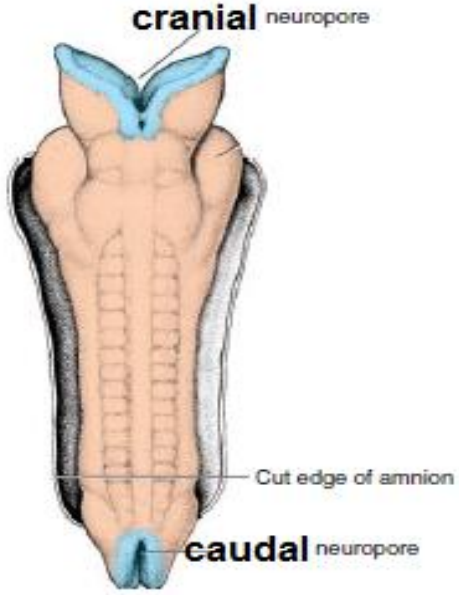
Fate of neural tube

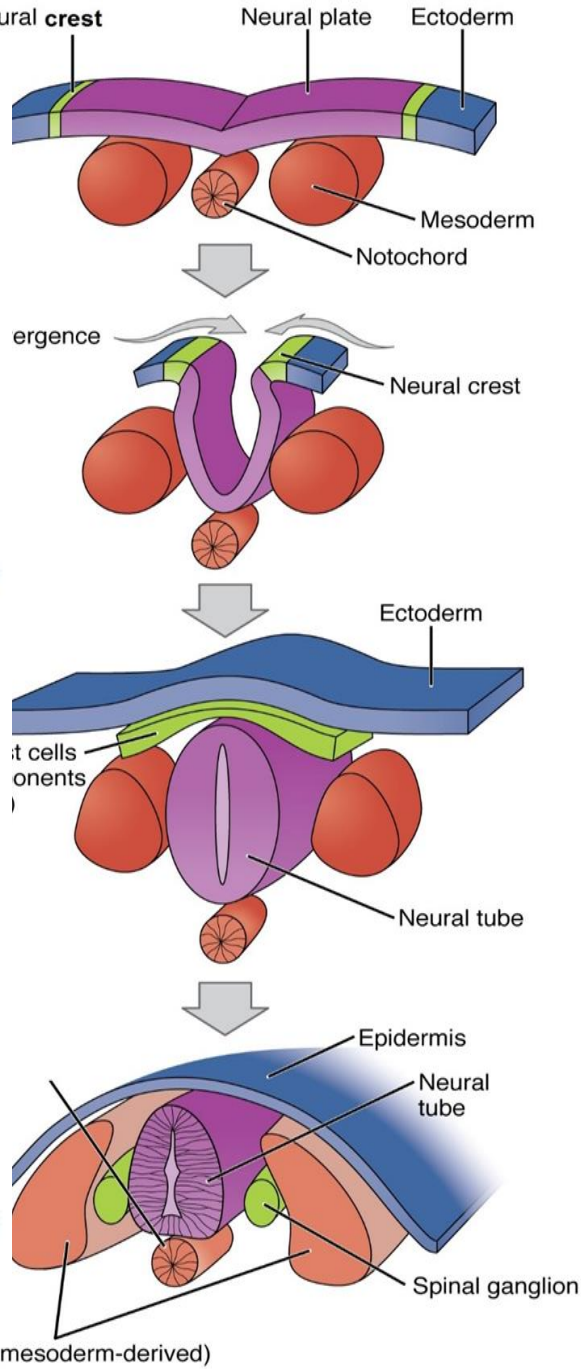
Cranial part form the brain ,
Caudal part form the spinal cord.

Fate of cavity of neural tube: -

gives ventricles of the brain,
central canal of the spinal cord







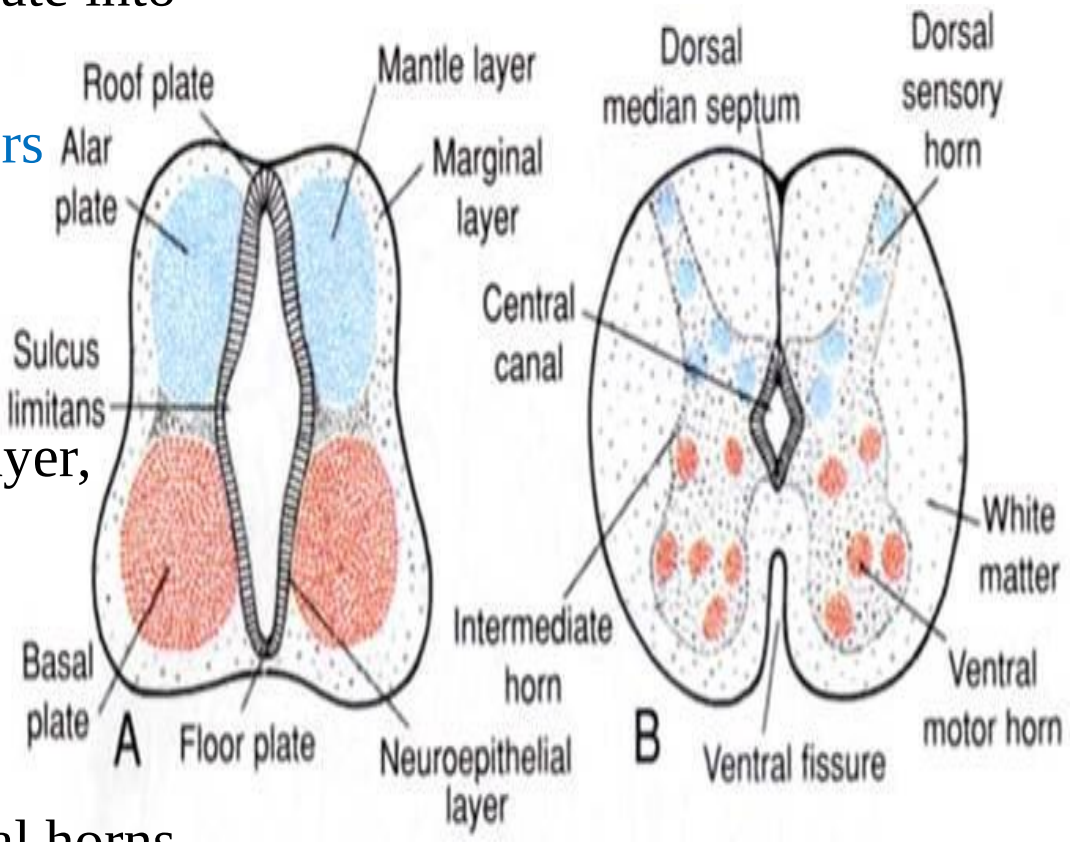
DEVELOPMENT OF THE SPINAL CORD

The wall of the developing spinal cord differentiate into
2 lateral walls, roof plate, floor plate

A-Lateral wall are thickened & formed of 3 layers

The inner ependymal layer: -
around the lumen (central canal) of the tube

The intermediate mantle layer: -
formed by the dividing cells of the ependymal layer, this layer forms the grey matter as follows



The cells of the mantle layer arranged into:-

1-Basal plate:-
lies ventrally ,
formed of motor cells which will form the ventral horns

2- Alar plate:-
lies dorsally ,
formed of sensory cells which will form the dorsal horn

N.B.:- the 2 plates are separated from each other by sulcus limitans

DEVELOPMENT OF THE SPINAL CORD

The outer marginal layer: -

formed later by processes of the nerve cells in the mantle layer.

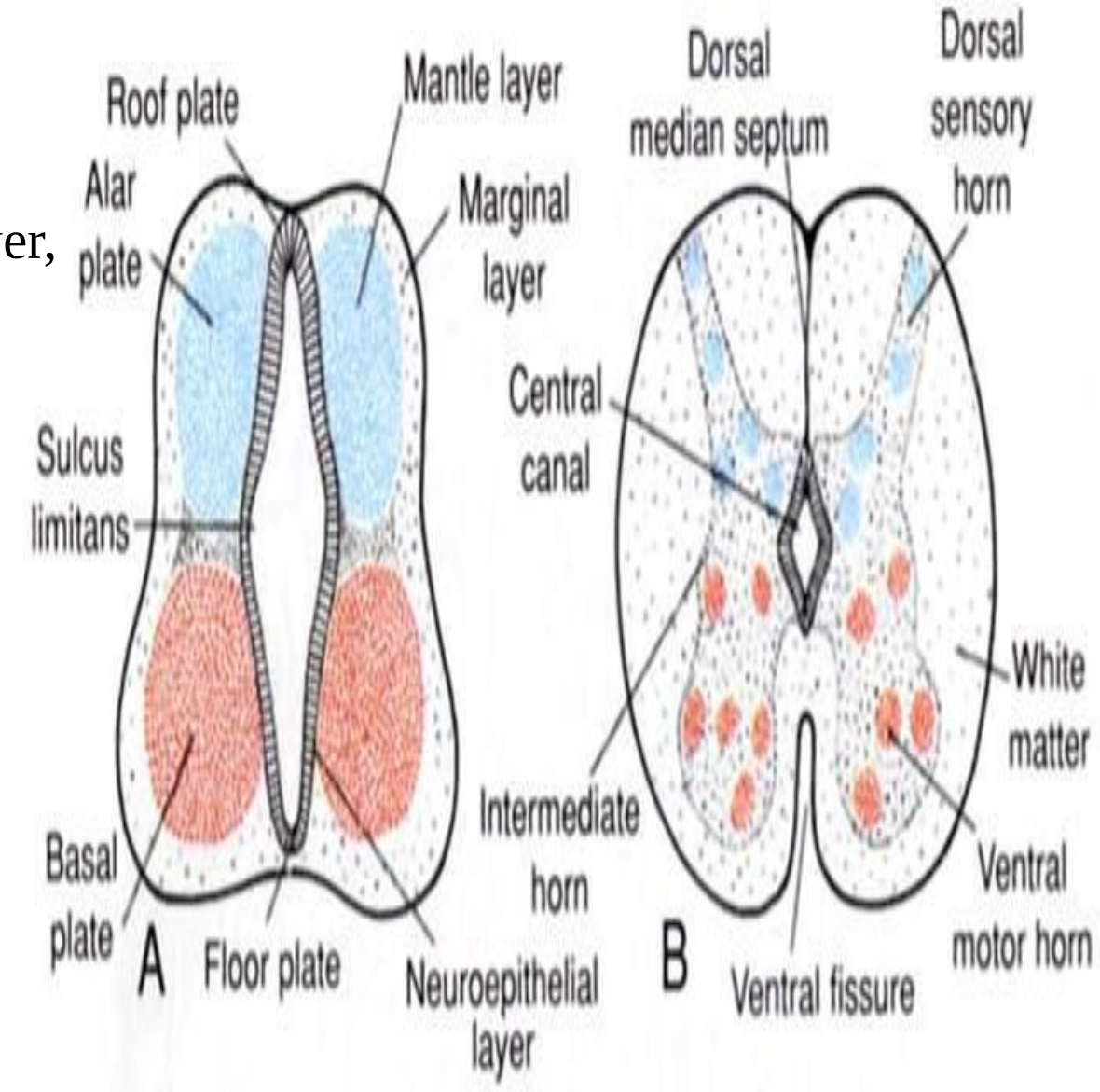
The nerve cell processes in the marginal layer, become white matter when myelinated.

B-Roof plate:-

thin sheet devoid of nerve cells

C-Floor plate:-

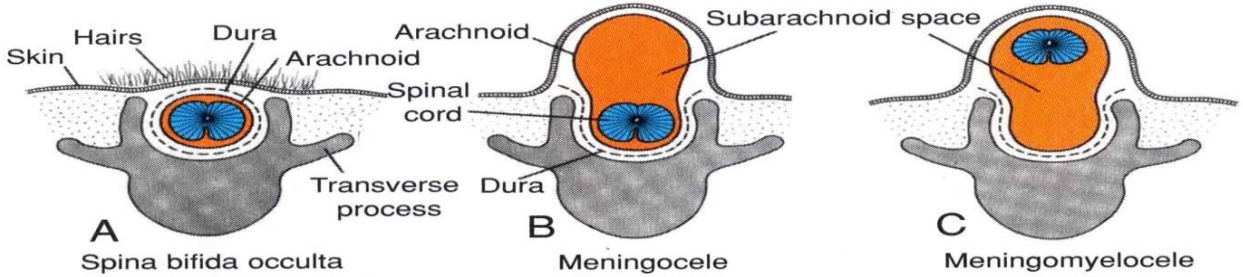
thin sheet devoid of nerve cells

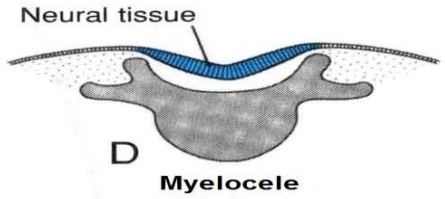


CONGENITAL ANOMALIES OF THE SPINAL CORD

spina bifida (cleft spine)

Def.:-Midline defect due to
incomplete fusion of the vertebral arch
(usually in lumbosacral region)





Various types of spina bifida.

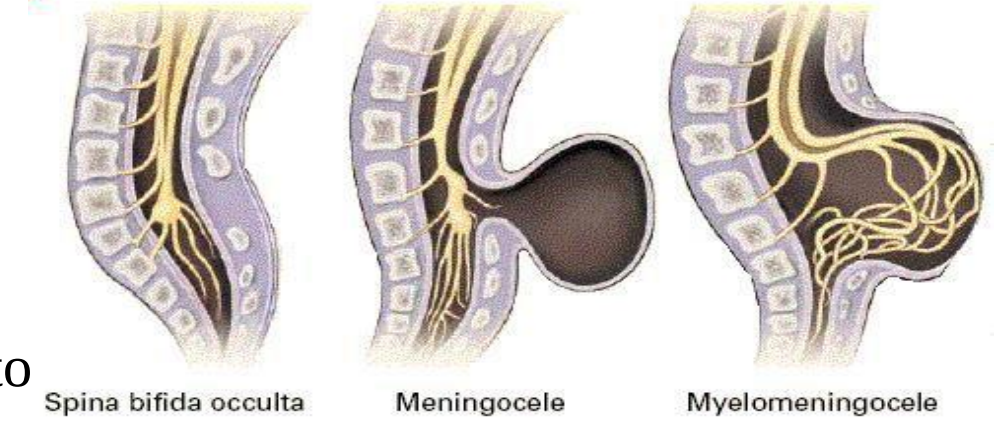
Types:-

1-Spina bifida occulta (closed) 20%

In this case the defect in the spine
is covered by skin contain tufts of hair .
It rarely cause symptoms

2-Spina bifida manifesta (open) 80%

In this case there is a defect in the spine
through which tissues may herniate It is divided into



a- Meningeocele:- herniation of meningeal sac filled with CSF

b- Meningeomyelocele:- herniation of meningeal sac filled with nervous tissue & CSF

c- Myelocele:- failure of fusion of neural tube with nervous tissue exposed to the surface

DEVELOPMENT OF THE BRAIN

the cranial part of the neural tube shows three dilatations.

• Craniocaudally, these are the

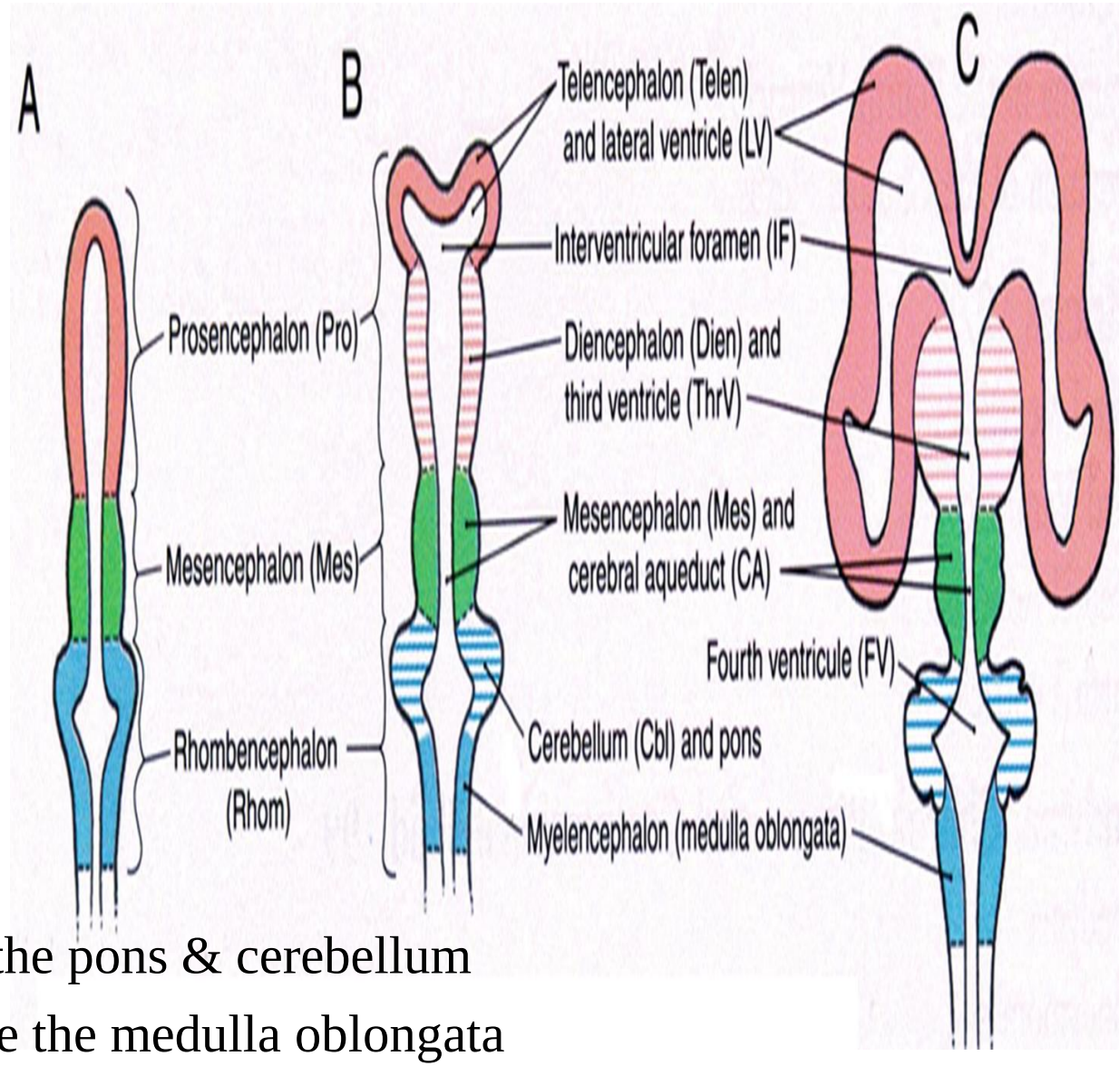
1- prosencephalon (forebrain vesicle):-
which will divided into 2vescicles

a- Telencephalon vesicle :-
which grow laterally &
give the 2 cerebral hemisphere

b-Diencephalon vesicle :-
which remain in midline &
give the diencephalon

2- mesencephalon(midbrain vesicle):-
give the midbrain

3- rhombencephalon (hindbrain vesicle).
which will divided into 2vescicles



a-Metencephalon vesicle :- which give the pons & cerebellum

b-Myelencephalon vesicle :- which give the medulla oblongata

DEVELOPMENT OF THE BRAIN STEM

As in the development the of the spinal cord, lateral walls of the brain stem are connected by a thin roof plate & a thin floor plate & will have a ventral basal lamina containing motor nuclei and dorsal alar lamina Containing sensory nuclei

-Each wall shows a sulcus limitans internally, separating the alar lamina from the basal lamina

*Differentiation of the basal & alar laminae

Columns of the Basal lamina 3 efferent columns

(1) Somatic efferent Column

lies close to the middle line

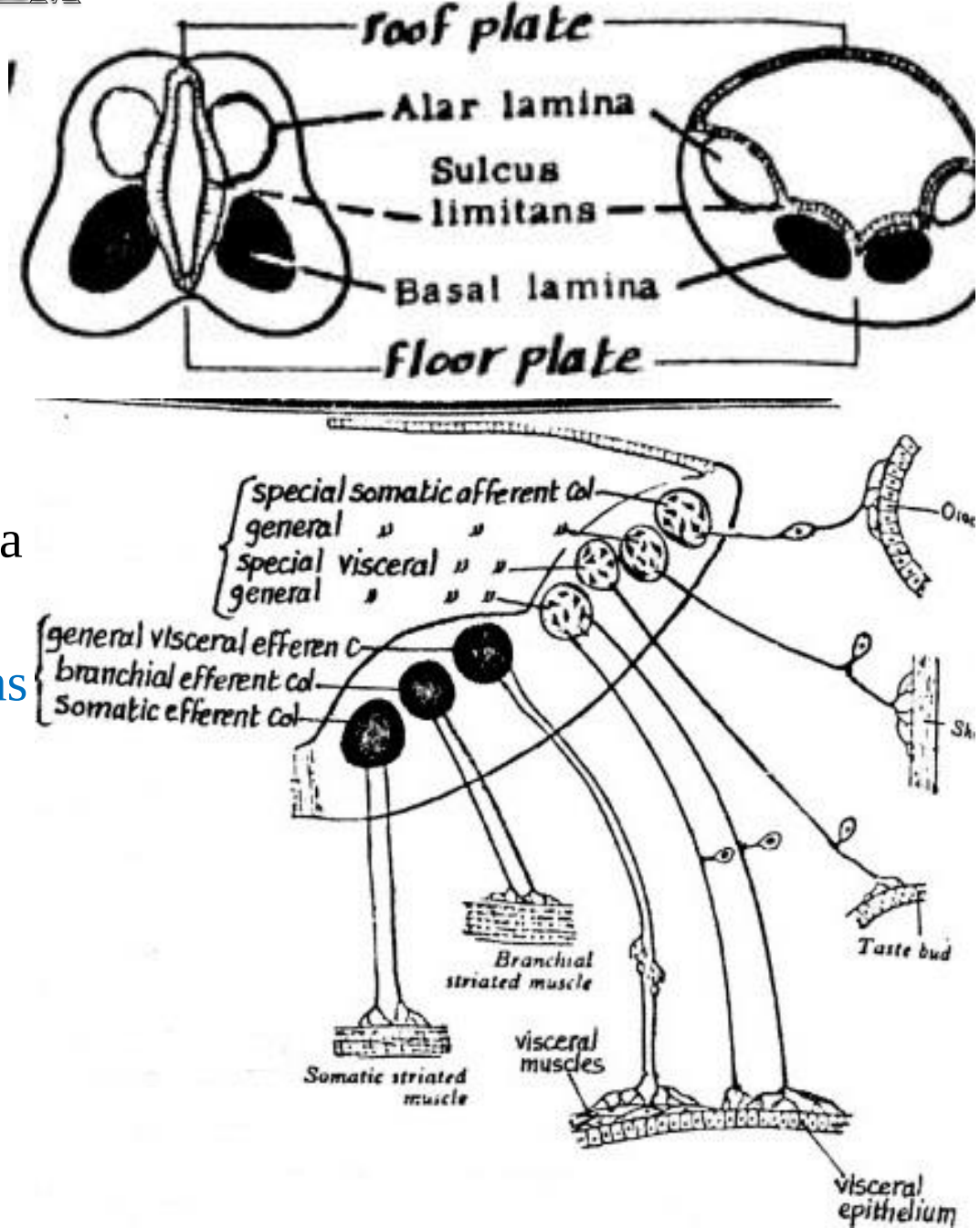
supply somatic striated muscles

differentiates into the following nuclei

12th nerve nucleus in medulla

6th nerve nucleus in pons.

3rd &4th nerves nuclei in the midbrain



DEVELOPMENT OF THE BRAIN STEM

Columns of the Basal lamina 3 efferent columns

(2)Special visceral (branchial)efferent Column

lies lateral to the somatic efferent column.

supply the muscles derived from the branchial arches

differentiates into the following nuclei:-

5^{th} &7^{th} nerves motor nuclei :in the pons.

9^{th} , 10^{th} , 11^{th} nerve motor nuclei: in the medulla

(which Join together forming nucleus ambiguus).

(3) General Visceral efferent Column: parasympathetic

lies Just lat to the special visceral efferent column

supplying smooth muscles &glands

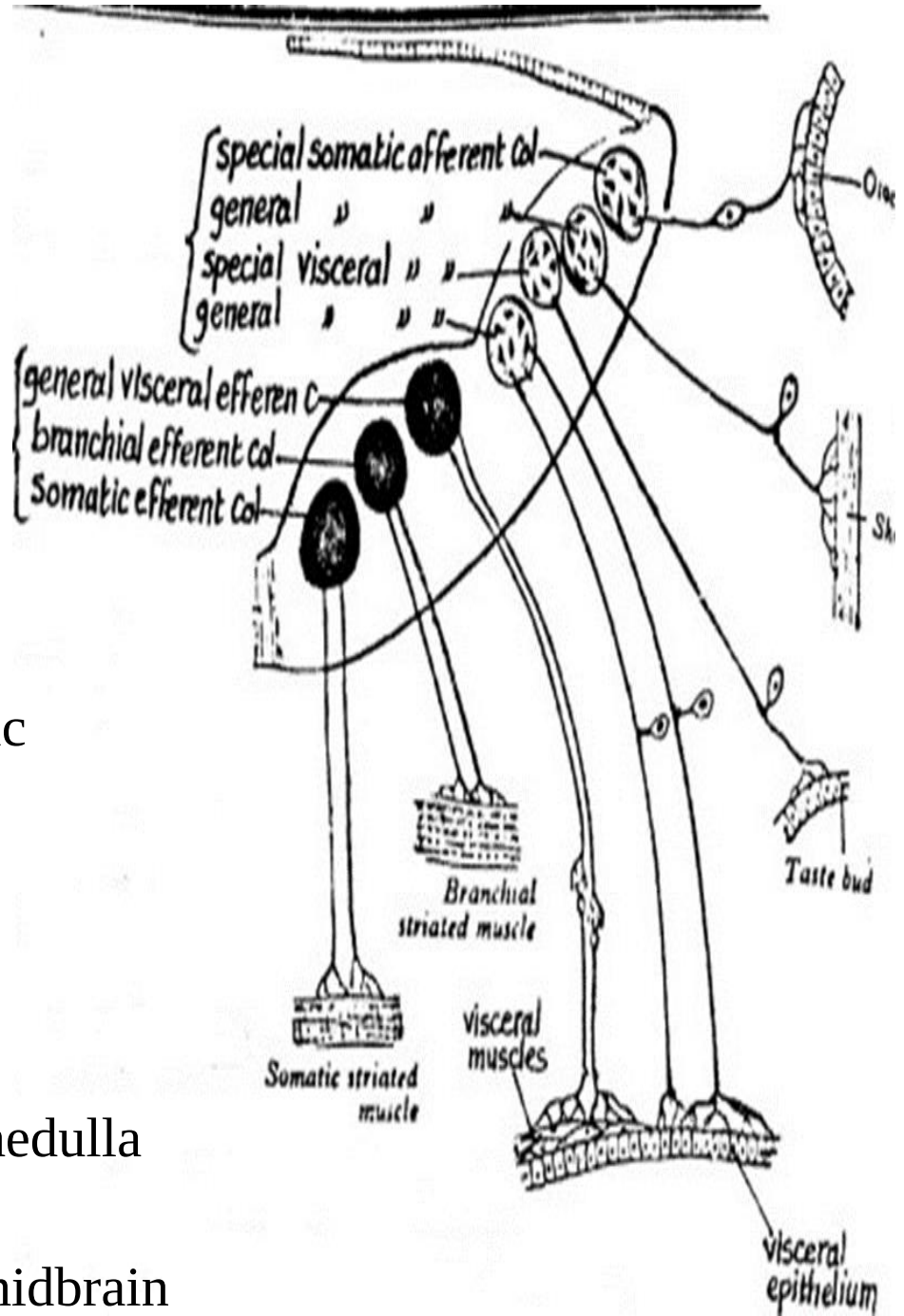
differentiates into the Following nuclei:

dorsal nucleus of vagus: in the medulla

inf. salivary nucleus (of glossopharyngeal n.) in the medulla

Sup. Salivary nucleus (of facial n.) in the pons

Edinger-Westphal nucleus (of oculomotor n-) in the midbrain



DEVELOPMENT OF THE BRAIN STEM

Columns of the alar lamina 4 afferent columns

General Visceral afferent Column

It is the most med. of the sensory Columns.

receives afferent sensory Fibres from the viscera.

represented by the sensory component of
the dorsal vagal nucleus

Special Visceral afferent column

lies lateral to the general visceral afferent column
receives taste sensation from the tongue & epiglottis

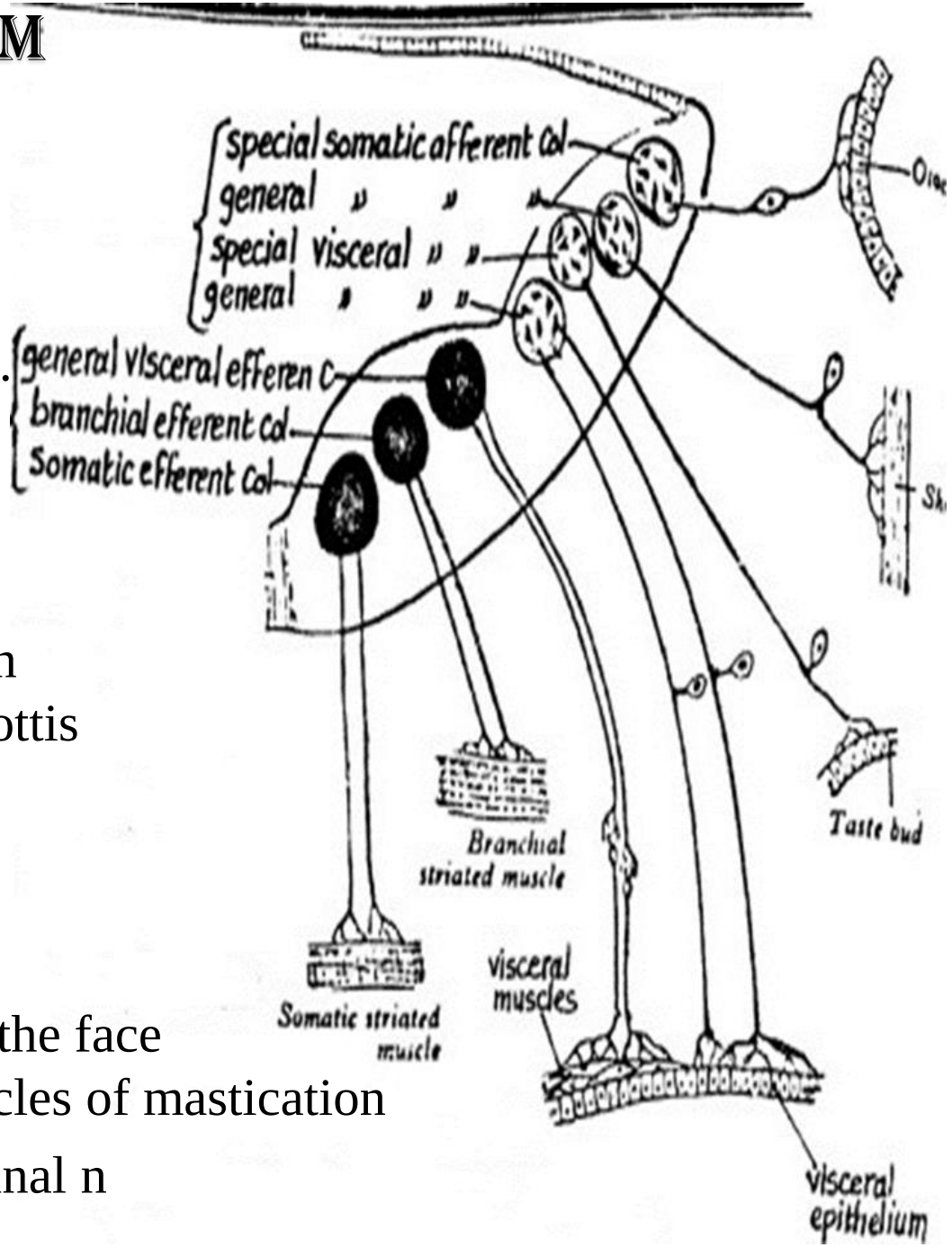
represented by the nucleus of tractus solitarius

General Somatic afferent column:

lies lat. to the special visceral afferent column.

receives afferent sensory fibres from the skin of the face
& scalp+ proprioceptive sensation from the muscles of mastication

differentiates into the 3 sensory nuclei of trigeminal n
(spinal, main sensory , mesencephalic)



DEVELOPMENT OF THE BRAIN STEM

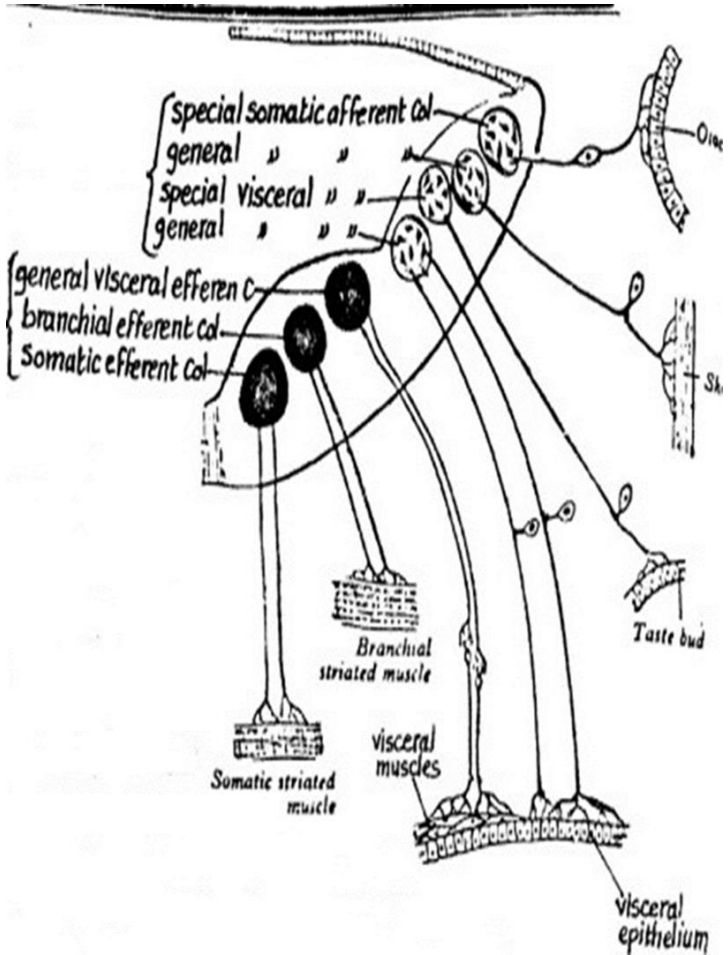
Columns of the alar lamina 4 afferent columns

Special Somatic afferent Column

the most lat-Column of the alar lamina

receives afferent auditory & vestibular fibres of the vestibulocochlear n.

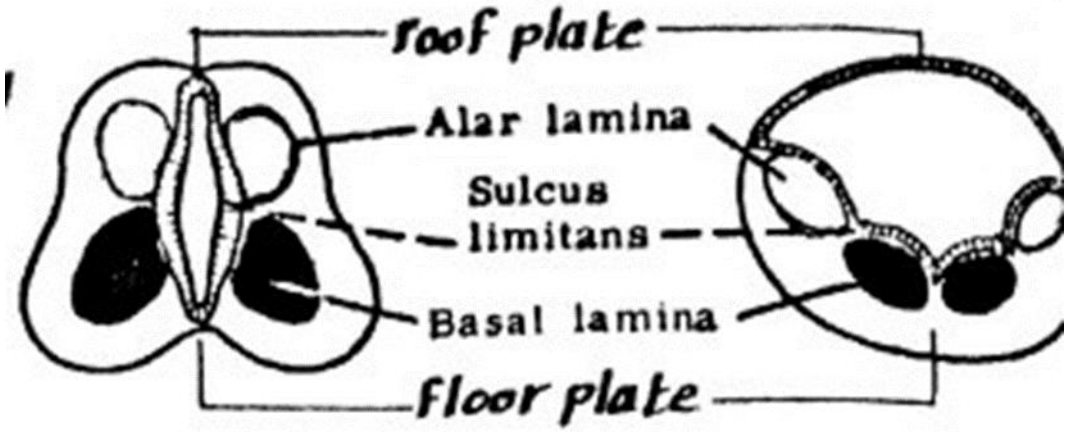
represented by the vestibular &cochlear nuclei



DEVELOPMENT OF THE BRAIN STEM

Development of the lumen of the brain stem

Formation of the 4th Ventricle



In the rhombencephalon alar laminae of both sides move away from each other

(as in the way of opening a book) leading

to widening of the lumen thus forming the 4th ventricle.

the thin roof plate becomes stretched &rhomboidal in shape, extending laterally to form the lat-recess of the 4th ventricle on each side

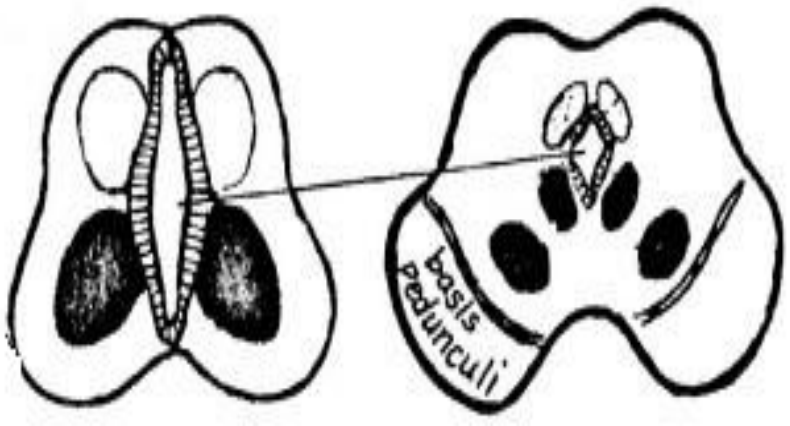
- resorption of the roof plate leads to the formation of a median foramen

(of Magendi) &2 lateral foramina (of Luschka)

Formation of the cerebral aqueduct

the lumen of the mesencephalon (midbrain)

becomes much reduced (due to thickening in the wall & is transformed into a central Canal
called the cerebral aqueduct of sylvius)



DEVELOPMENT OF THE CEREBRAL HEMISPHERE

*The 2 cerebral hemispheres arise as 2 evaginations from the lat. wall of the forebrain

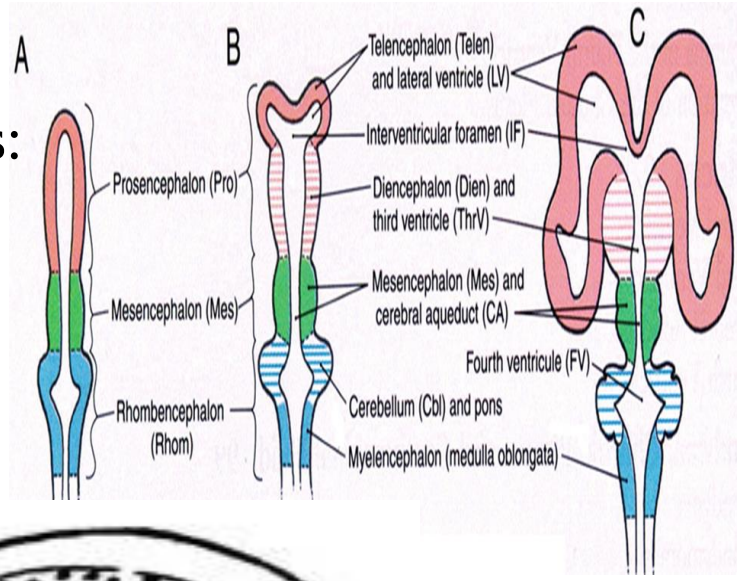
*the Cavity of each evagination expands forming lat-ventricle

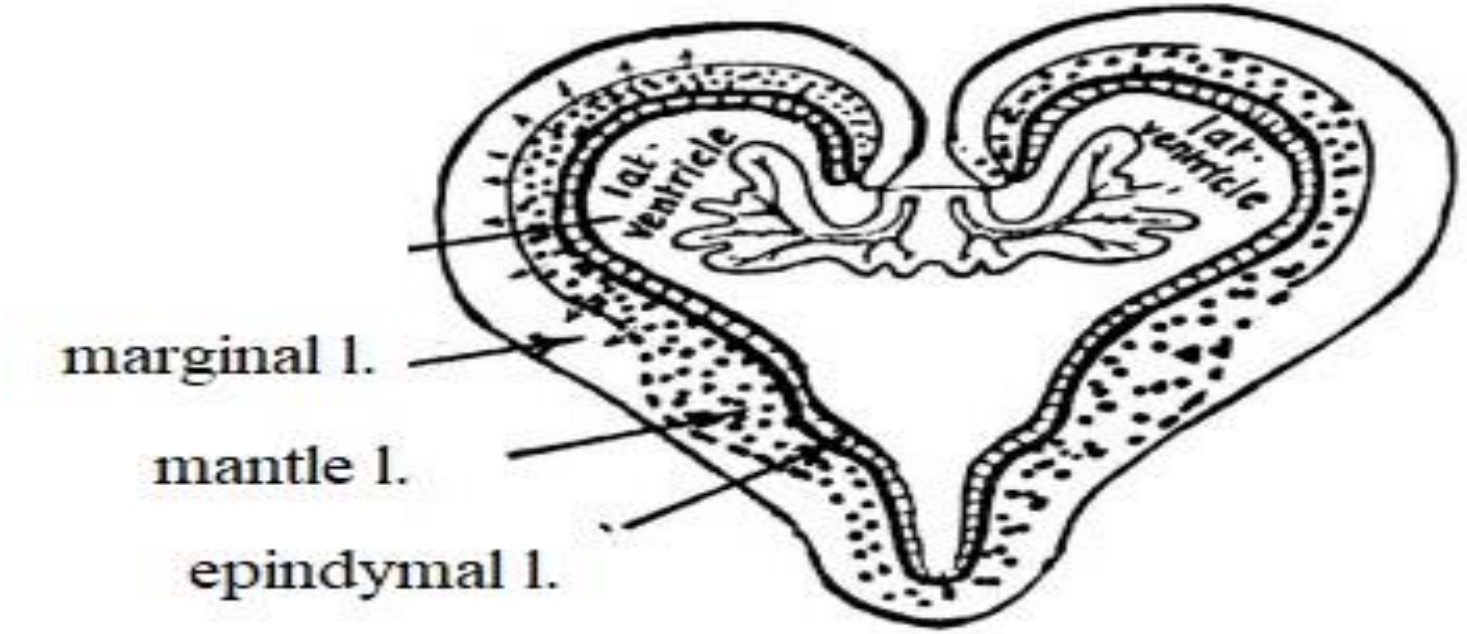
*the wall of each hemisphere is formed of the following layers:

(a) outer marginal layer formed of white matter-

(b) middle mantle layer formed of nerve cells (neuroblasts)

(C) inner ependymal layer lining the cavity of the lat-ventricle





DEVELOPMENT OF THE CEREBRAL HEMISPHERE

*As development proceeds the following changes occur:

1) the neuroblasts of the wall of the hemisphere except its base) migrate from the mantle layer to the marginal layer forming the grey matter of the cortex-

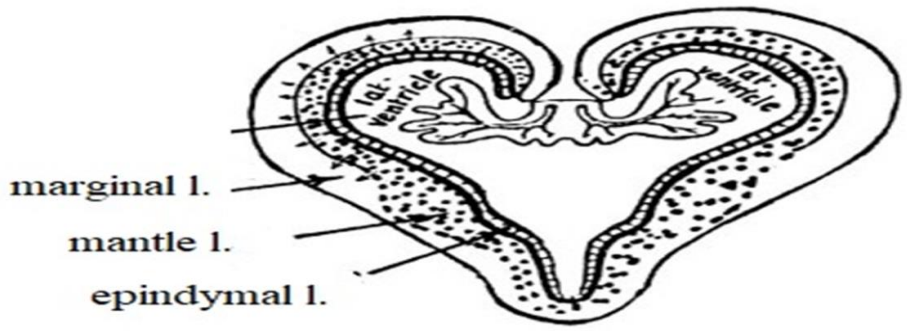
& the axons of these neuroblasts invade the rest of the wall

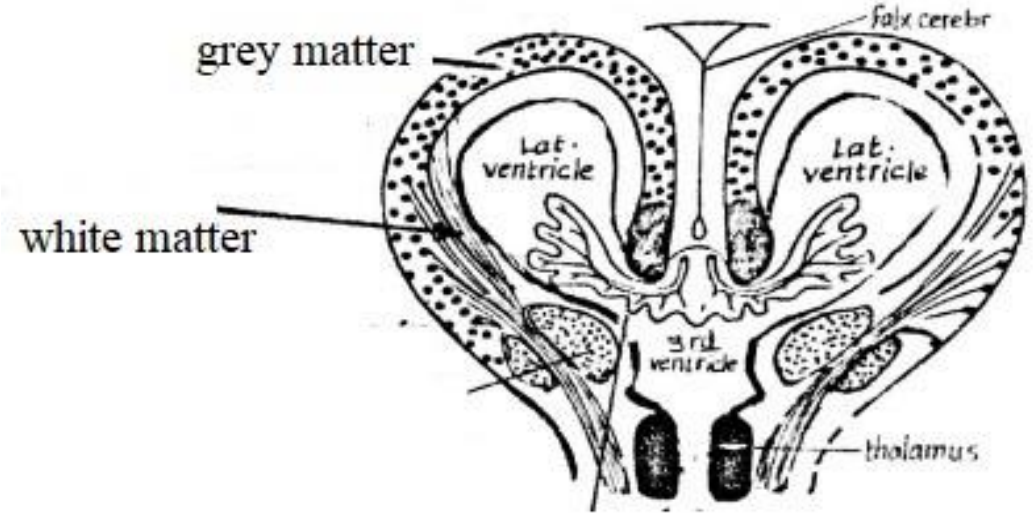
forming the white matter of the cerebral hemisphere

2) the neuroblasts of the mantle layer at the base of the

hemisphere do not migrate to the marginal layer but remain

deeply situated forming masses of grey matter (Corpus striatum)





CONGENITAL ANOMALIES OF THE BRAIN

Encephalocele

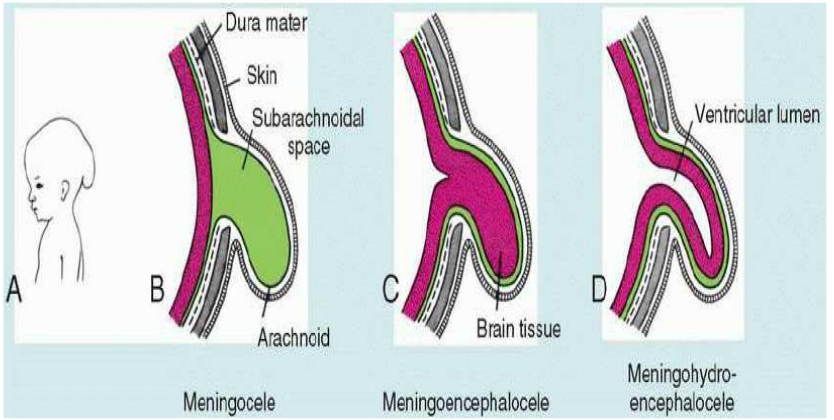
1-Anencephaly:-

Def.:- failure of development of cerebral hemisphere & vault of th skull due to Failure of the Closure of cranial end of the neural tube

2-Encephalocele (high Spina bifida)

Def.:-

Cranial defect (usually in occipital region) through this defect tissue may herniate



Types:-

a-Meningeocele: herniation of meningeal sac filled with CSF

b-Meningeoencephalocele:- herniation of meningeal sac filled with CSf & brain tissue

c-Meningeohydroencephalocele: herniation of meningeal sac filled CSf & brain tissue &brain ventricle

CONGENITAL ANOMALIES OF THE BRAIN

3-microcephaly: - small brain

4-hydrocephalus:- large brain due to
dilatation of brain ventricles
as a result of obstruction of CSF circulation

Hydrocephalus

THANQ