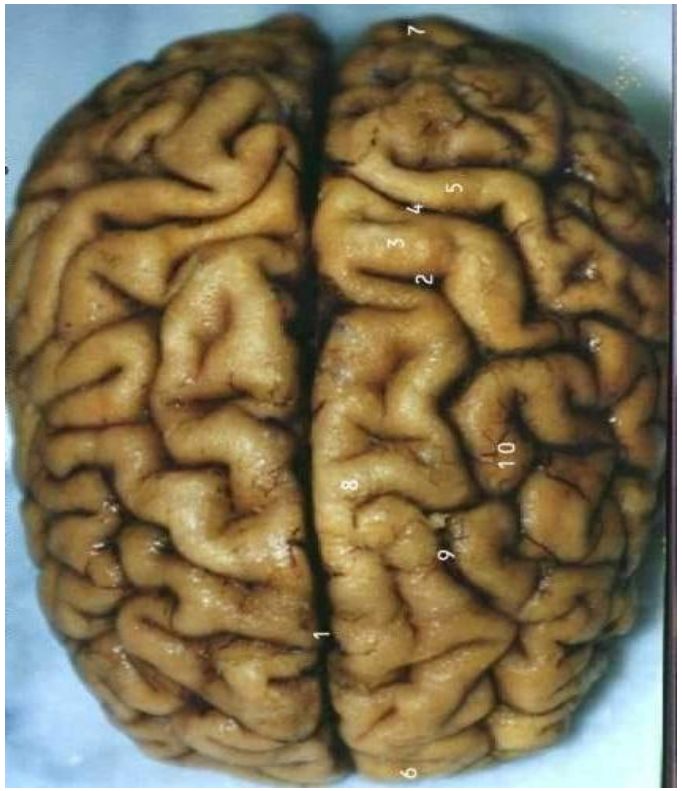
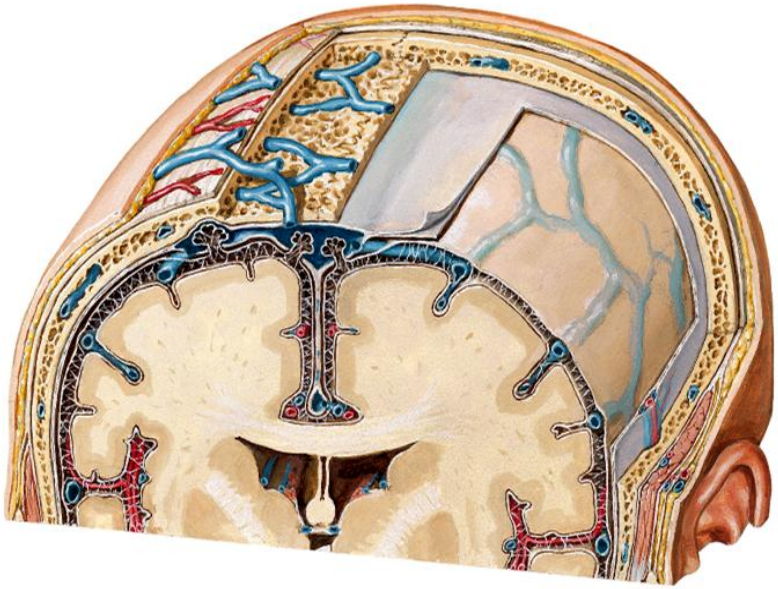
Histology of the cerebral Cortex

Cerebrum

- The largest portion of the brain.
- The surface is marked by **Gyri** separated by **Sulci**
- 2 hemispheres connected by the **corpus callosum.**





TThe cerebral hemispheres consist of :

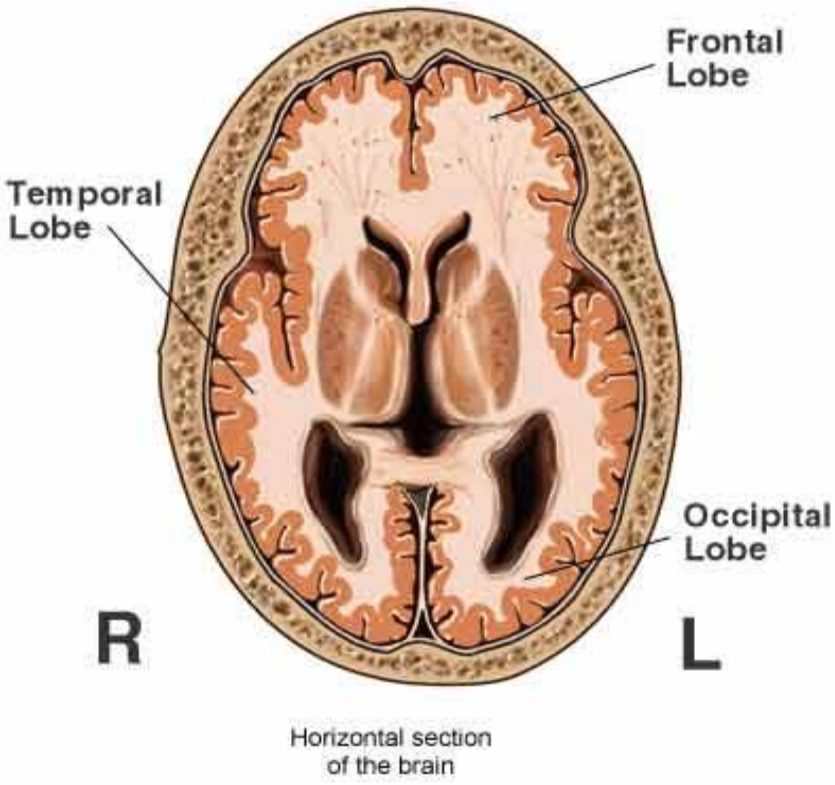
- **Outer grey matter**

overlying the central medullary mass of

- **Central white matter**.

white matter contains :

collection of **nerve cells** called the **basal ganglia.**



Horizontal section of the brain

❑grey matter (cortex)

in the **fresh state** is grey.

It is **composed of:**

- ➢ **nerve cell bodies**.
- ➢ **Unmyelinated** NF
- ➢ **neuroglia**
- ➢ **A rich capillary bed**

❑white matter (medulla)

- in the **fresh state** is white.

It is composed of:

- ➢ **Myelinated NF**
- ➢ **neuroglia**
- ➢ **Few blood capillaries.**

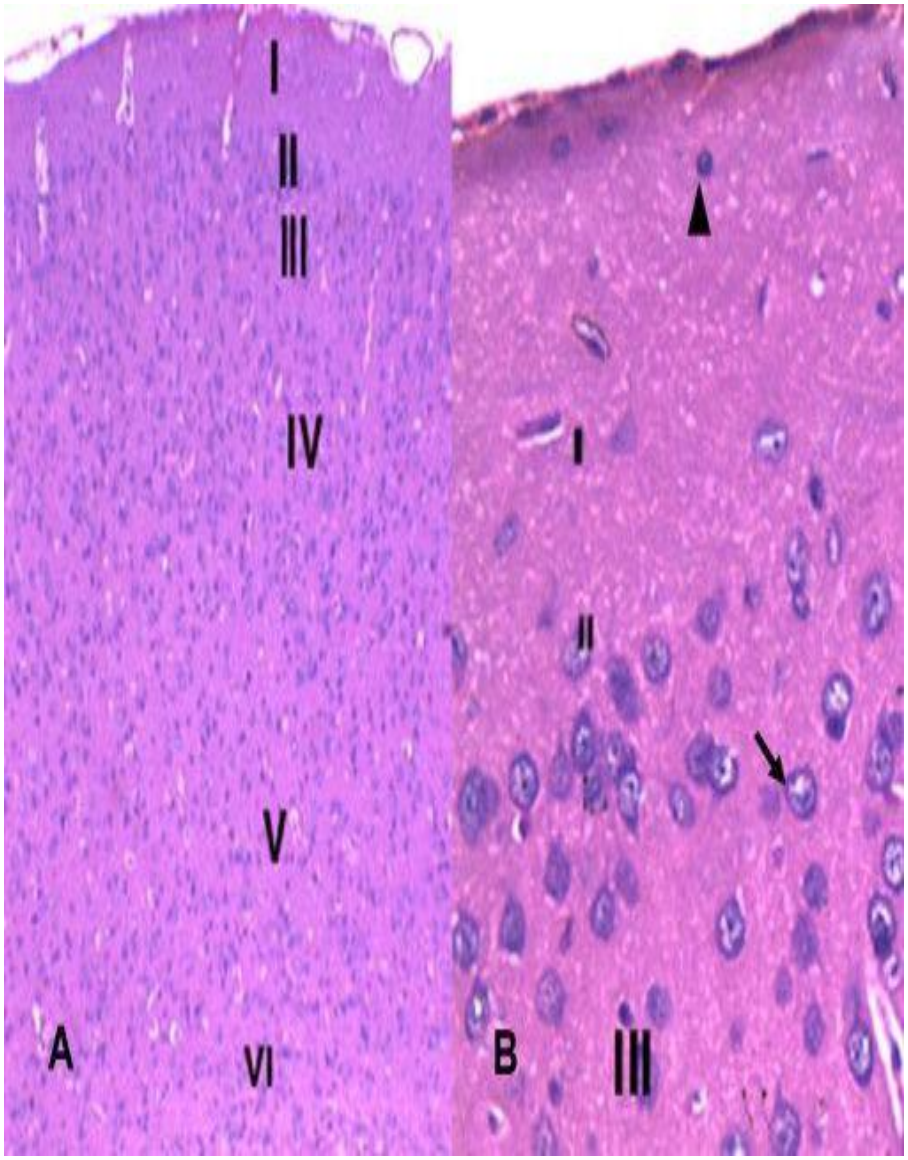
Histological section of cerebral cortex contain:

1-cell bodies of neurons ► ► laminae

2- supporting neuroglia.

3- capillaries.

4- The neuropil

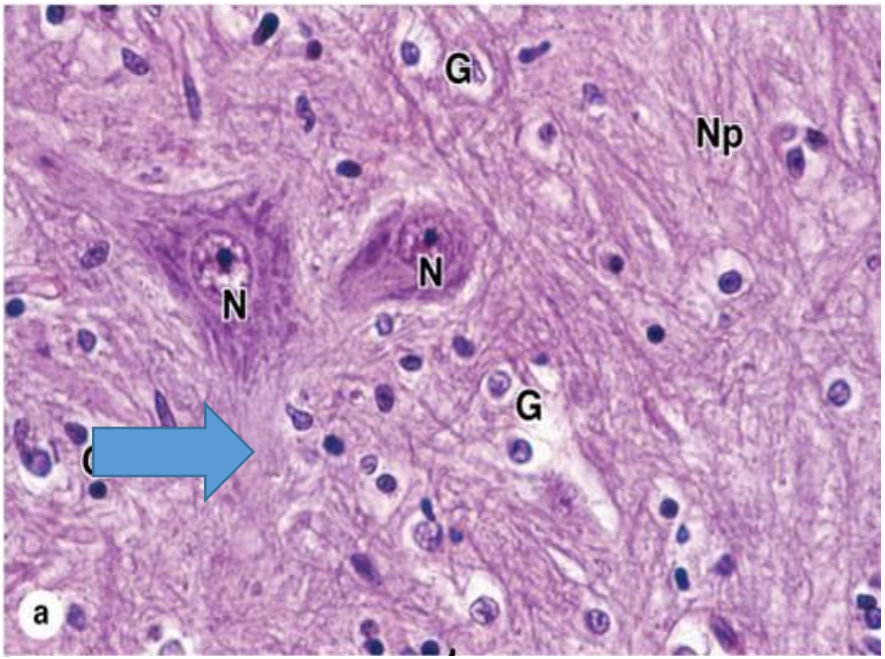


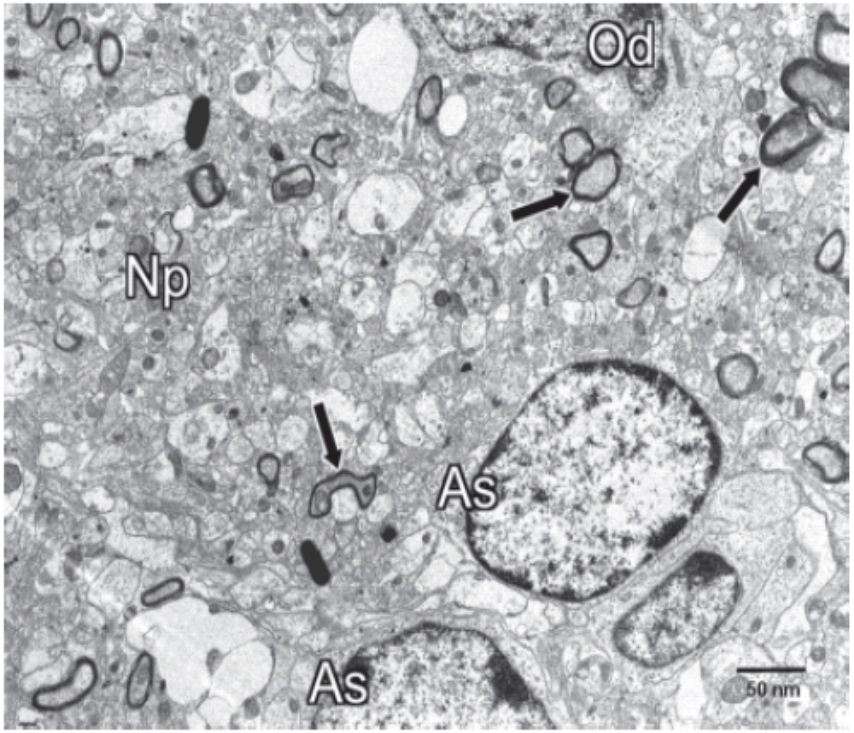
The neuropil

- **H&E:** <u>structureless</u> substance
- **EM:** network of :

1. Nerve cell processes.
2. Cell bodies and processes of astrocytes.
3. Intercellular spaces containing tissue fluid

► ► sensitive to changes in **O2 & sugar.**



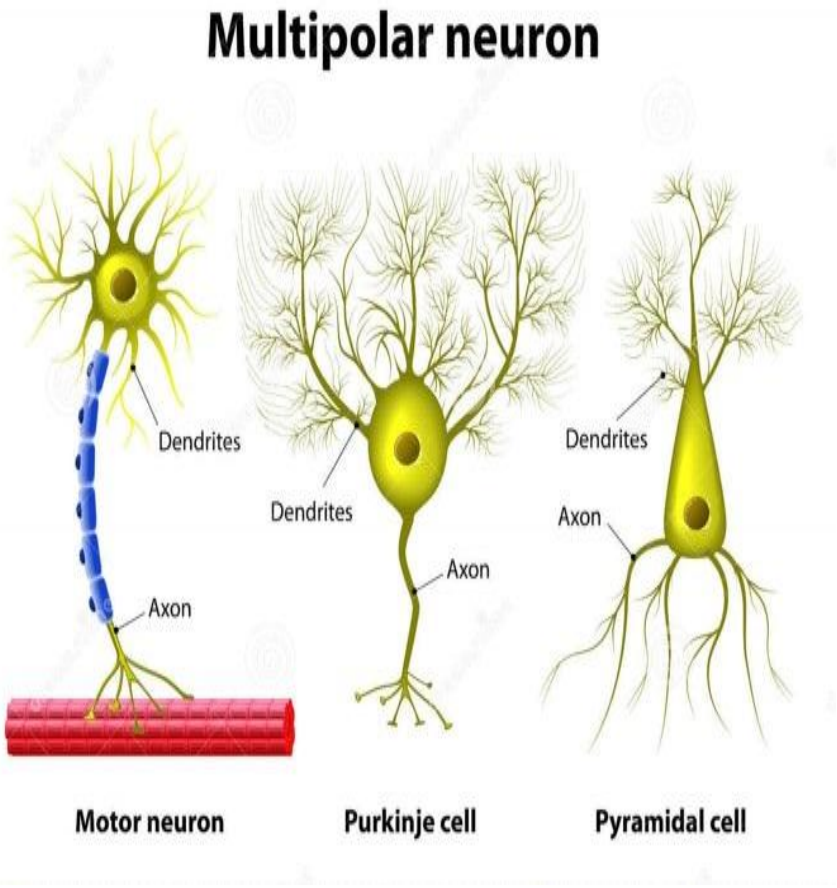


Types of neurons in the cerebral cortex

2 main types arranged in layers called **(laminae)**

1. **Pyramidal cells:**
2. **Stellate cells:**

- **Horizontal cells of Cajal**
- **Fusiform cells**
- **Granule cells**
- **Cells of Martinotti**



6 Layers of the cerebral cortex in the motor area

From outside ------inside

1- Molecular layer (plexiform)

▲ **Fibers:** parallel to surface.

= dendrites of **pyramidal**

+ axons of **granule** & **Martinotti** cells.

▼ **Cell bodies:**

horizontal cells of Cajal

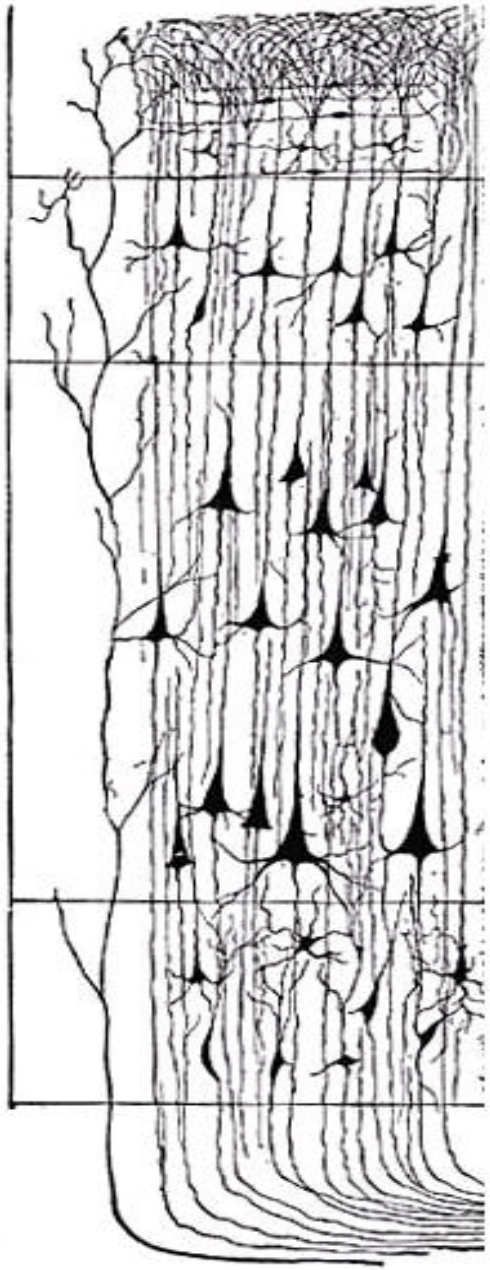
+ Neuroglia

2- External granular layer

Cell bodies: ▲ ▲ **granule** cells

3- External pyramidal cell layer

Cell bodies: **small & med-sized pyramidal**



4- Internal granular layer

Cell bodies: ▲ ▲ **granule** cells

5- Internal pyramidal cell layer

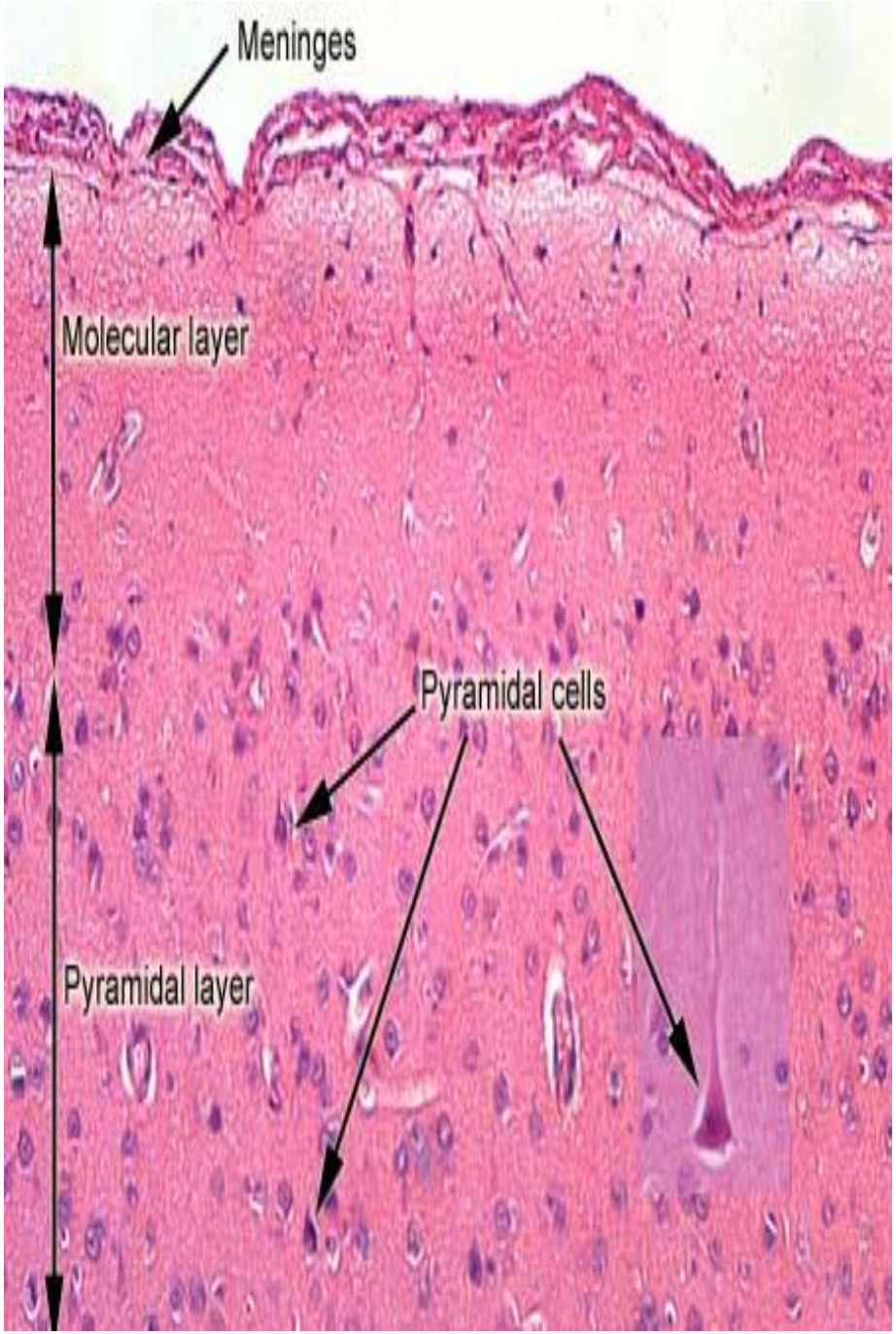
med.- sized & Large **pyramidal** cells

= **Betz cells**

6- The polymorphic layer multiform

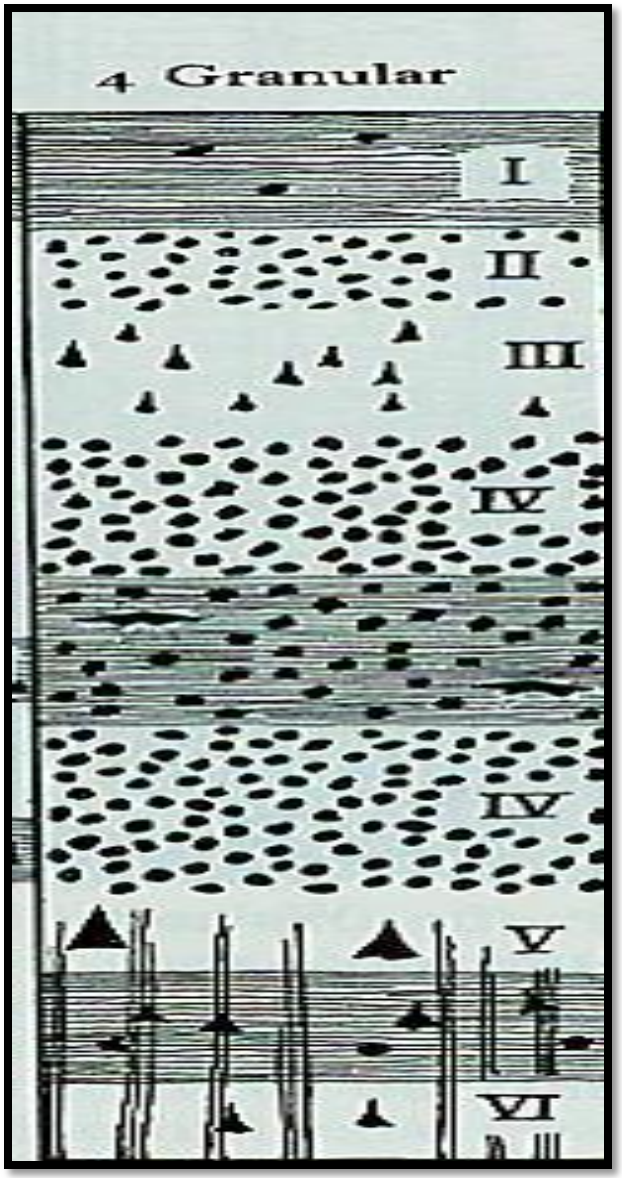
The deepest & broadest

Contain cells of **Martinotti**



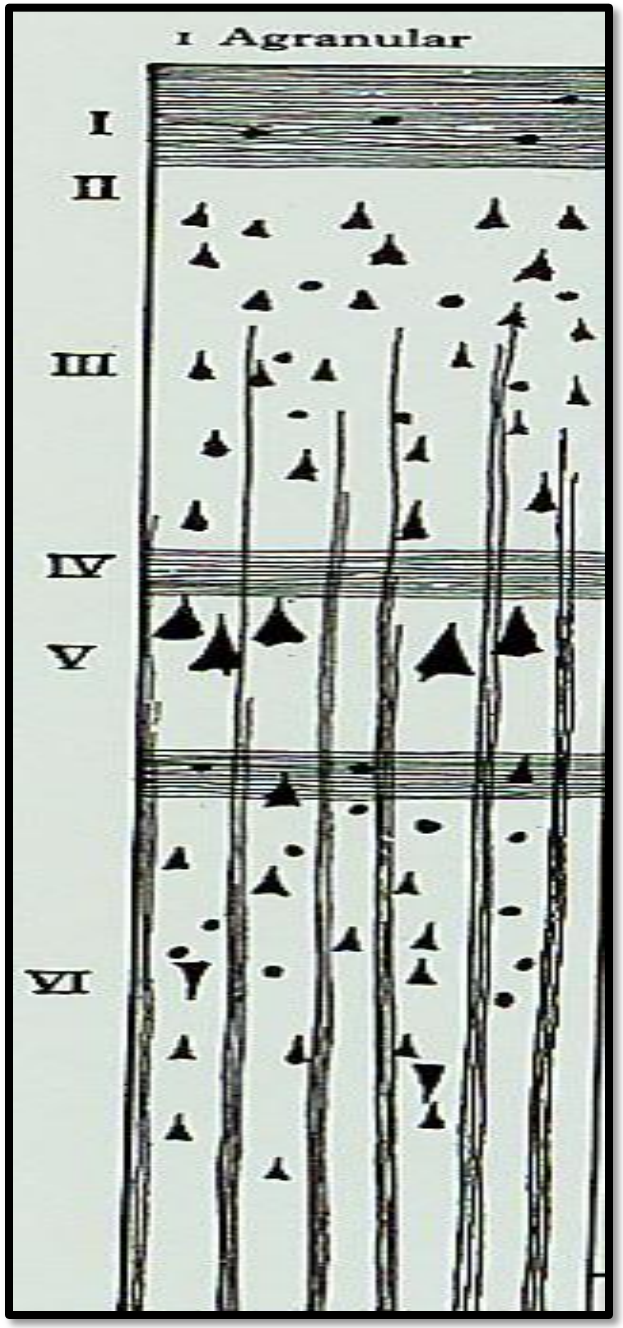
Cyto-architecture of some cerebral areas

- The cerebral cortex shows the same general structure (laminar pattern) with certain modifications in some cortical areas to perform different functions.
- A **Brodmann area** is a region of the cerebral cortex , defined by its cytoarchitecture

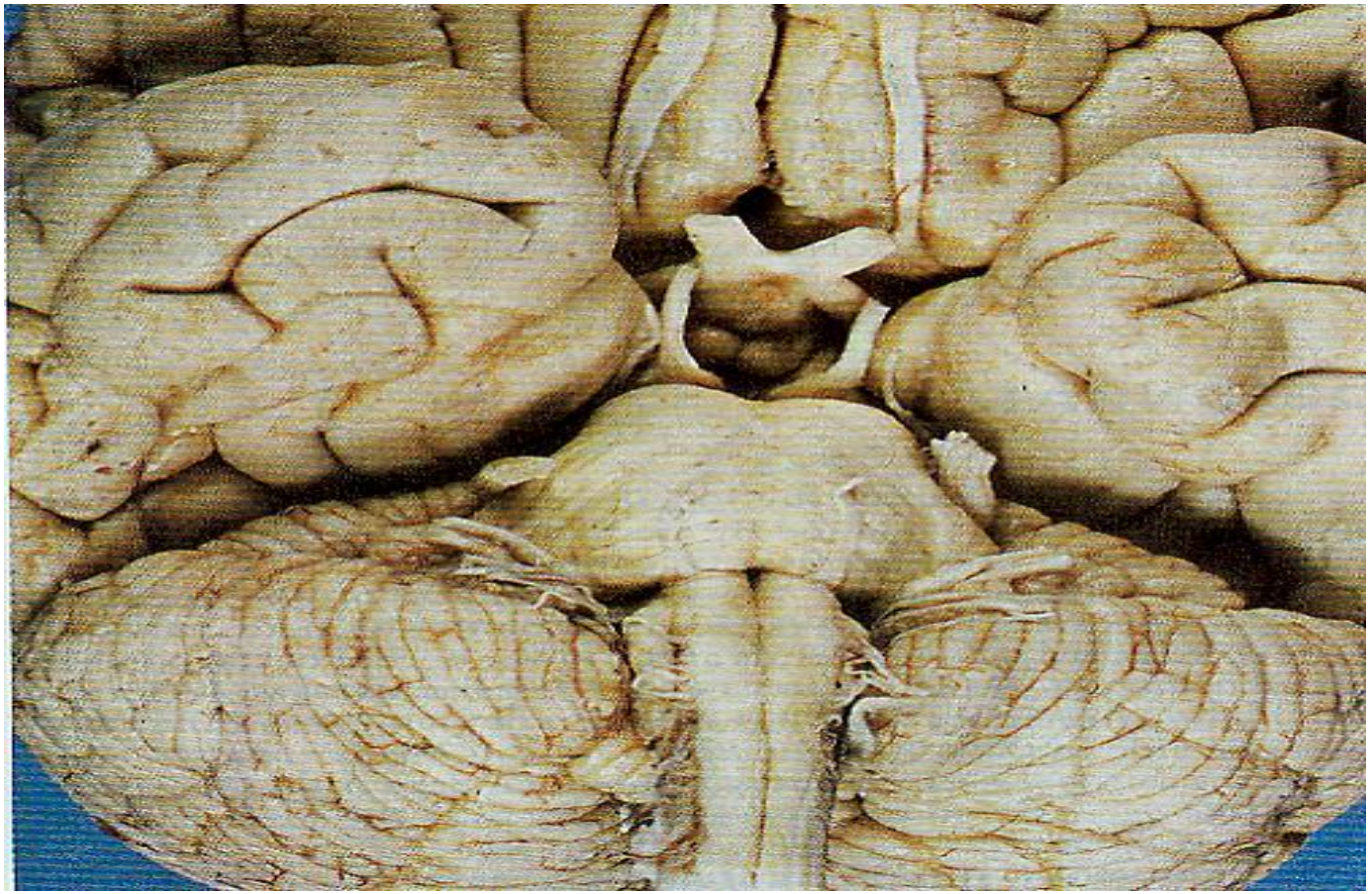


1. The sensory area It is of ***granular*** **type.** The granular layers are well developed, whereas, the pyramidal layers are ill-defined due to the small size and few number of their pyramidal cells.

2. <u>The motor area .</u> It is of the ***agranular* cytological type**. It has few scattered granule cells, while the pyramidal cell layers are well developed. **Betz cells** are found in the inner pyramidal layer.

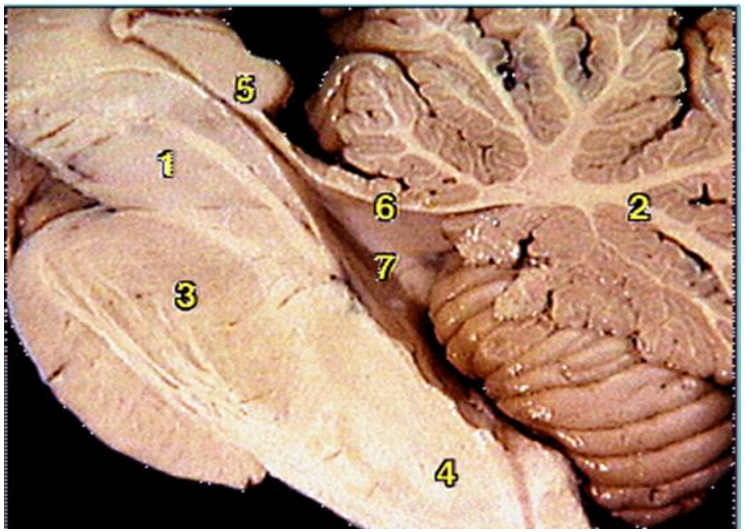


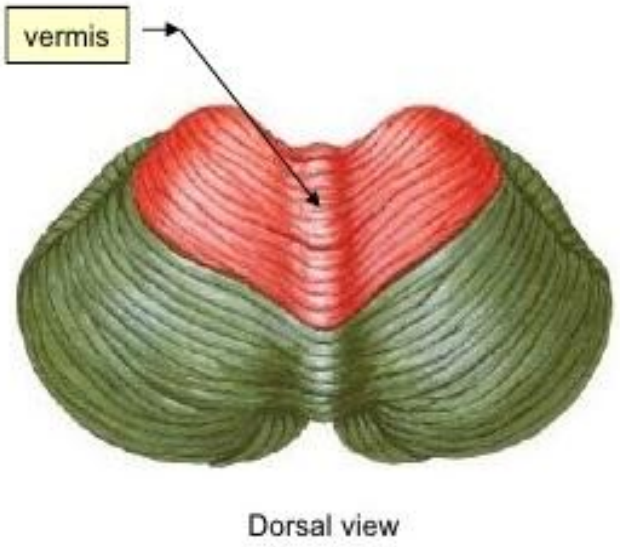
Histology of the cerebellum



Cerebellum

- **2nd largest region of the brain.10% of the brain by volume, but it contains 50% of its neurons.**
- Lies in the posterior cranial fossa covered by tentorial membrane.
- separated from the **brain stem** by **4th** ventricle.
- 2 hemispheres separated by the **vermis.**
- Its surface is marked **(laminated appearance).**

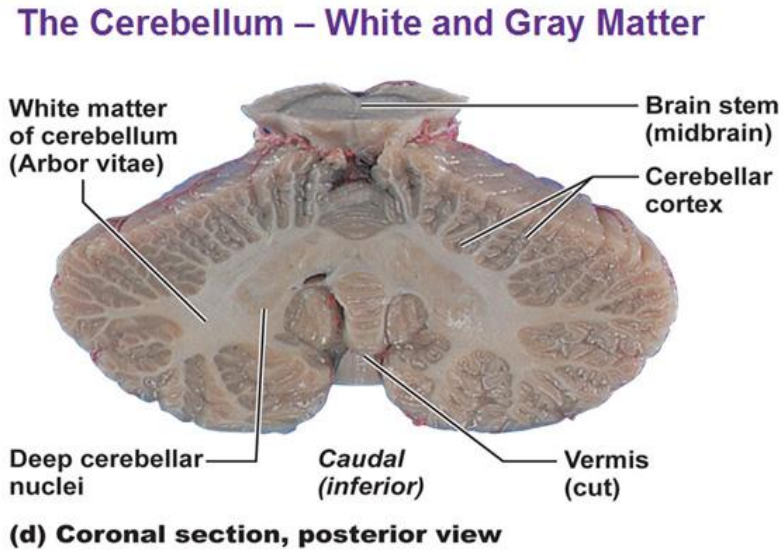


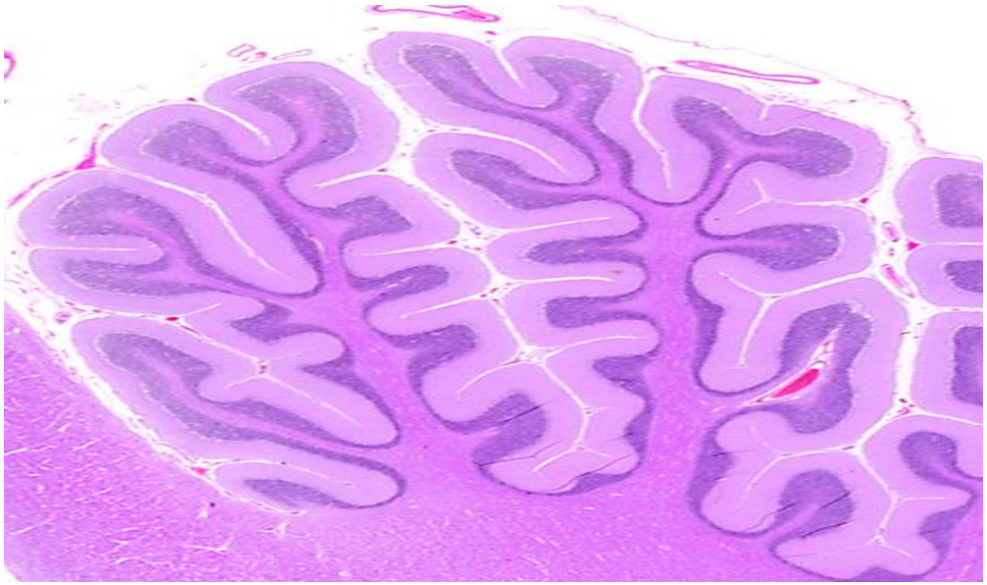


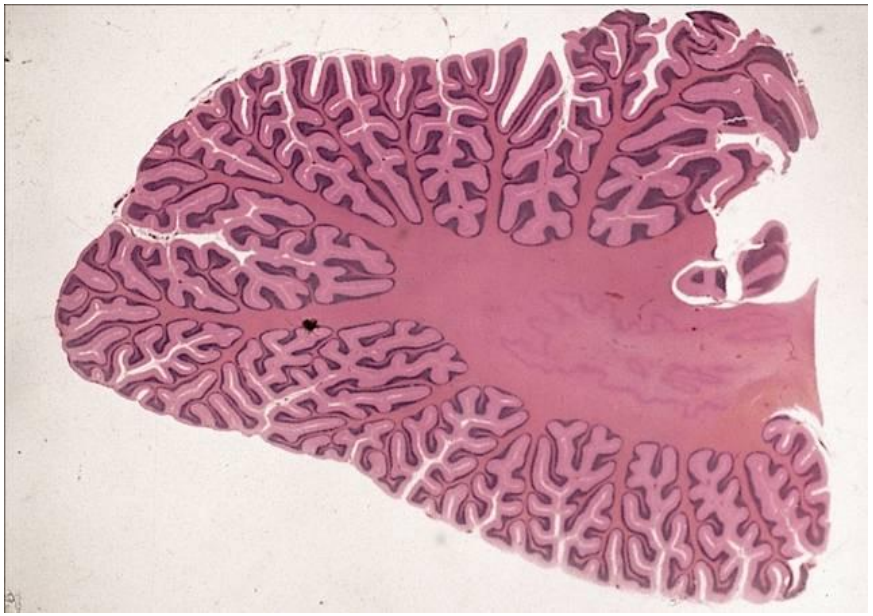
Cerebellar cortex

form **Folia,** a branching array that in a sectional view resembles a tree

•External grey matter + core of white matter contain **deep cerebellar nuclei**

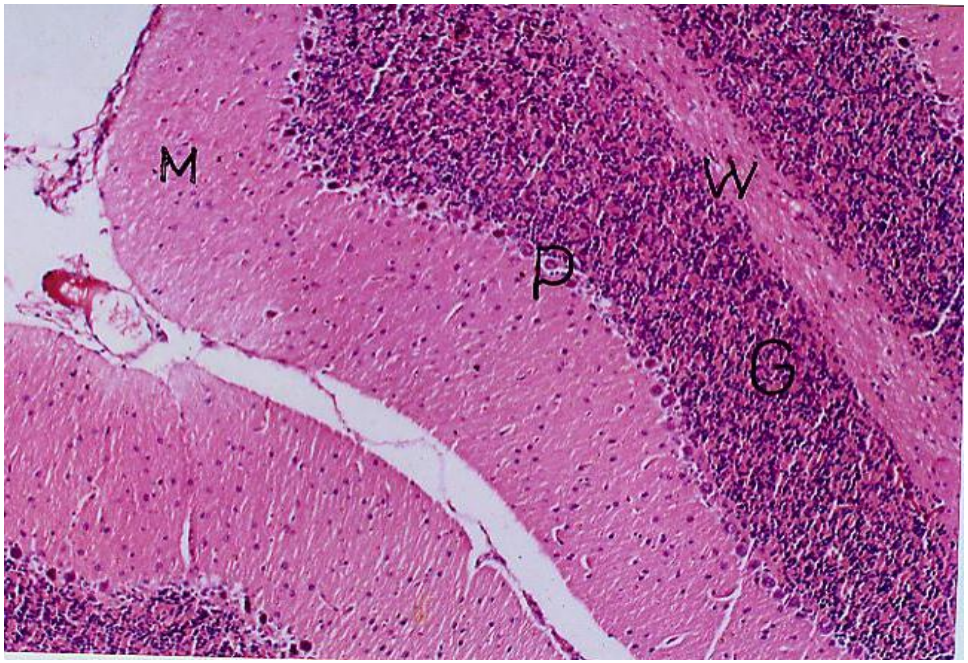






Layers of the cerebellar cortex

1-Molecular layer:
2- Purkinje cell layer.
3- Granular layer.



1-Molecular layer:

▲▲**Fibers:-**

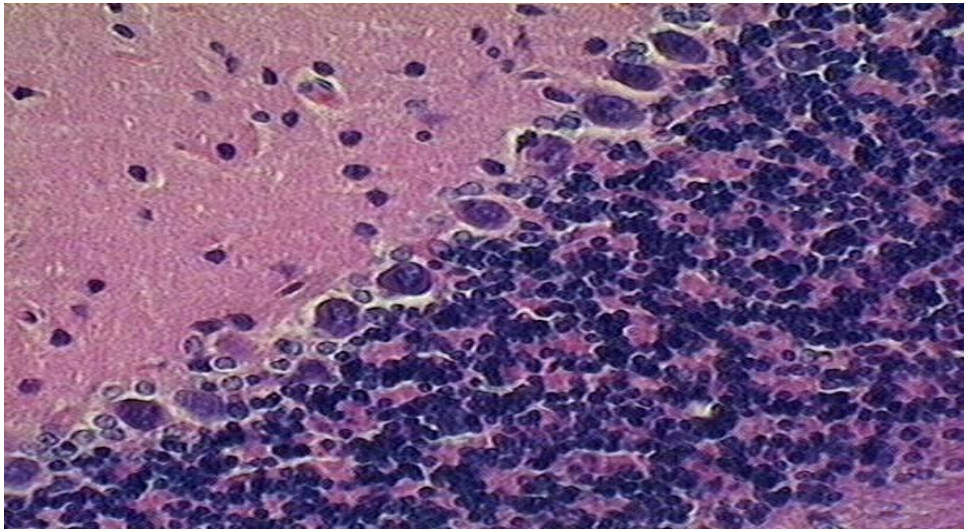
- **dendrites** of **Purkinje cells + Golgi cells.**
- **climbing fibers=**

(from **inferior olive** to Purkinje cells)

- **axons of granular cells.**

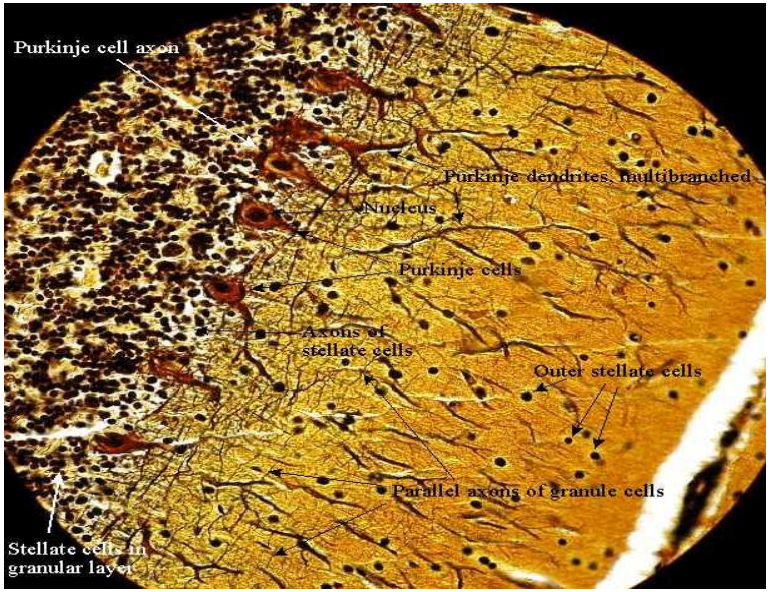
▼▼**Cells:-**

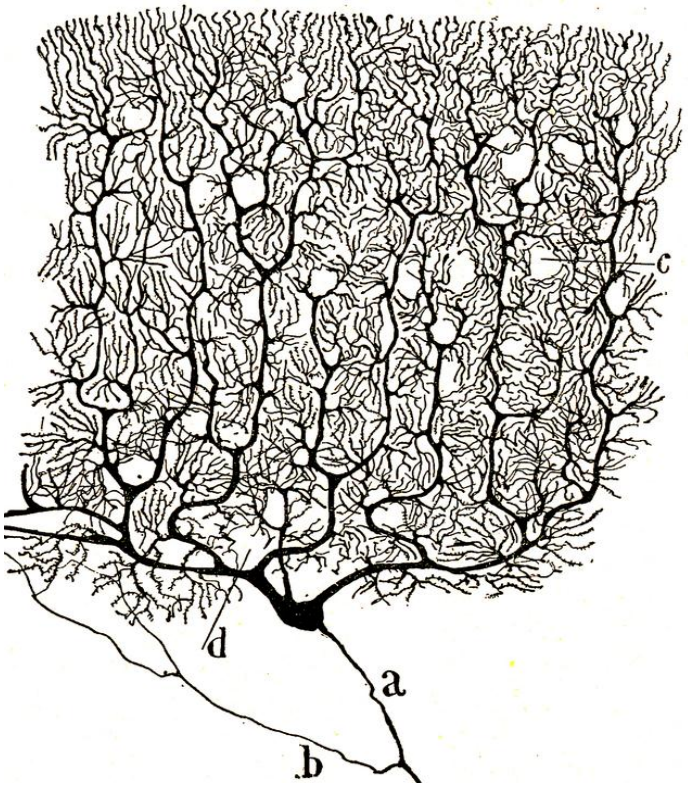
- **basket cells**
- **neuroglia.**

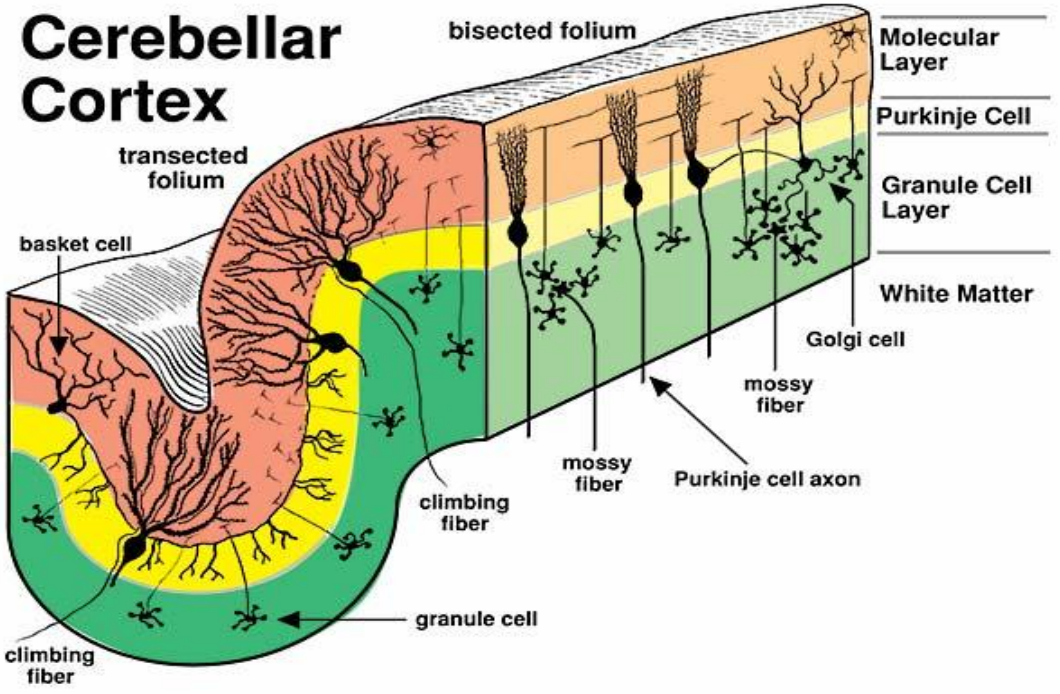


2- Purkinje cell layer:

huge pyriform, in single layer whose **extensive dendritic arborization** Axons.....to deep cerebellar nuclei.

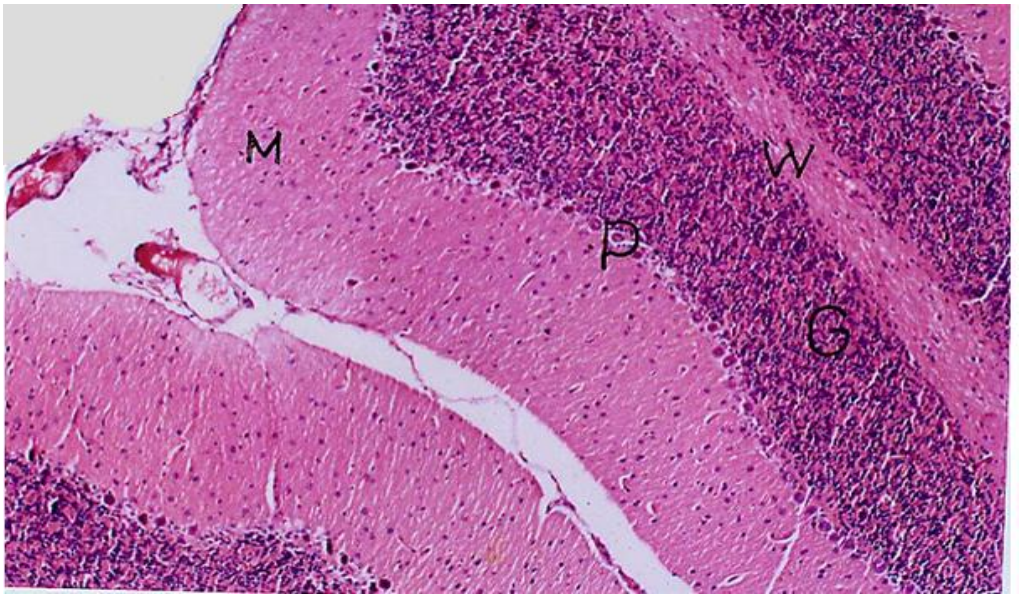


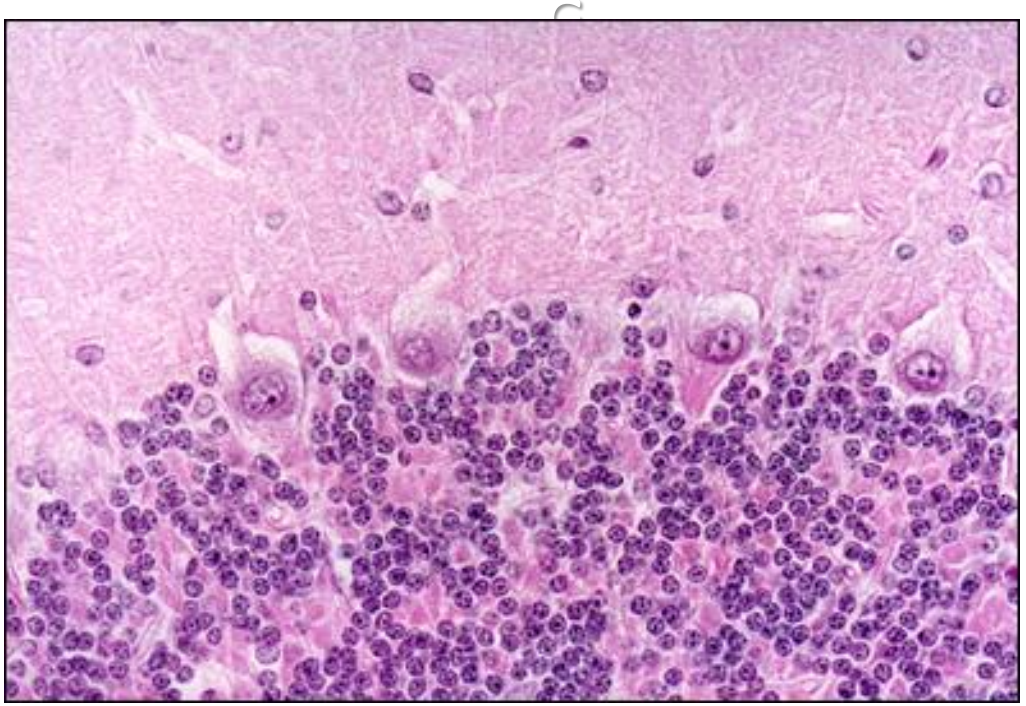




3- granular layer:

- **Densely packed small stellate granule cells:**
- receive **mossy fibers**.
- Axons to molecular layer.
- **Golgi cells**:
- extensive branching dendrites in different planes...
- receive **recurrent collateral fibers.**





The cerebellar glomeruli:

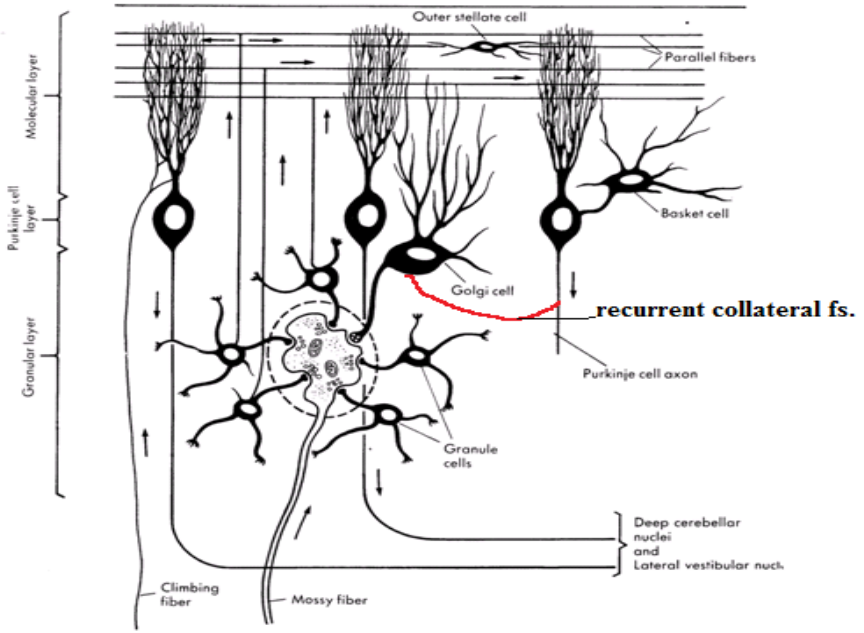
These are the complex synaptic regions between:

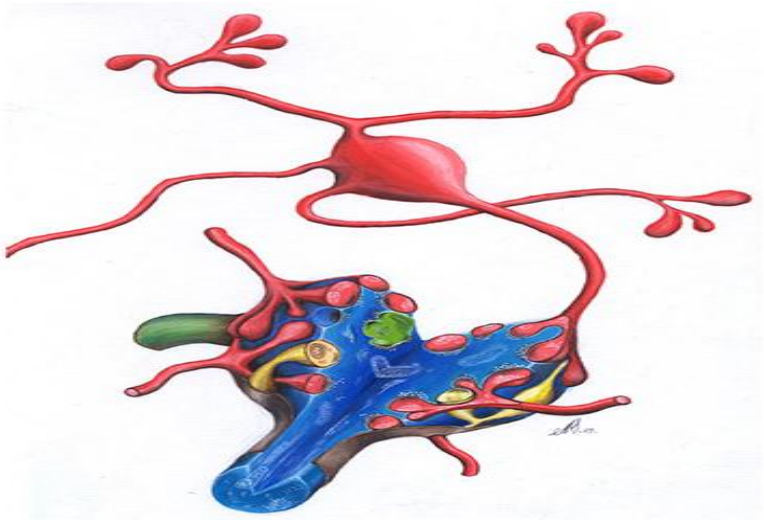
- **mossy fibers**

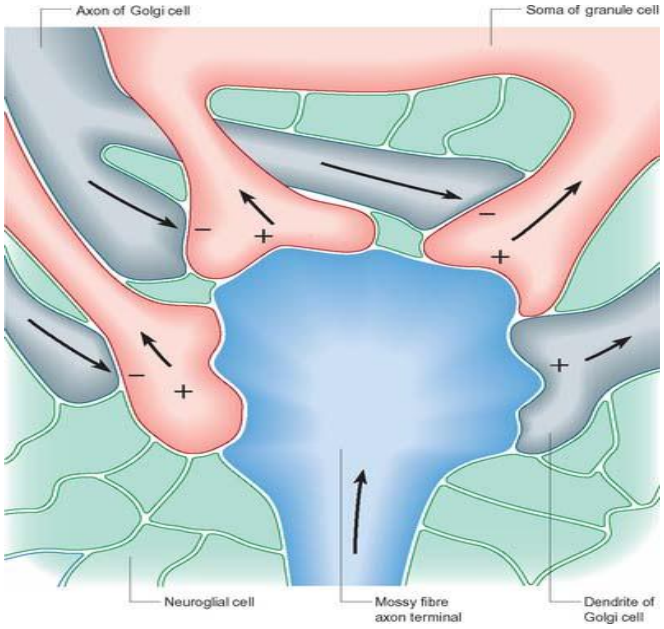
(Rosettes endings)+

- **dendrites of granule cells**
- **axons of Golgi cells.**
- enclosed in neuroglial capsule.

characterize the granular layer.



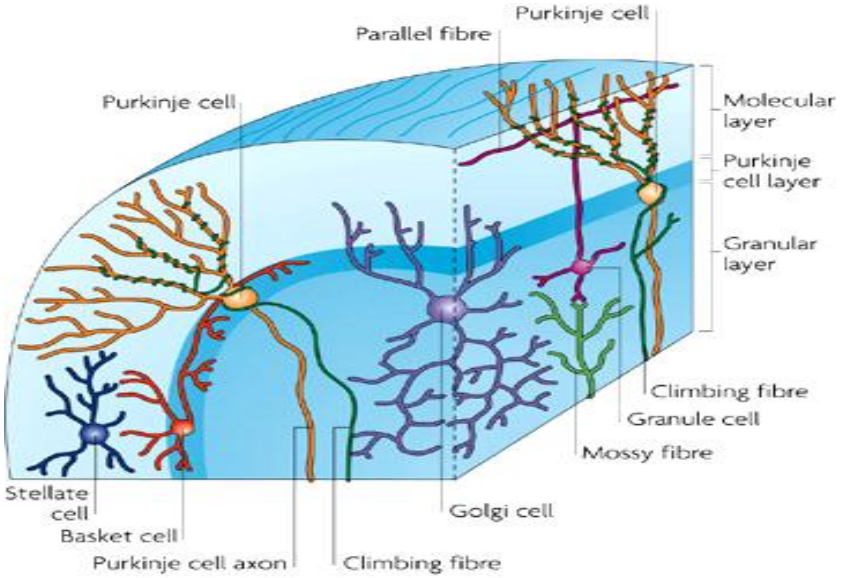


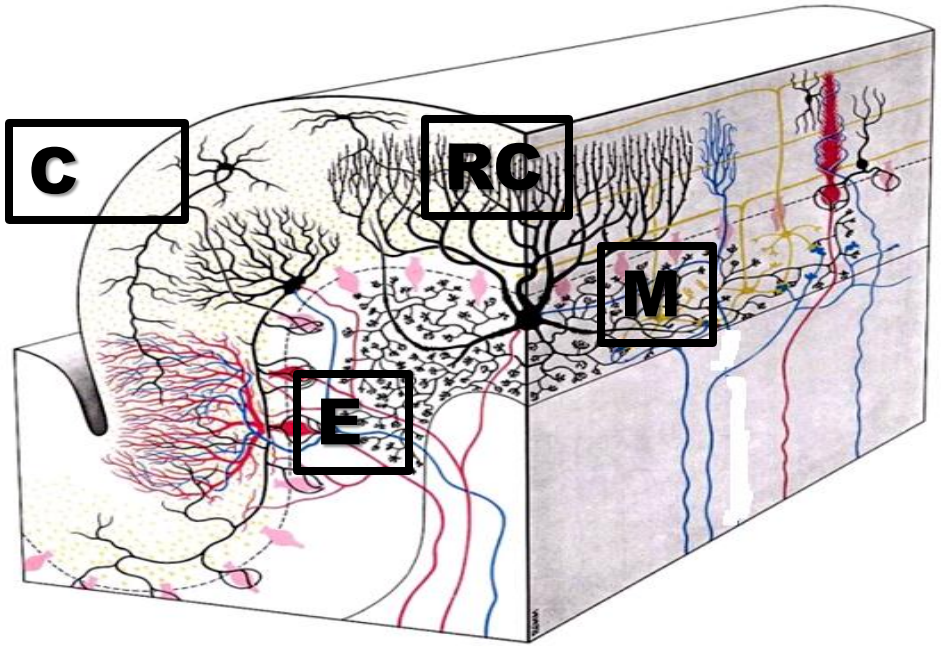


The fiber architecture of the cerebellar cortex:

It includes:

- **Afferent fibers** are the fiber inputs to the cerebellar cortex, these are:
  - **Mossy fibers** which constitute the majority of afferent fibers to the cerebellar cortex. They end on the granule cells.
  - **Climbing fibers** which are the olivo- cerebellar fibers that end on the dendrites of Purkinje cells.
  - **Recurrent collaterals** arise from axons of Purkinje cells and end on dendrites of Golgi cells.
- **Efferent fibers** are the axons of Purkinje cells that **end on the deep cerebellar nuclei.**

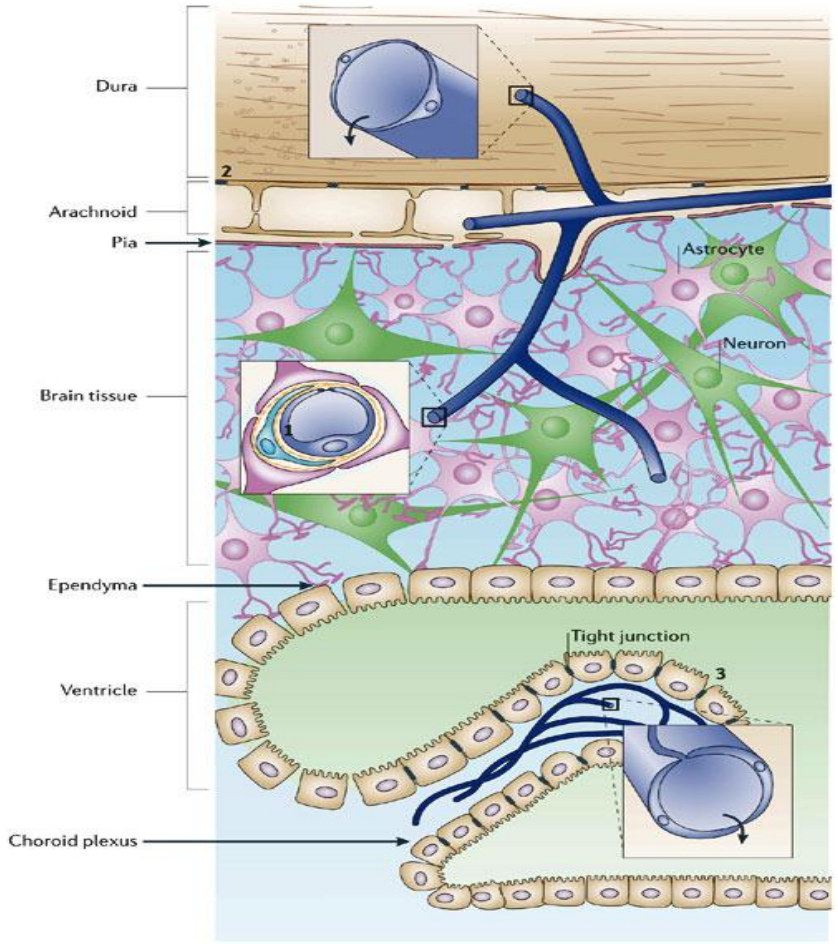




The Brain Barriers

The neural tissue of the brain and spinal cord are protected by several barriers which preserve the homeostasis (internal environment) of the CNS. These are:

1- Blood- CSF barrier: It keeps the chemical stability of the CSF different from that of the blood plasma. This barrier is situated at the tight junctions between the ependymal cells of the choroid plexus.



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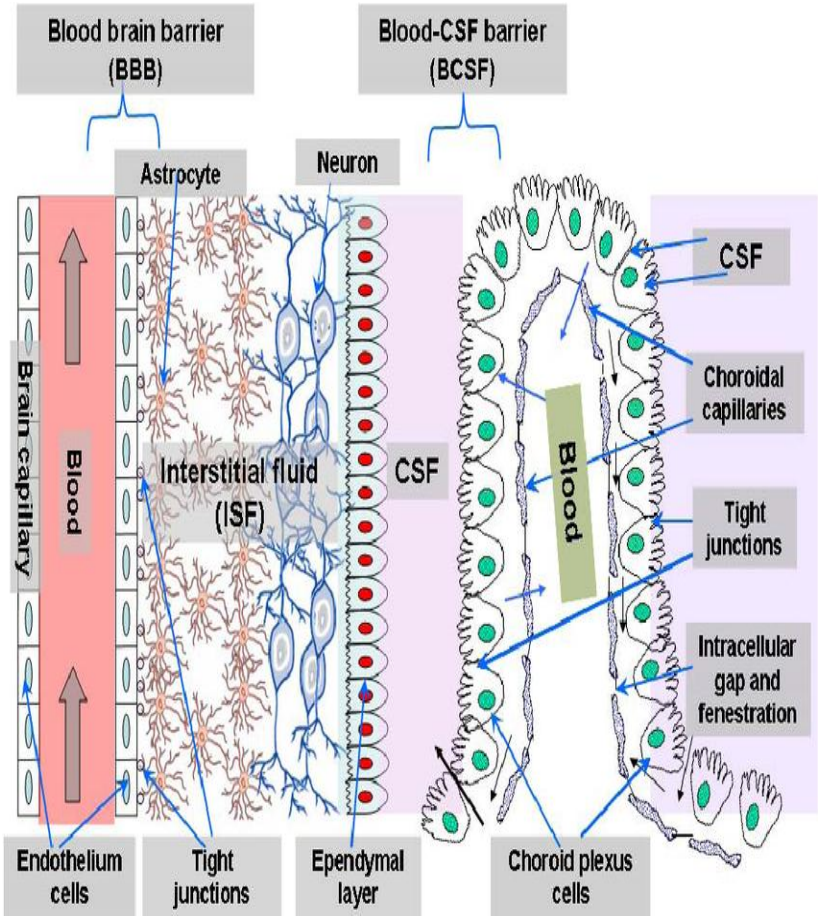
2- Brain- CSF barrier:

It separates the CSF from the surrounding brain tissue.

It is formed of:

- The ependymal cells lining the brain ventricles and the central canal of the spinal cord.



***3-* Blood- brain barrier:** It is a highly selective barrier that prevents the passage of harmful materials e.g. toxins, foreign proteins and some drugs. In addition, it allows the exchange of gases (O2, CO2) and many simple solutions (glucose) essential for nutrition of neurons.

The blood- brain barrier is established by :

I- The specific microscopic structure of CNS capillaries which is formed of:

- The **non-fenestrated capillaries** of the CNS with **tight** (occluding) **junctions** between the lining endothelial cells.
- The CNS capillaries are invested by **continuous basal lamina**.
- **Neuroglial processes** (end feet of astrocytes) that completely surround the blood capillaries.

II- The physiological transport system: that controls the endothelial permeability of blood- born substances. The trans- endothelial transport of CNS capillaries is completely restricted to receptor- mediated transport with very few pinocytotic vesicles.