




# CEREBELLUM


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- **CONTROL OF CEREBELLUM IS IPSILATERAL .**
  - **CEREBELLUM : SILENT AREA OF CNS**

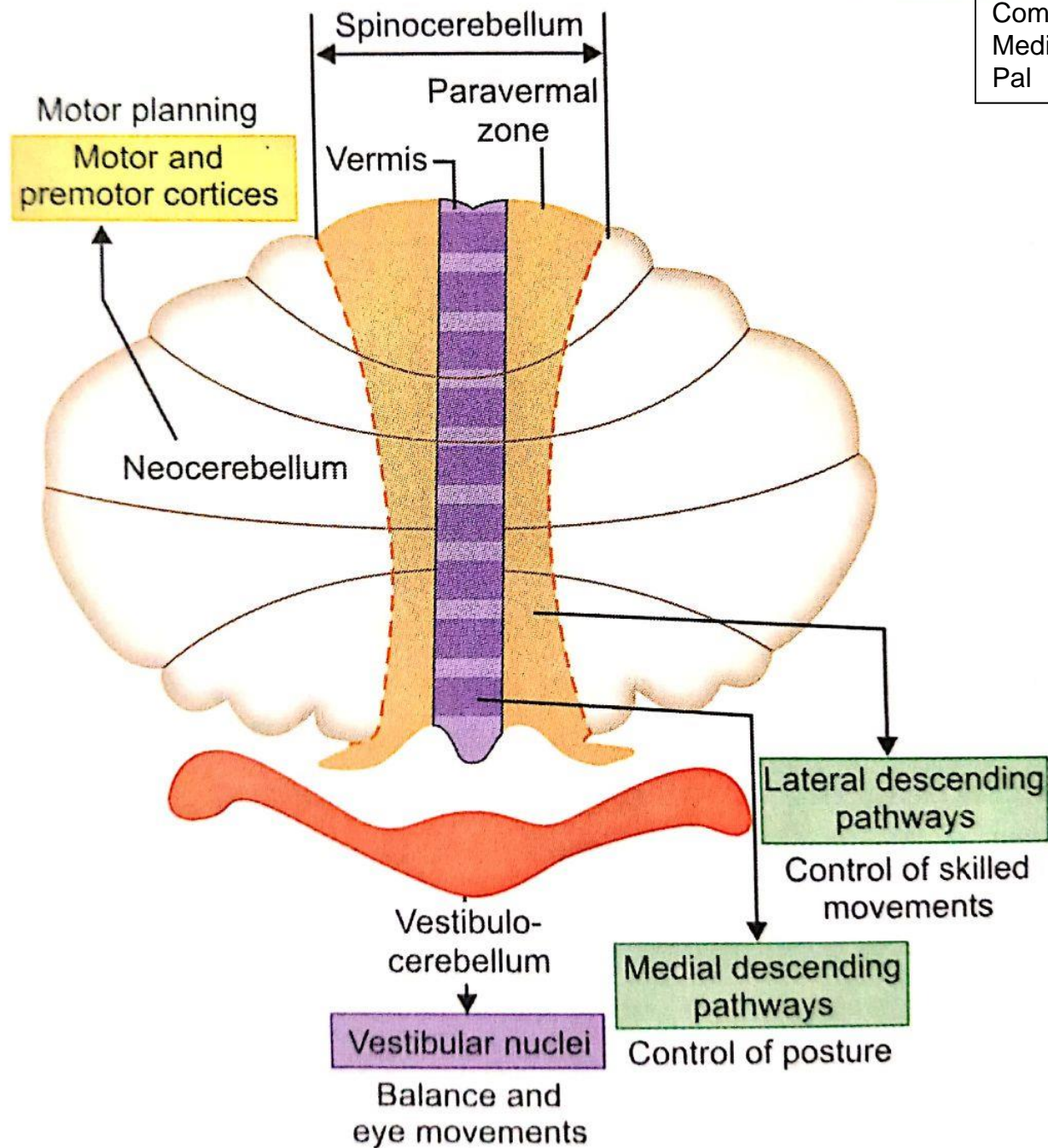


# PARTS OF CEREBELLUM

- CENTRAL BODY: VERMIS
  - LATERAL LOBES:  
RIGHT AND LEFT CEREBELLAR  
HEMISPHERES
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# ANATOMICAL DIVISIONS OF CEREBELLUM

- **ANTERIOR LOBE:** lingual, lobules centralis and culmen
- **POSTERIOR LOBE:** lobules simplex, declive, tuber, pyramis, uvula, parafloccule, ansiform and paramedian lobule.
- **FLOCULONODULAR LOBE:** floccules, nodule



**Fig. 132.2:** Functional divisions and functions of cerebellum.

# DEVELOPMENTAL (PHYLOGENETIC) DIVISIONS

- 1) **ARCHICEREBELLUM**-FLOCCULONODULAR LOBE
- 2) **PALEOCEREBELLUM** -entire anterior lobe except lingual, and following parts of posterior lobe: pyramis, uvula and paraflocculus
- 3) **NEOCEREBELLUM**: whole of posterior lobe except pyramis and uvula.

# FUNCTIONAL DIVISIONS

- **VESTIBULOCEREBELLUM**: Flocculonodular lobe. Concerned with body posture and equilibrium, N. fastigius.
- **SPINOCEREBELLUM**: paleocerebellum: anterior lobe except lingual, and following parts of posterior lobe: pyramis, uvula and paraflocculus, N. globosus and emboliformis.
- **CORTICOCEREBELLUM**: neocerebellum, posterior lobe except pyramis and uvula, N. dentatus.

# DIVISION OF CEREBELLUM

<b>anatomical</b>	anterior lobe posterior lobe flocculonodular lobe
<b>Phylogenetical</b>	archicerebellum palaeocerebellum neocerebellum
<b>Functional</b>	vestibulocerebellum (N fatigius ) spinocerebellum (N interposed ) cerebrocerebellum (N dentatus)



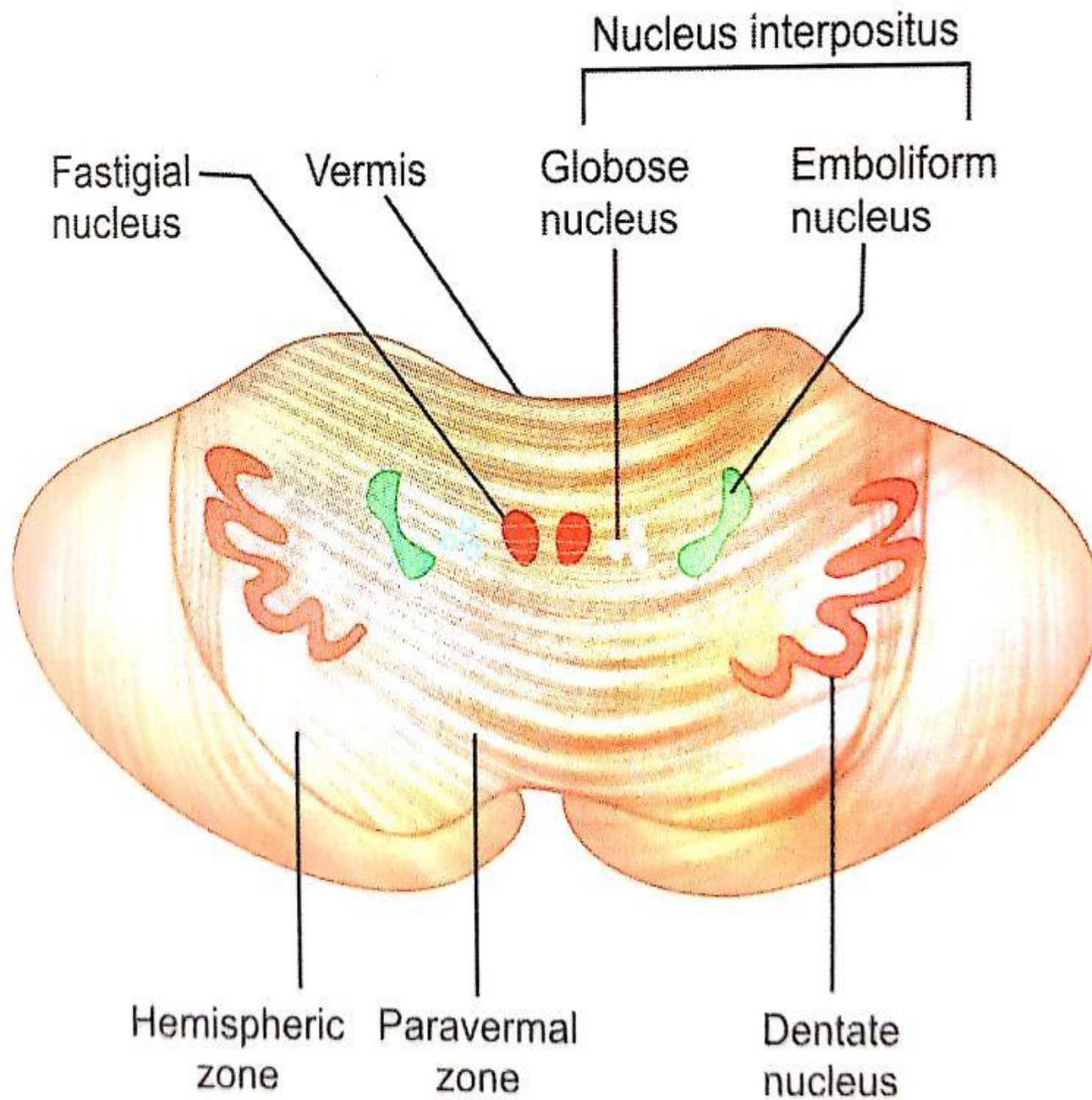


# CEREBELLUM

- CEREBELLAR CORTEX
  - WHITE MATTER
  - CEREBELLAR NUCLEI
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# CEREBELLAR NUCLEI

- Cerebellar hemisphere has grey matter outside and white matter inside.
- White matter has many nuclear masses called roof nuclei. From medial to lateral side:
  - Nucleus fastigijs
  - Nucleus globosus
  - Nucleus emboliformis
  - Nucleus dentatus (LARGEST).
- All efferent connections are made through these nuclei.

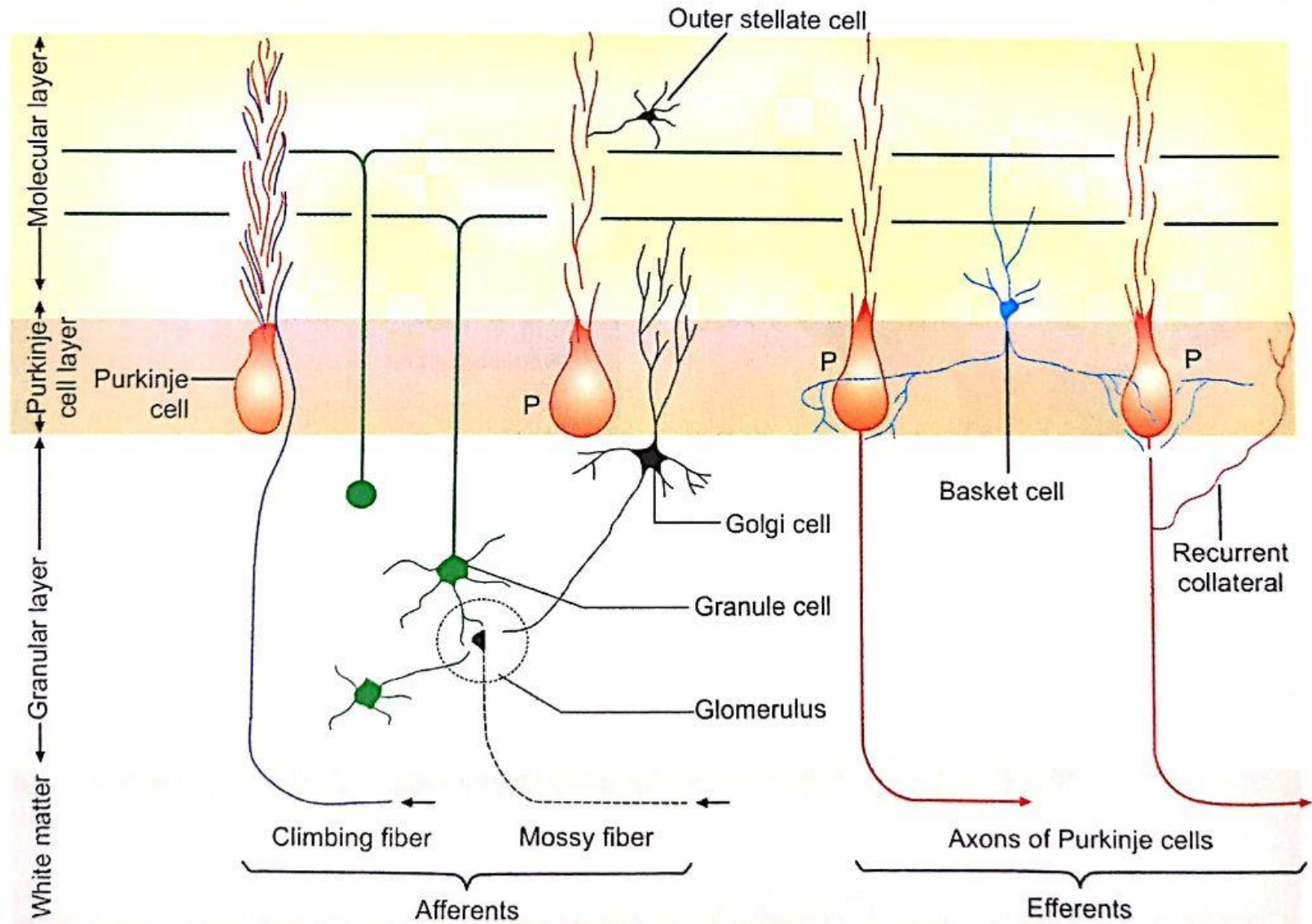


**Fig. 132.4:** Location of deep cerebellar nuclei.

# HISTOLOGY OF CEREBELLUM

OUTER GRAY MATTER (CORTEX) : 3 LAYERS

- 1) **OUTER MOLECULAR LAYER-**
  - \* STELLATE CELLS, BASKET CELLS
  - \* PARELLEL FIBERS (GRANULE CELLS)
  - \* CLIMBING FIBERS (TERMINAL PORTIONS)



**Fig. 132.3:** Layers of cerebellar cortex. Note the outer molecular layer, middle Purkinje cell (P) layer and inner granular layer.

## 2) PURKINJEE LAYER:

FLASK SHAPED PURKINJEE CELLS

FINAL COMMON PATHWAY

## \* 3) GRANULAR LAYER:

GRANULAR CELLS AND GOLGI CELLS

MOSSY FIBERS : GLOMERULUS


ALL CELLS ARE INHIBITORY (SECRETE GABA) EXCEPT  
GRANULE CELLS ( GLUTAMATE).

# WHITE MATTER OF CEREBELLUM

- FORMED BY AFFERENT AND EFFERENT NERVE FIBERS.
- THREE BUNDLES:
  - 1) SUPERIOR CEREBELLAR PEDUNCLE (BRACHIA CONJUNCTIVA): MIDBRAIN, MAINLY EFFERENT FIBERS
  - 2) MIDDLE CEREBELLAR PEDUNCLE (BRACHIA PONTIS): PONS, AFFERENT FIBERS
  - 3) INFERIOR CEREBELLAR PEDUNCLE (RESTIFORM BODY): MEDULLA OBLONGATA, AFFERENT FIBERS



# CEREBELLAR NEURONAL CIRCUITS


- FEED FORWARD INHIBITION OF PURKINJEE CELLS
  - FEED FORWARD INHIBITION OF GRANULE CELLS
  - CEREBELLAR NUCLEI: FAVOURS EXCITATION
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# AFFERENT FIBERS TO CEREBELLAR CORTEX

- **CLIMBING FIBERS**: FROM INFERIOR OLIVARY NU. OF MEDULLA VIA OLIVOCEREBELLAR TRACT



CONVEY PROPRIOCEPTIVE IMPULSES FROM CORTEX, DIFFERENT PARTS OF BODY  
TERMINATE ON PURKINJEE CELLS  
COLLATERALS TO CEREBELLAR NUCLEI



- **MOSSY FIBERS:**

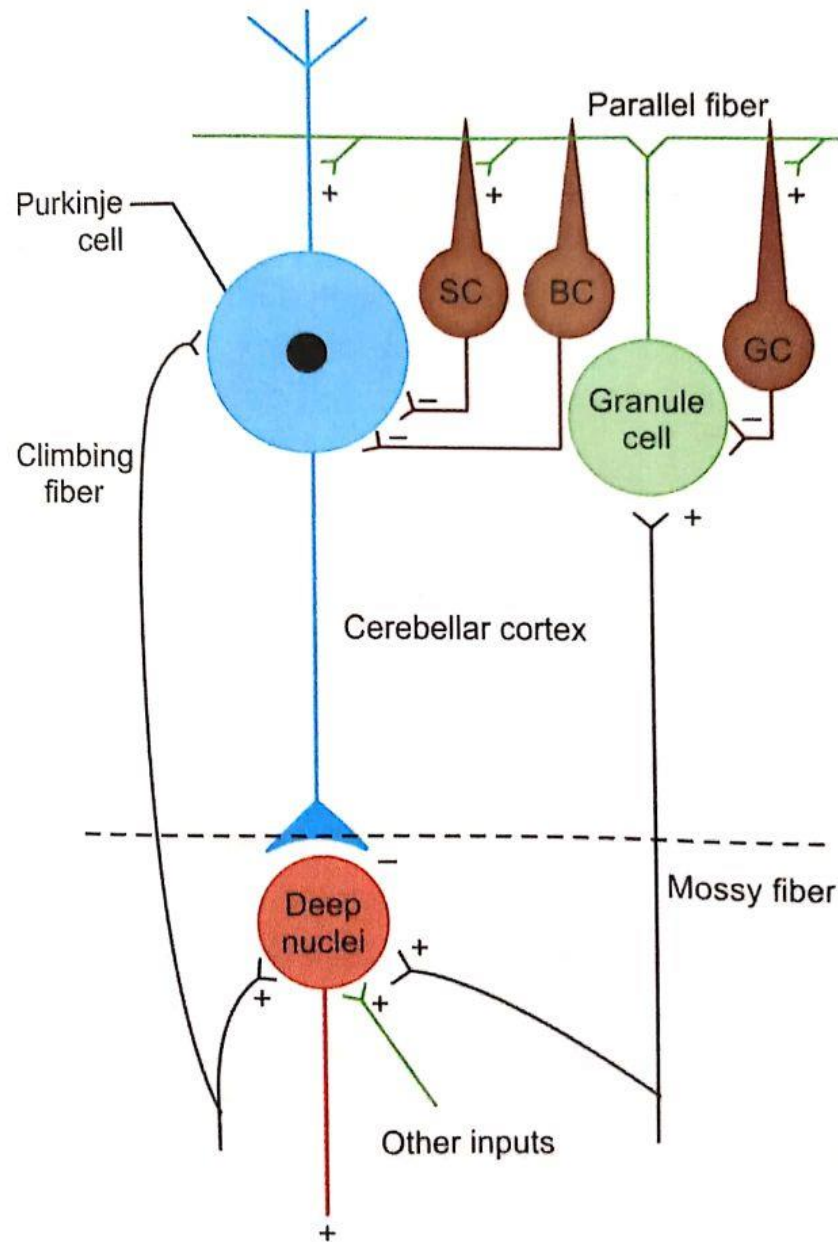
FROM CORTEX, PONS, MEDULLA AND SPINAL CORD: axons of spinocerebellar, vestibulocerebellar, reticulocerebellar, cuneocerebellar and cortico ponto cerebellar tracts.



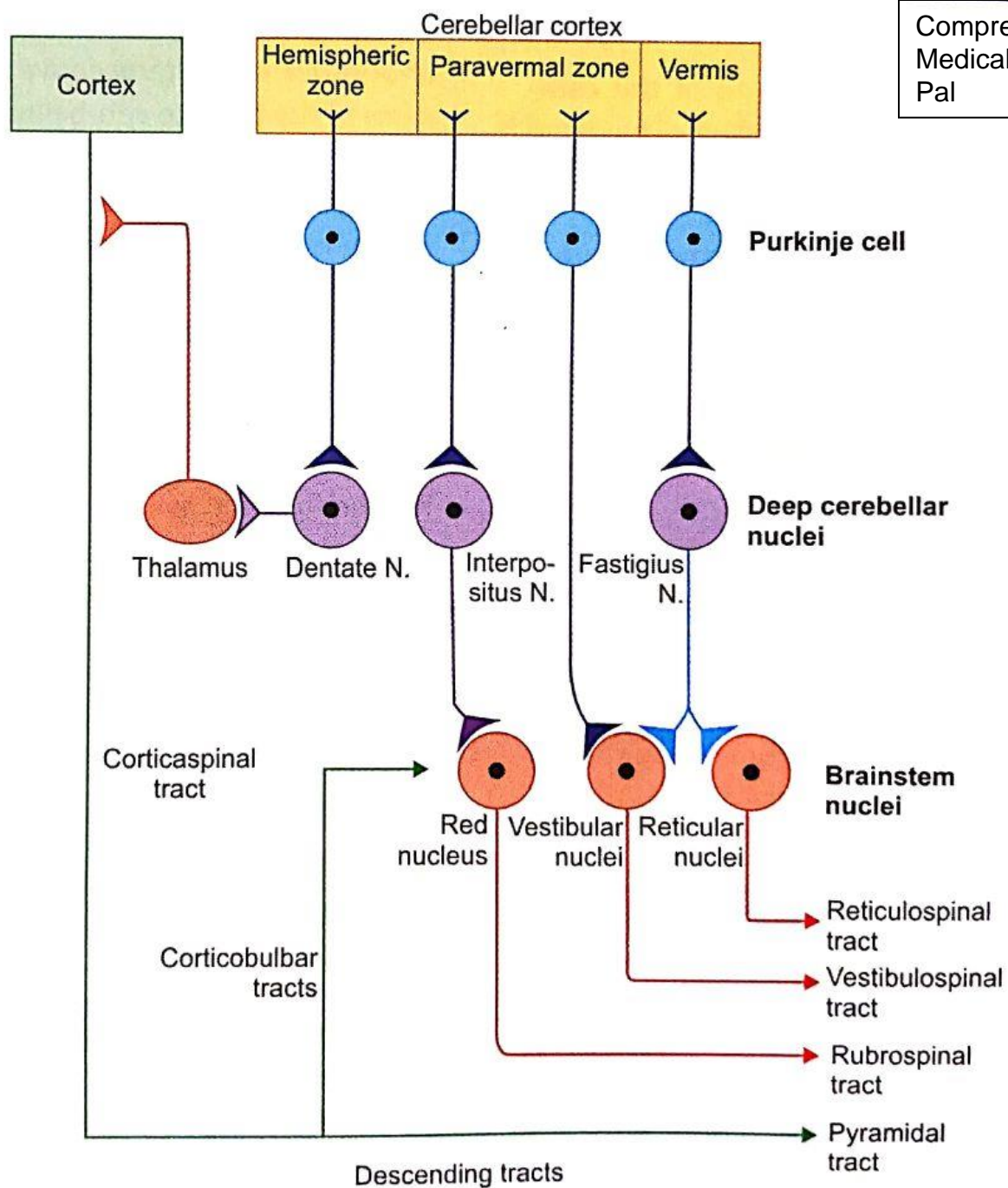
DENDRITES OF GRANULE AND GOLGI CELLS  
SYNAPSE ON MOSSY FIBERS

# NEURONAL ACTIVITY IN CEREBELLUM

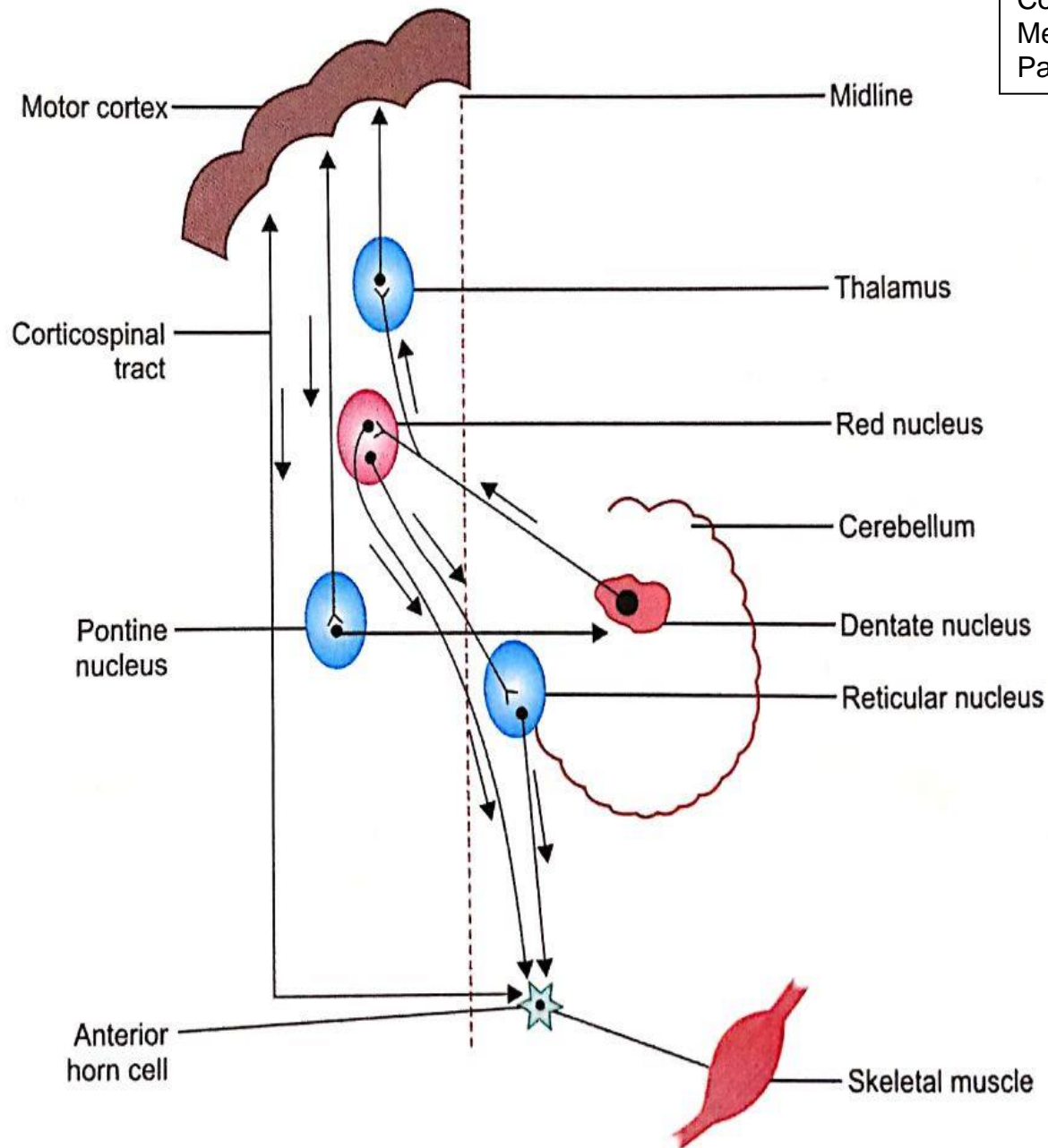
- climbing fibers excite purkinjee cells and cerebellar nuclei by releasing aspartate
- mossy fibers excite purkinjee cells (via granule cells) and cerebellar nuclei by releasing glutamate
- granule cells excite purkinjee cells, stellate cells, basket cells through parallel fibers by releasing glutamate or aspartate
- stellate cells and basket cells inhibit purkinjee cells through gaba.
- golgi cells inhibit granule cells
- cerebellar nuclei are excited by climbing and mossy fibers and in turn send excitatory impulses to thalamus and brainstem
- purkinjee cells inhibit cerebellar nuclei via gaba
- all this for well organised and coordianted movements



**Fig. 132.6:** Inputs and internal connections of cerebellum. Note, inspite of inhibitory inputs from Purkinje cells, the output of deep cerebellar nuclei is always excitatory. BC: Basket cell; SC: Stellate cell; GC: Golgi cell.



**Fig. 132.5:** Major output pathways from cerebellum. Note, cerebellum projects to all descending pathways.



**Fig. 132.8:** The cerebellar connection to explain its comparator of a servo mechanism.

# AFFERENTS

**Inferior cerebellar peduncle: (ENTRANCE GATE)**

\* *Dorsal spinocerebellar tract*

• *Cuneocerebellar T. ( external arcuate fibers)*

• *Reticulocerebellar fibres,*

*Olivocerebellar fibres,*

*Vestibulocerebellar fibres.*

■ ***middle cerebellar peduncle:*** cerebro-ponto-cerebellar fibres

■ ***superior cerebellar peduncles,***

(a) *Ventral spinocerebellar tract*

(b) *Tectocerebellar tract*

# EFFERENTS



## *superior cerebellar peduncle: (EXIT GATE)*

- \* Efferent fibres to motor cortex (area 4): They form dentato-rubrothalamo-cortical path, cerebello-thalamocortical path
- \* reticulospinal tracts

*inferior cerebellar peduncle:* cerebellovestibular fibres







# FUNCTIONS OF CEREBELLUM

- Maintenance of **TONE, POSTURE AND EQUILIBRIUM.**
- VESTIBULOCEREBELLUM: POSTURE AND EQUILIBRIUM
- SPINOCEREBELLUM: TONE, COORDINATION DURING MOVEMENT
- CORTICOCEREBELLUM: COORDINATION OF SKILLED VOLUNTARY ACTIVITIES

# VESTIBULOCEREBELLUM

- **MAINTAINANCE OF POSTURE AND EQUILIBRIUM**
- **POSITION OF EYES IN RELATION TO MOVEMENTS OF THE HEAD**
  
- **AFFERENT CONNECTIONS:**
- VESTIBULOCEREBELLAR TRACT:  
VESTIBULAR APP. – VESTIBULAR NUCLEI - CEREBELLAR NUCLEI: Gives information about gravity, linear movement, acceleration.
- - SPINOCEREBELLAR AND CUNEOCEREBELLAR T.
- - RETICULOCEREBELLAR T.
  
- **EFFERENT CONNECTIONS:**
- CEREBELLOVESTIBULAR TRACT- REFLEXES INVOLVING TRUNK, NECK AND EXTREMITIES  
(VESTIBULOSPINAL T.- EXTRAPYRAMIDAL SYSTEM)

# SPINOCEREBELLUM (PALEOCEREBELLUM)

- CONNECTED WITH SPINAL CORD

## EFFERENT CONNECTIONS:

- 1) FASTIGIOBULBAR T.
- 2) CEREBELLORETICULAR T.
- 3) CEREBELLOLIVARY T.

## AFFERENT CONNECTIONS:


- DORSAL SPINOCEREBELLAR T.
- VENTRAL SPINOCEREBELLAR T.
- CUNEOCEREBELLAR T.
- OLIVOCEREBELLAR T.
- PONTOCEREBELLAR T.
- TECTOCEREBELLAR T.
- TRIGEMINOCEREBELLAR T.

# FUNCTIONS OF SPINOCEREBELLUM

- RECEIVING AREA FOR TACTILE, PROPRIOCEPTIVE, AUDITORY AND VISUAL IMPULSES
- REGULATES POTURAL REFLEXES BY MODIFYING MUSCLE TONE VIA GAMMA MOTOR NEURONS (ALPHA GAMMA LINKAGE)
- ADJUSTMENT OF POSTURE IN RESPONSE TO AUDITORY AND VISUAL STIMULUS.



# CORTICOCEREBELLUM (NEOCEREBELLUM)

- INCLUDES LATERAL PORTIONS OF CEREBELLUM
  - LARGEST PART.
  - CONNECTED WITH CORTEX.
  - NEWER PART
  - **Concerned with planning, programming and coordination of skilled movements.**
  - **Appropriate regulation of time, rate, range (extent), force and direction of muscular activity.**
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# CONNECTIONS

- **AFFERENT:**

  - PONTOCEREBELLAR TRACT

  - OLIVOCEREBELLAR TRACT

- **EFFERENT:**

  - DENTATOTHALAMIC TRACT

  - DENTATORUBRAL TRACT

- \* CEREBRO CEREBELLO CEREBRAL  
CONNECTION

# MECHANISM OF ACTION

- COMPARATOR FUNCTION: compares cortical commands to muscles & actual muscle move.
- DAMPING ACTION: smooth, accurate movements, without oscillations, agonist antagonists.
- CONTROL OF BALLISTIC MOVEMENTS: rapid alternating movements- typing, dancing.
- TIMING AND PROGRAMMING MOVEMENTS: sequential movements- learning- stored in cortex.
  - \* Predictive fn.
- SERVOMECHANISM: execution of skilled move.

# LESION TO CEREBELLUM

- DISTURBANCES IN TONE AND POSTURE:
  - 1) ATONIA: loss or decreased tone
  - 2) ATTITUDE
  - 3) DEVIATION MOVEMENT: affected arm deviates on stretching
  - 4) DEEP REFLEXES: pendular jerks
  - 5) NYSTAGMUS: to and fro movements of eyeball



## ■ DISTURBANCES IN EQUILIBRIUM:


- 1) STANDING: legs spread to get broad base, body sways
- 2) GAIT: staggering, drunken gait

## ■ DISTURBANCES IN VOLUNTARY MOVEMENTS;

- 1) ATAXIA: lack of coordination ( decomposition of move.)
- 2) ASYNERGIA: lack of co. bet. Group of muscles
- 3) ASTHENIA: feebleness or slowness of muscles
- 4) DYSMETRIA: over or undershooting
- 5) INTENTION TREMORS
- 6) NYSTAGMUS: to & fro eyeball movements
- 7) REBOUND PHENOMENON
- 8) DYSARTHRIA: speech disturbance, scanning speech
- 9) ADIADOCHOKINESIA



## CLINICAL CONDITIONS INVOLVING CEREBELLUM:

- 1) Charcoat's triad: Disturbance in cerebellar connections with brainstem: Nystagmus, dysarthria and intention tremors.
  - 2) Friedreich's disease (hereditary): Degeneration of spinocerebellar tracts and other cerebellar connections leading to signs of cerebellar lesions.
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**THANK  
YOU**