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Cerebellum

M1 – CNS Sequence
Peter Hitchcock, Ph.D.

Winter, 2009



The topic of today's lecture is the cerebellum. The principal function of the cerebellum is to coordinate goal-directed and spontaneous movements, including eye movements, and regulate posture.

I. Gross anatomy of the cerebellum

II. Internal cellular anatomy and synaptic connections (circuitry)

III. Functional organization (3 functional domains)

a. vestibulocerebellum

b. spinocerebellum (2 subdivisions)

c. cerebrocerebellum

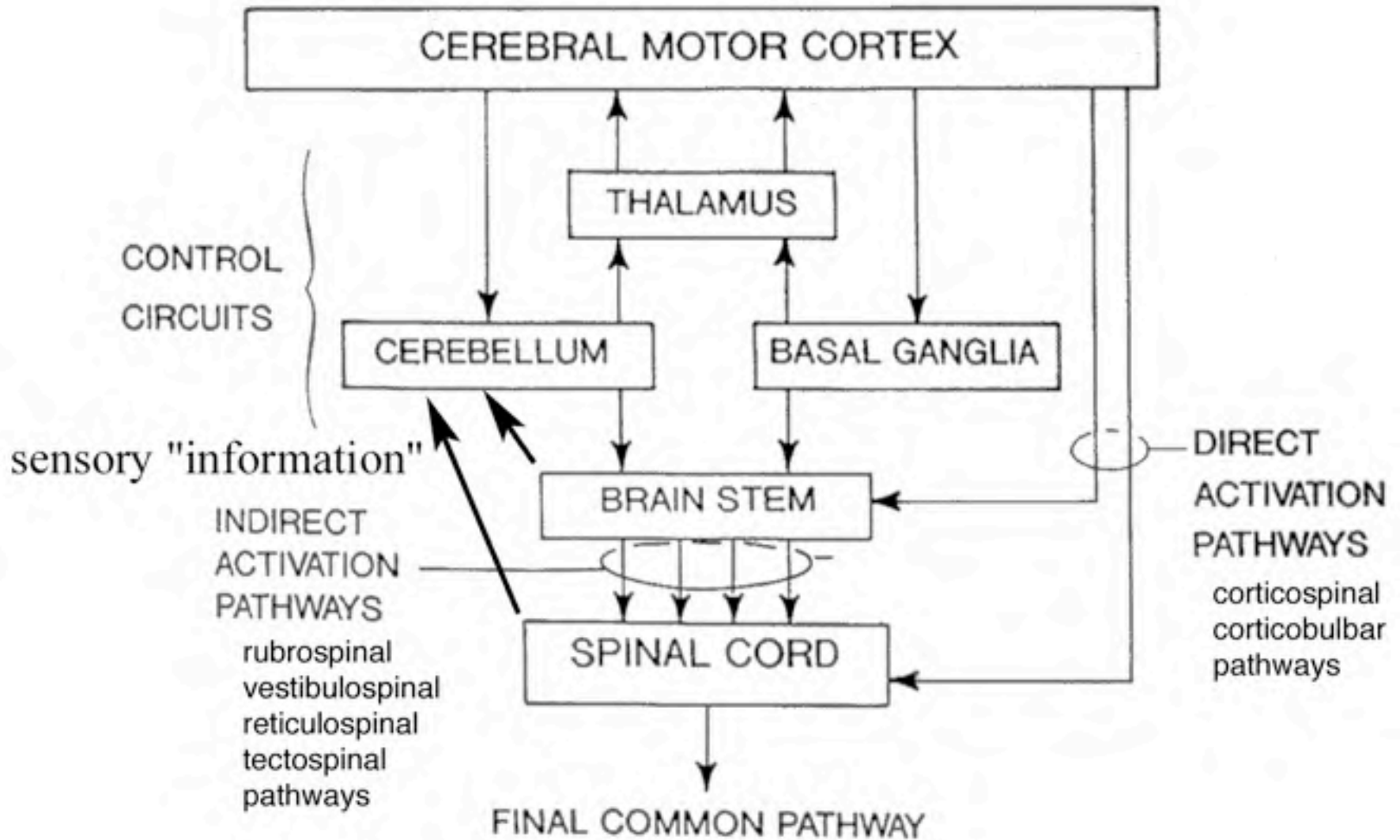
IV. Motor learning and plasticity

V. Clinical aspects of the cerebellum

VI. The cerebellum and cognition

VII. Blood supply to the cerebellum

A schematic model of the motor system. The cerebellum influences movements via connections to both the brainstem and cerebral cortex



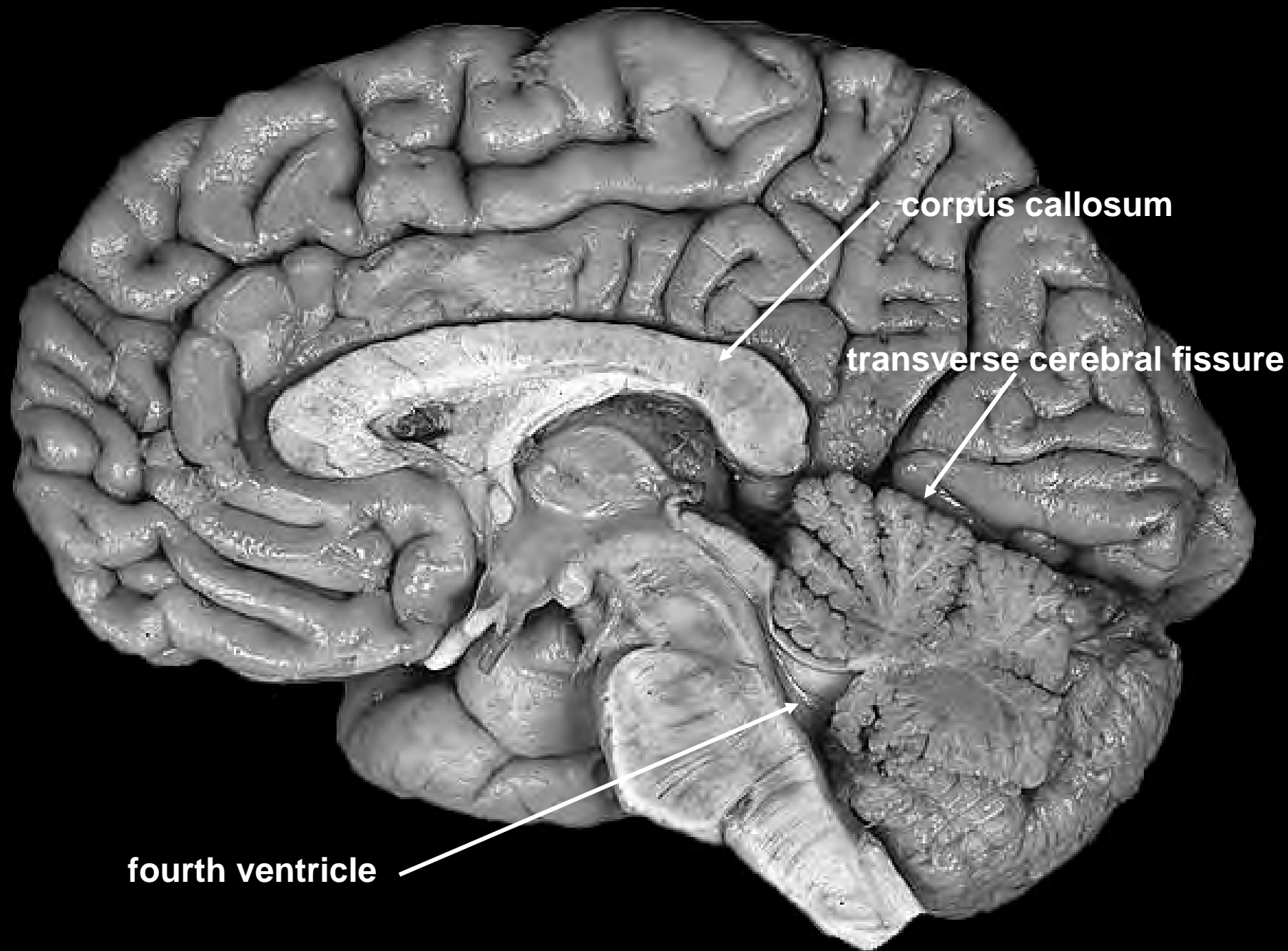
GENERAL FEATURES:

The cerebellum regulates the following 5 functions:

- 1) muscle tone**
- 2) coordination of goal directed and spontaneous movements**
- 3) posture and balance**
- 3) eye movements**
- 4) motor learning**
- 5) some cognitive functions (e.g., language acquisition)**

•Each hemisphere of the cerebellum influences motor activity on the ipsilateral half of the body

•The cerebellum compares the motor plan (intent) created in the cortex with motor performance (reported from the periphery) and functions to smoothen and coordinate the movements. This is accomplished by making synaptic contacts with the brainstem 'motor' centers and the cerebral hemispheres.



corpus callosum

transverse cerebral fissure

fourth ventricle

dorsal view

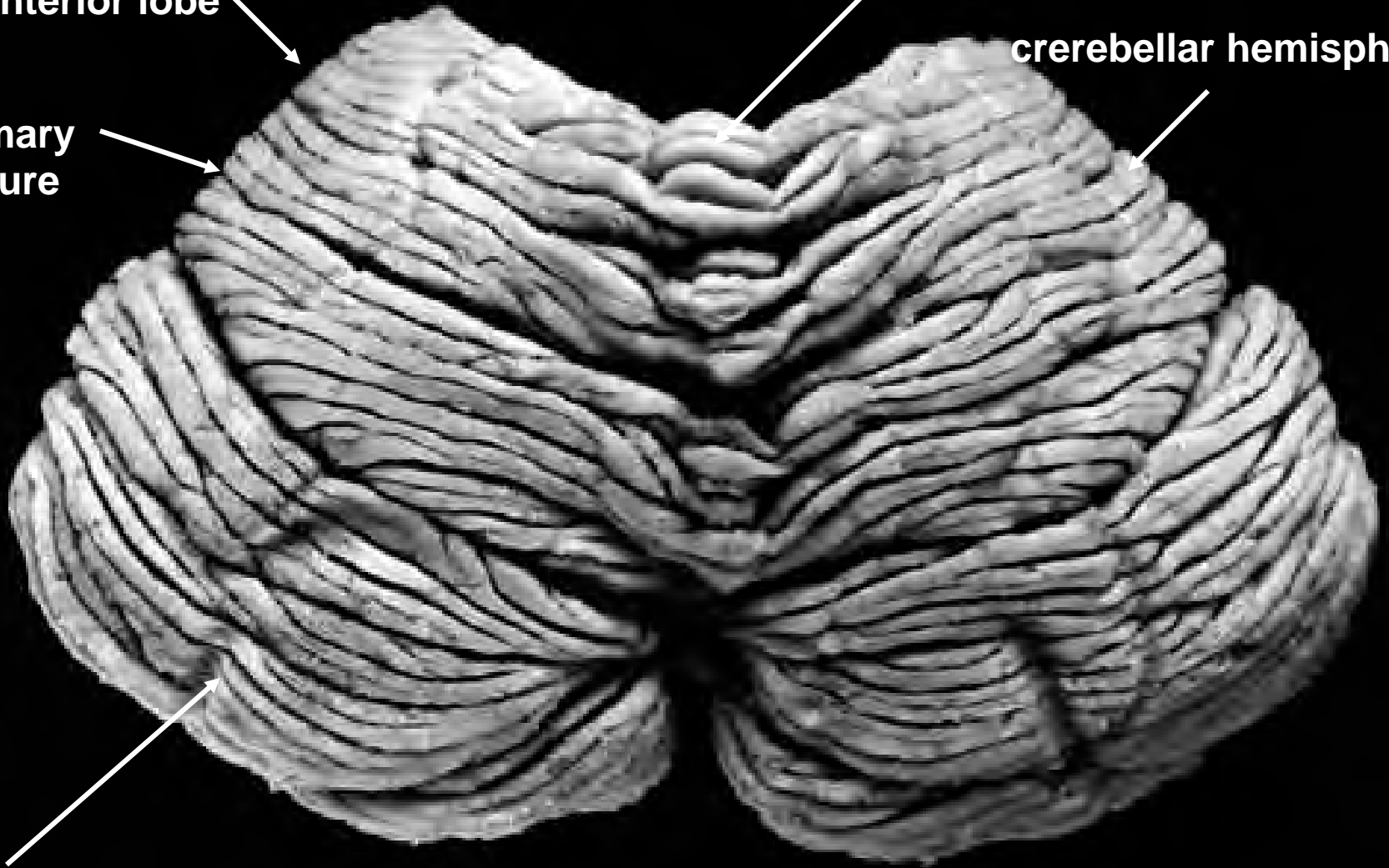
anterior lobe

vermis

crerebellar hemisphere

**primary
fissure**

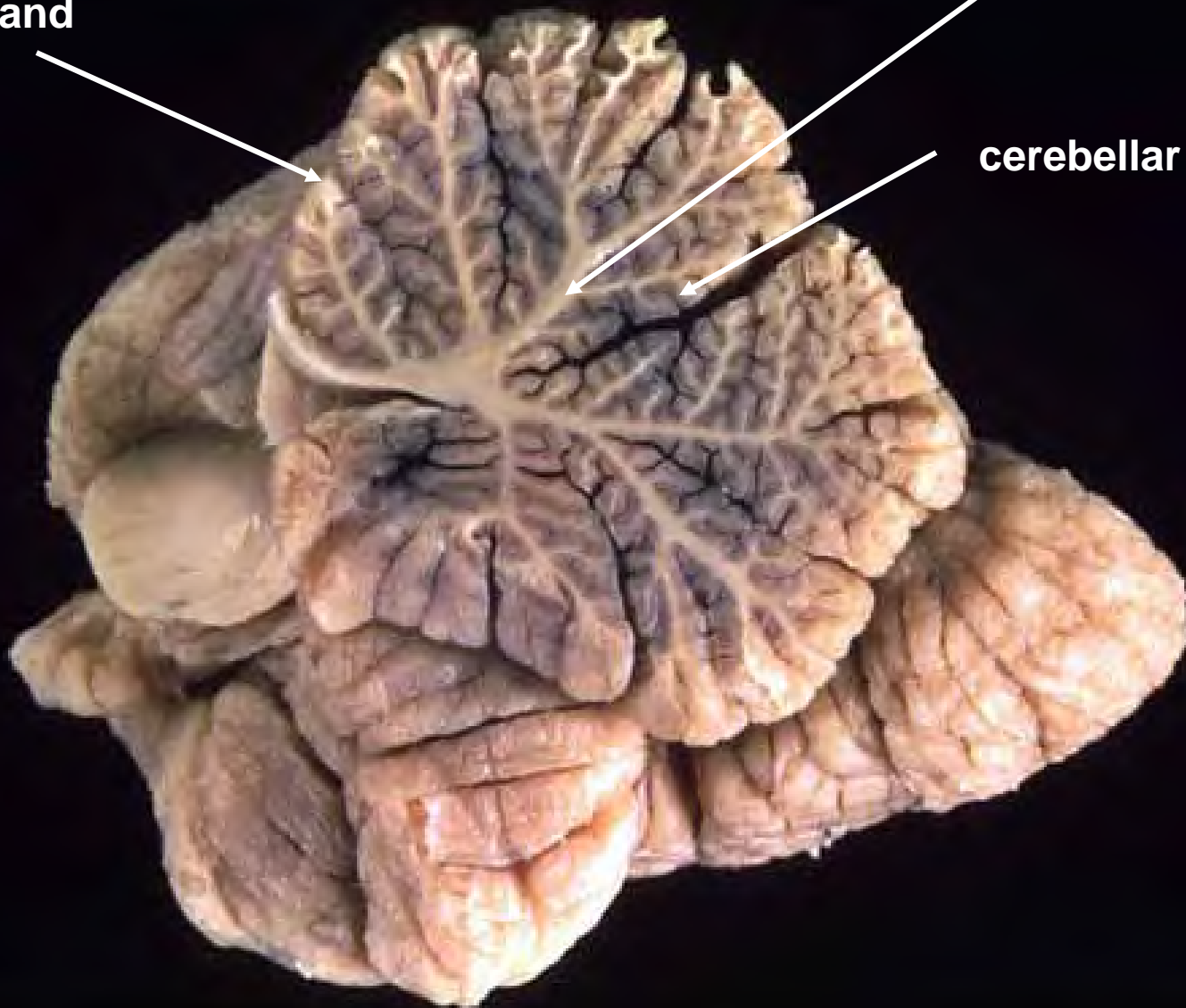
posterior lobe

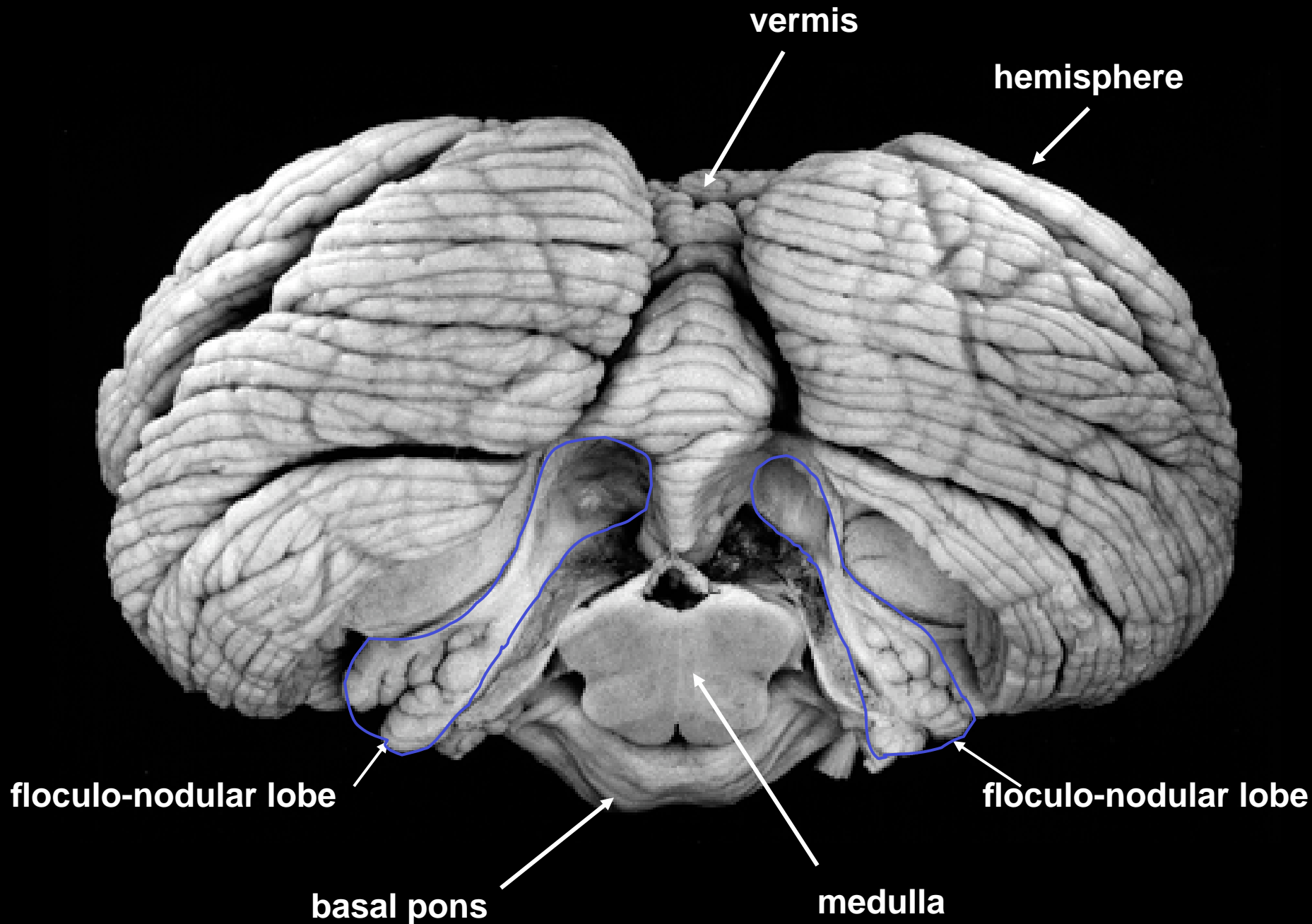


**lobules and
folia**

cerebellar white matter

cerebellar cortex



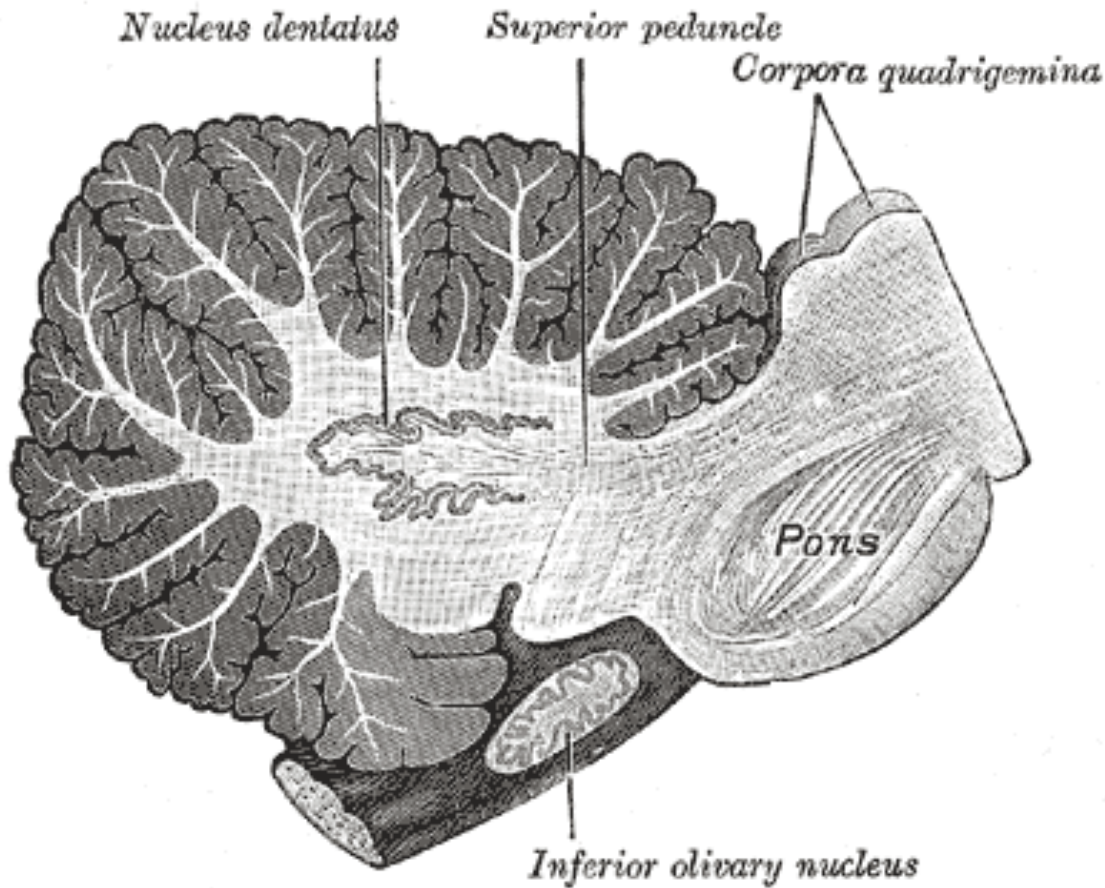


there are three pairs of nuclei that lie within the cerebellar white matter, known as the 'deep cerebellar nuclei' :

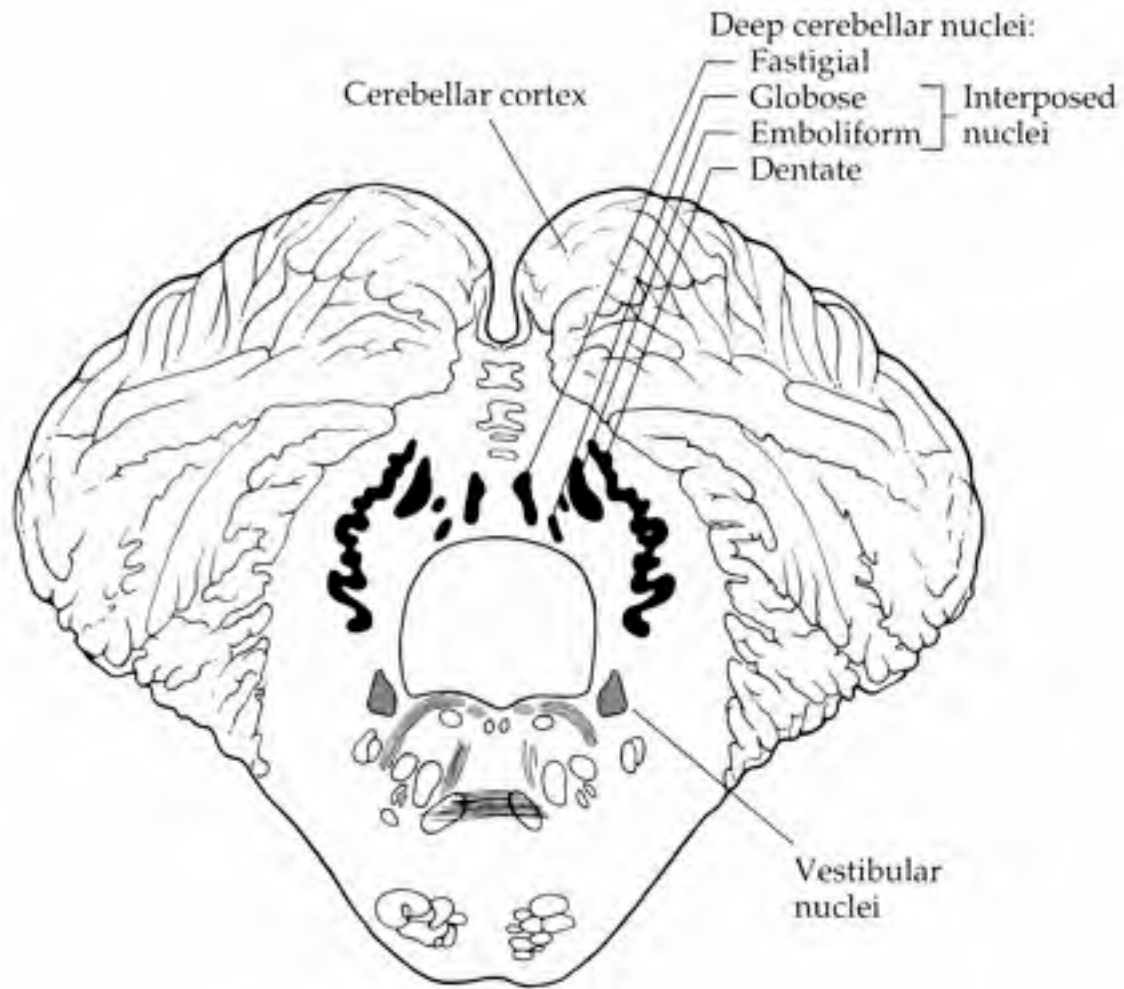
(from lateral to medial)

- dentate
- emboliform
- globose
- fastigial

interposed nucleus

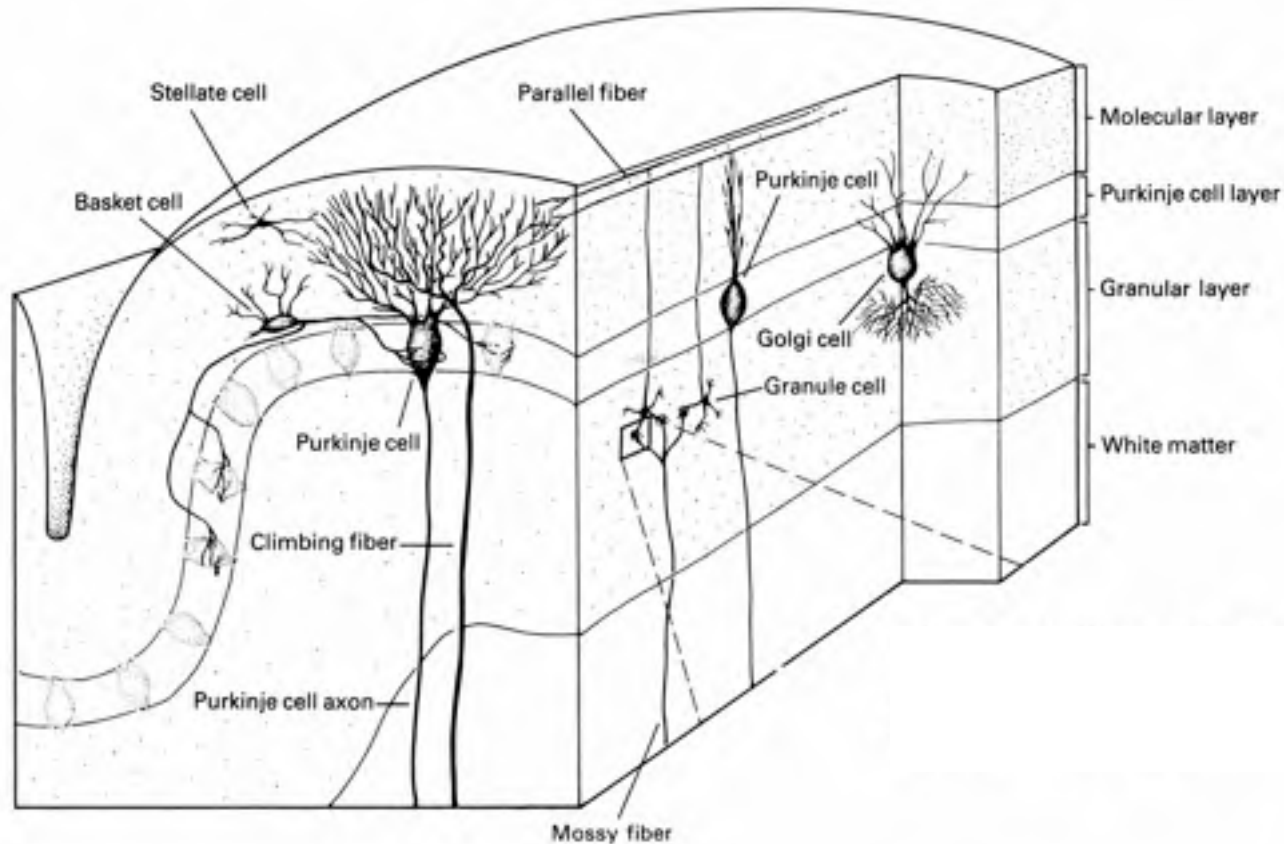


(Emboliform, globose, fastigial nuclei visible but not labeled)

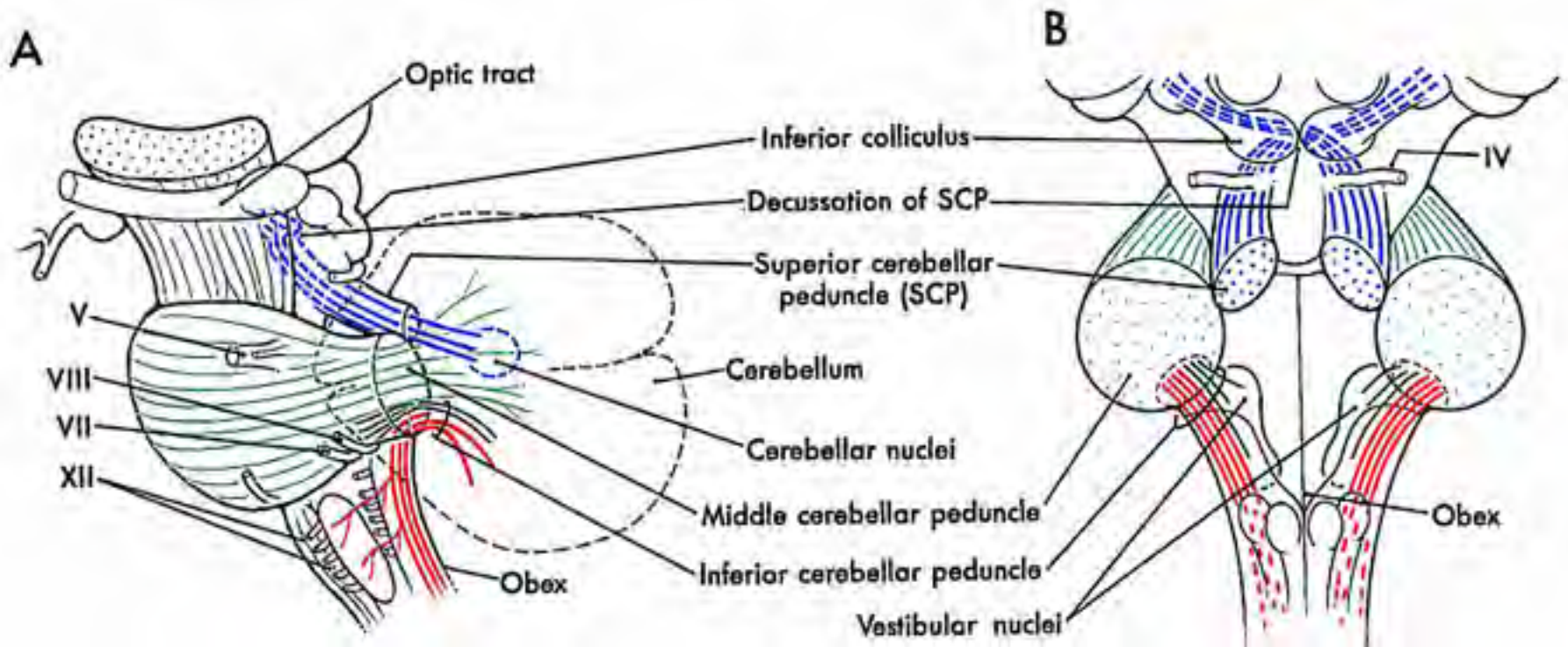


cross section through a portion of a single folium

- the cerebellum has three cellular layers (plus underlying white matter)
- there are three kinds of neurons in the cortex, Purkinje cell, granule cell, and interneurons (3 types)

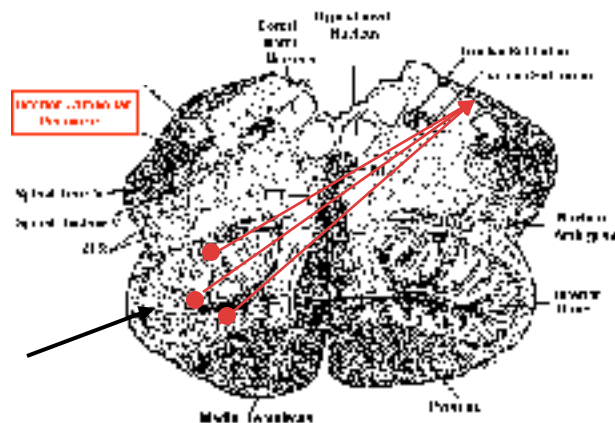


- climbing fibers originate from the contralateral inferior olive
- mossy fibers originate from all other afferents that enter the cerebellum

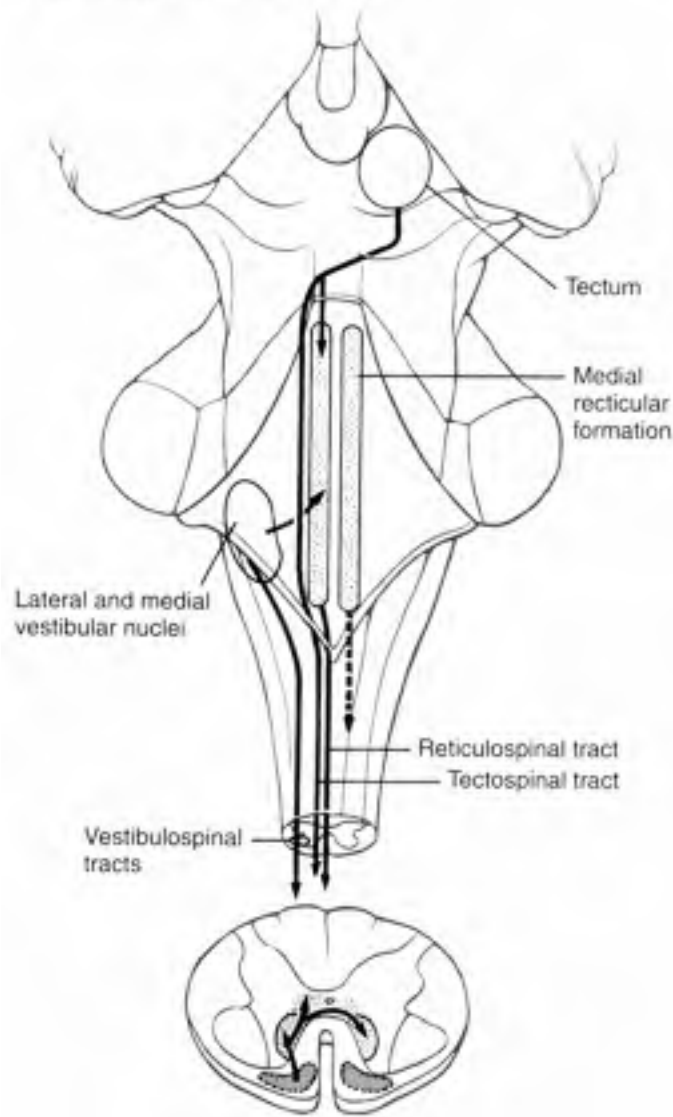


superior - mostly efferent
middle - afferent
inferior - mostly afferent

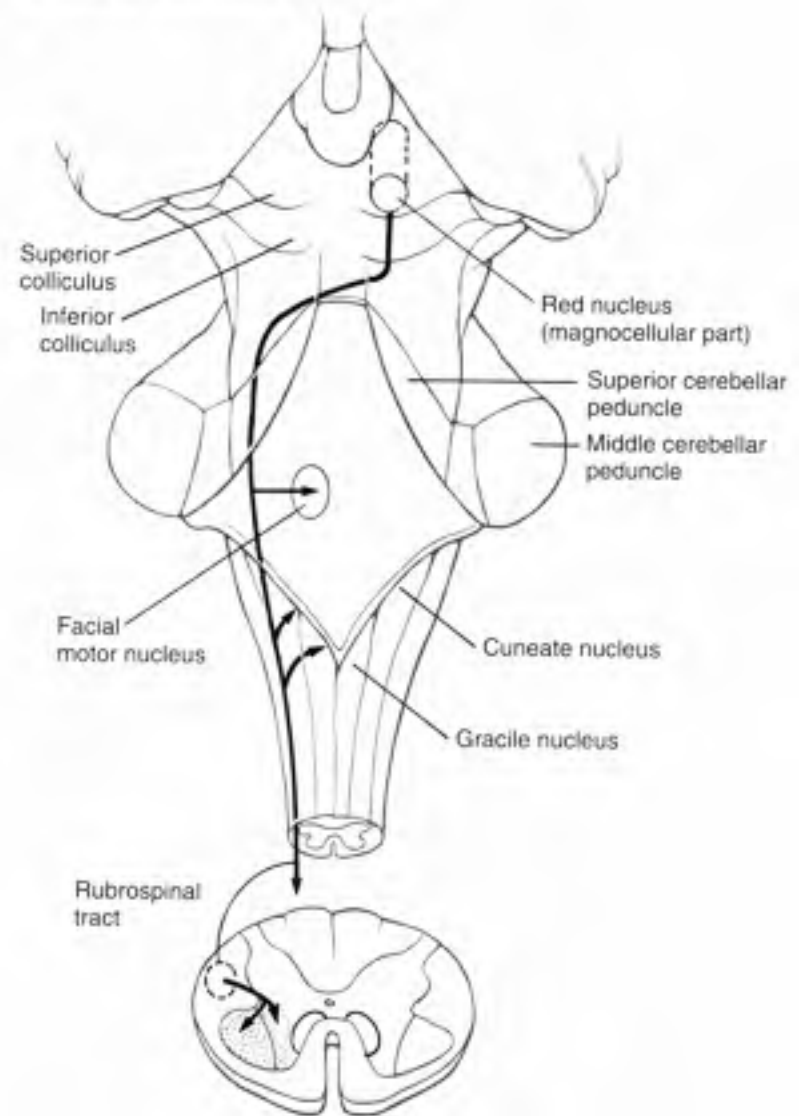
inferior olive



A Medial brain stem pathways

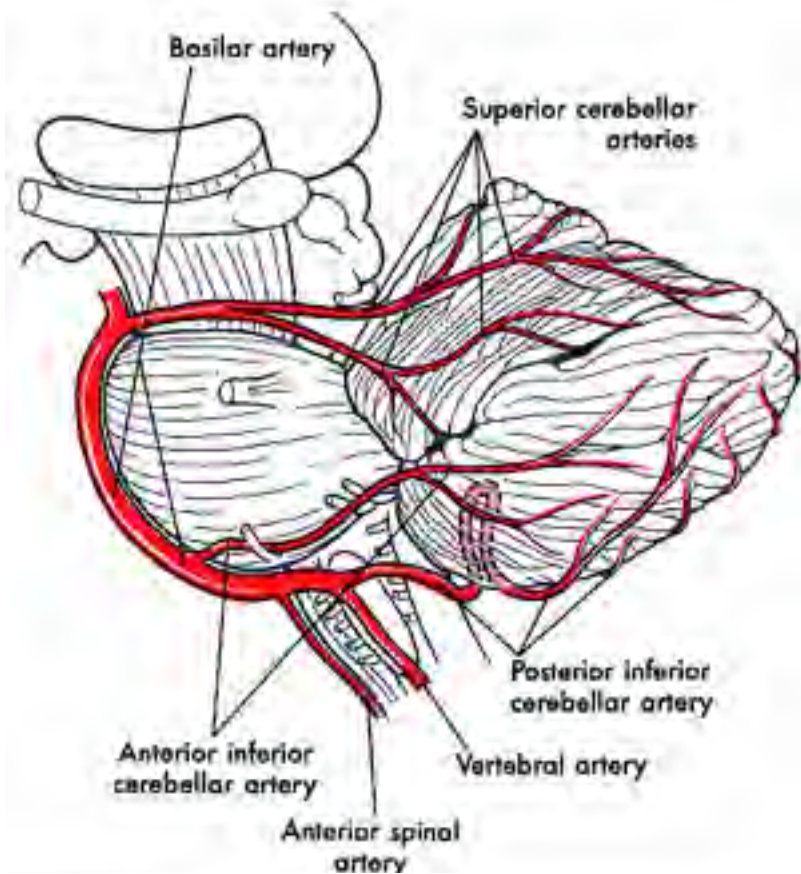


B Lateral brain stem pathways



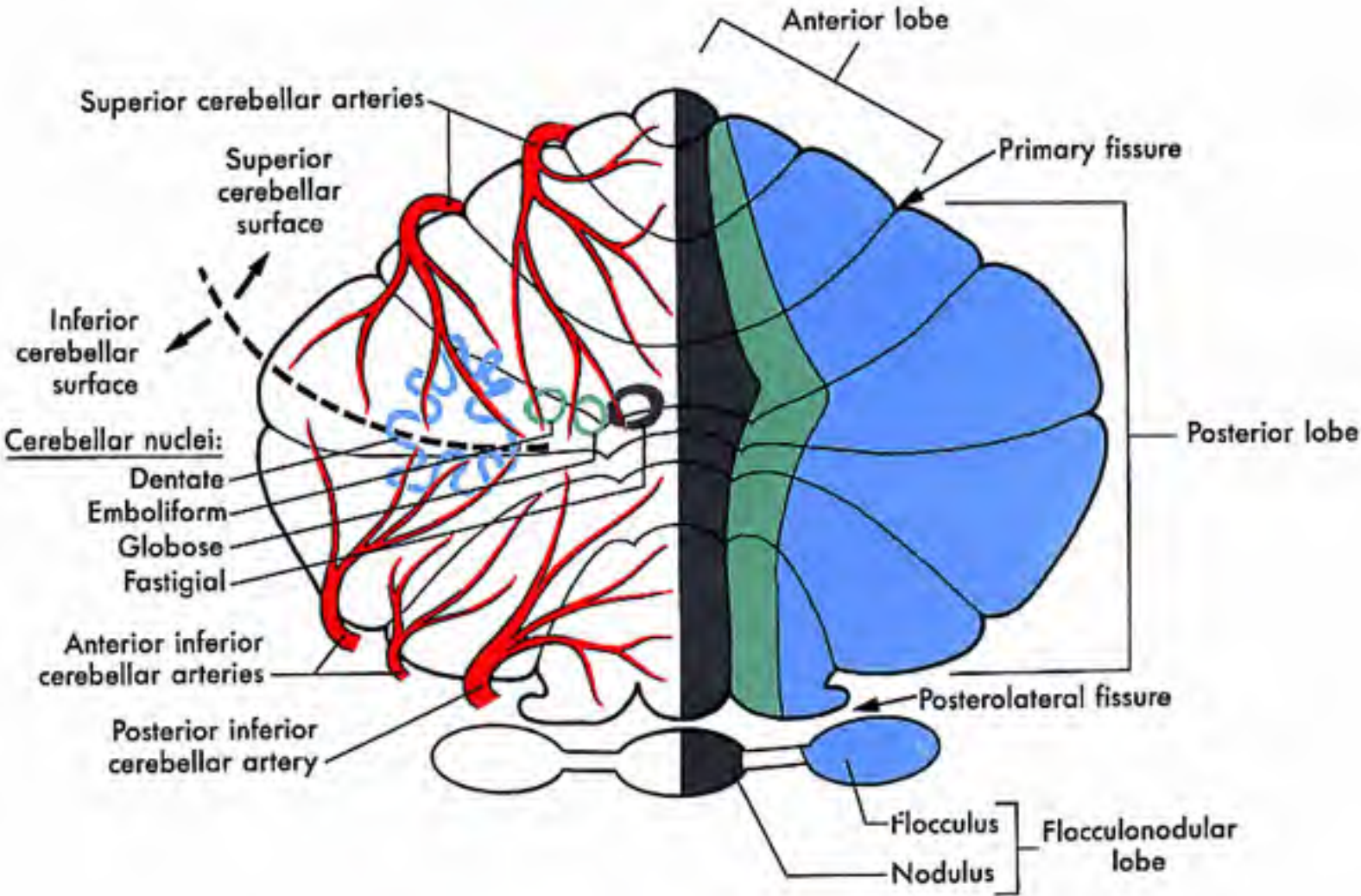
The cerebellum is supplied by vessels that branch from the basilar artery -

- superior cerebellar arteries
- anterior inferior cerebellar arteries
- posterior inferior cerebellar arteries

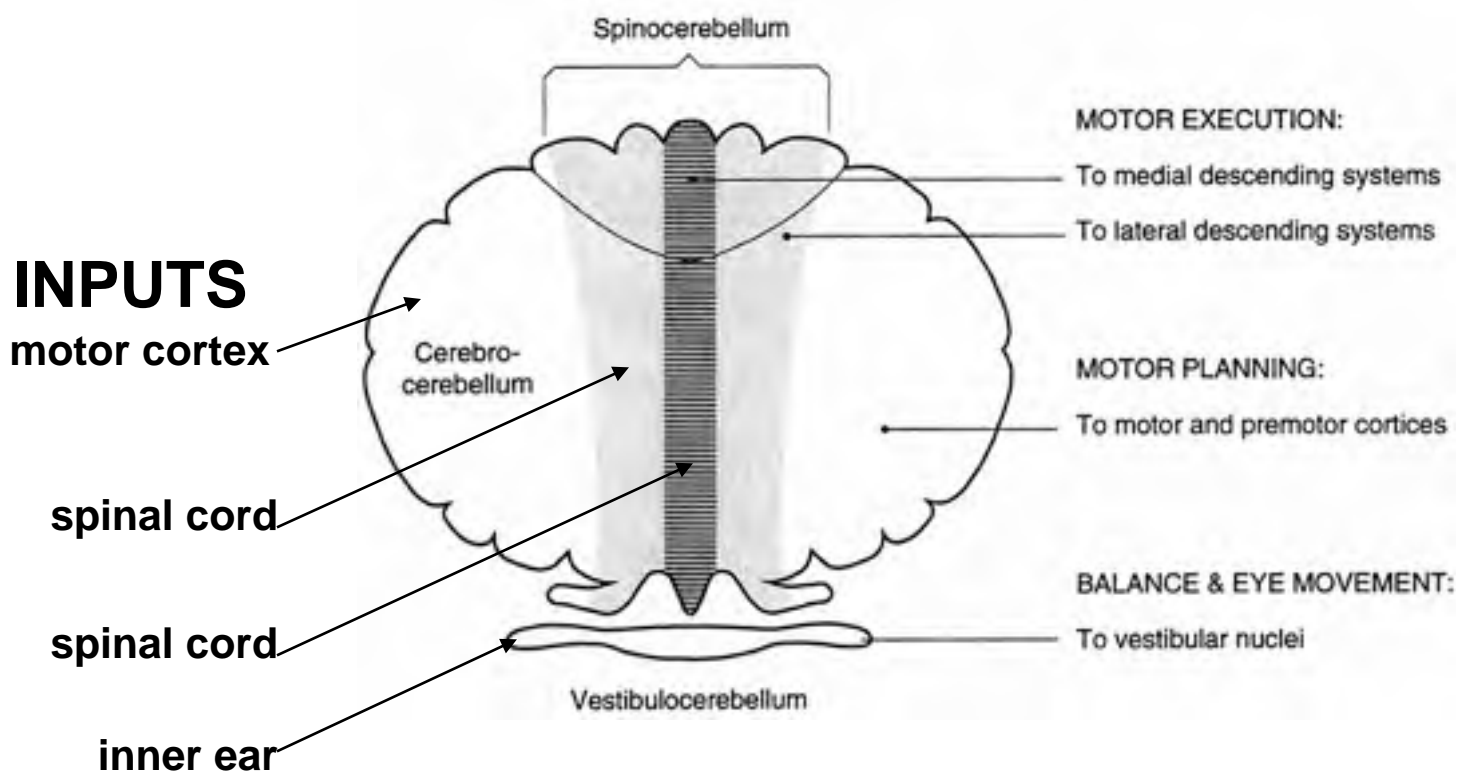


blood supply

longitudinal, functional domains



Summary diagram of the inputs and outputs of the cerebellum



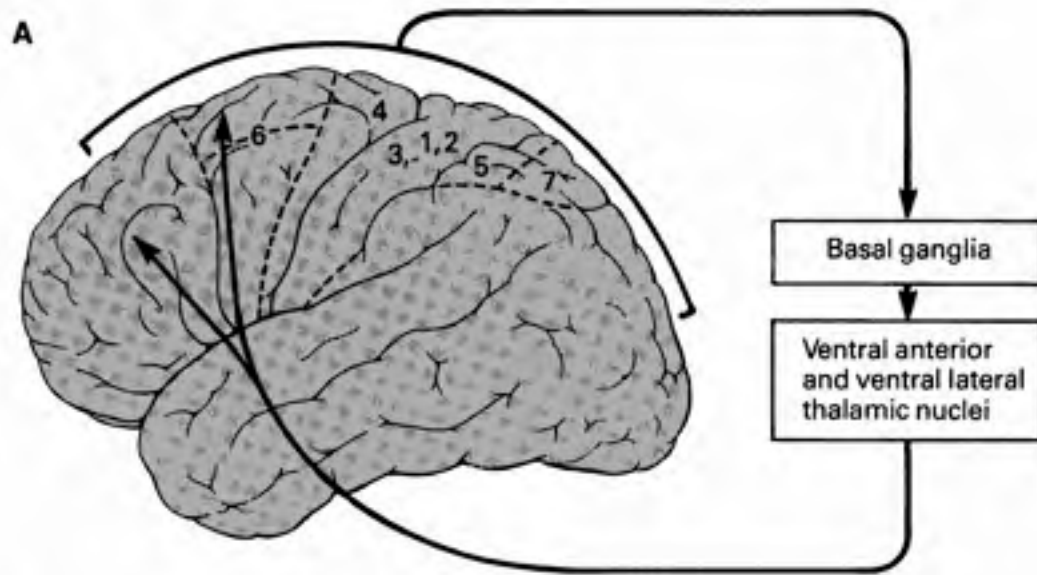
The cerebellum is believed to be the neural substrate critical to learning complex motor skills, e.g., riding a bike; professional musicians

Loss of cerebellar function does not produce paralysis or the inability to initiate a movement. Rather, cerebellar disease produces disturbances in the coordination and fine control of movements and posture.

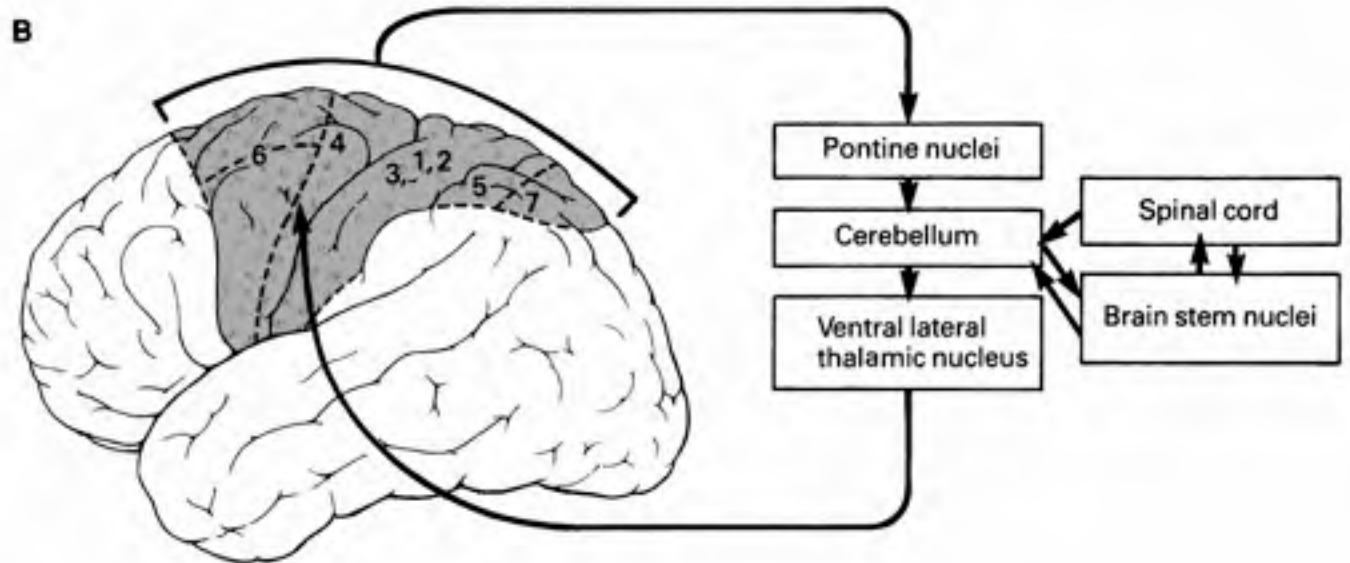


**Image
demonstrating
loss of
cerebellar
function
removed**

Basal ganglia



Cerebellum



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