medulla oblongata, pons, mesencephalon, cerebellum

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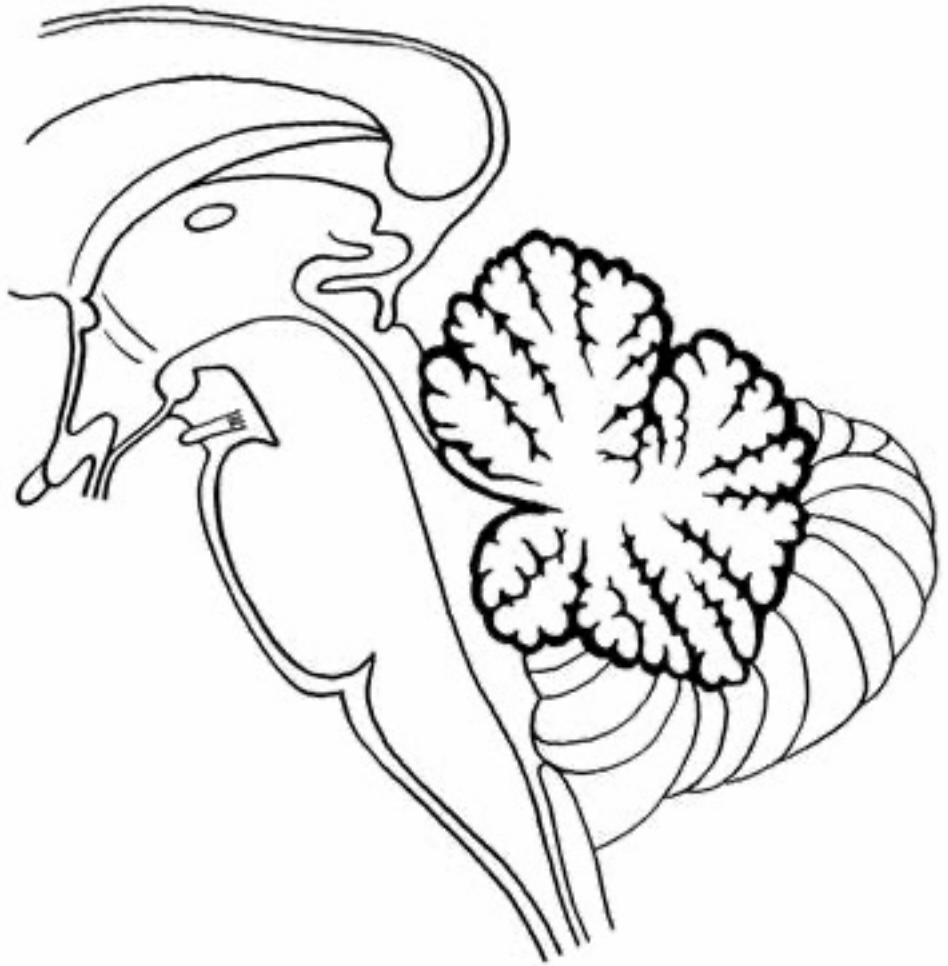
Images – Thieme Atlas of Anatomy, Gray‘s Anatomy, Základy Anatomie

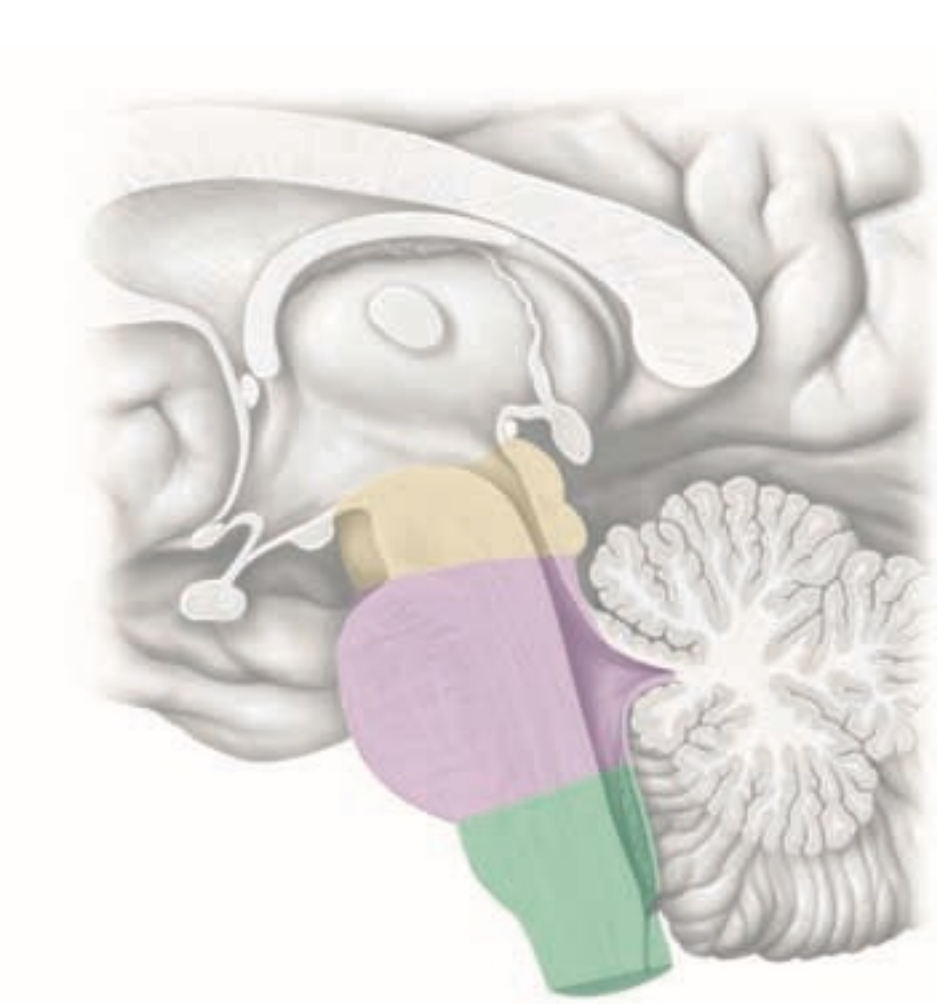
Brain stem

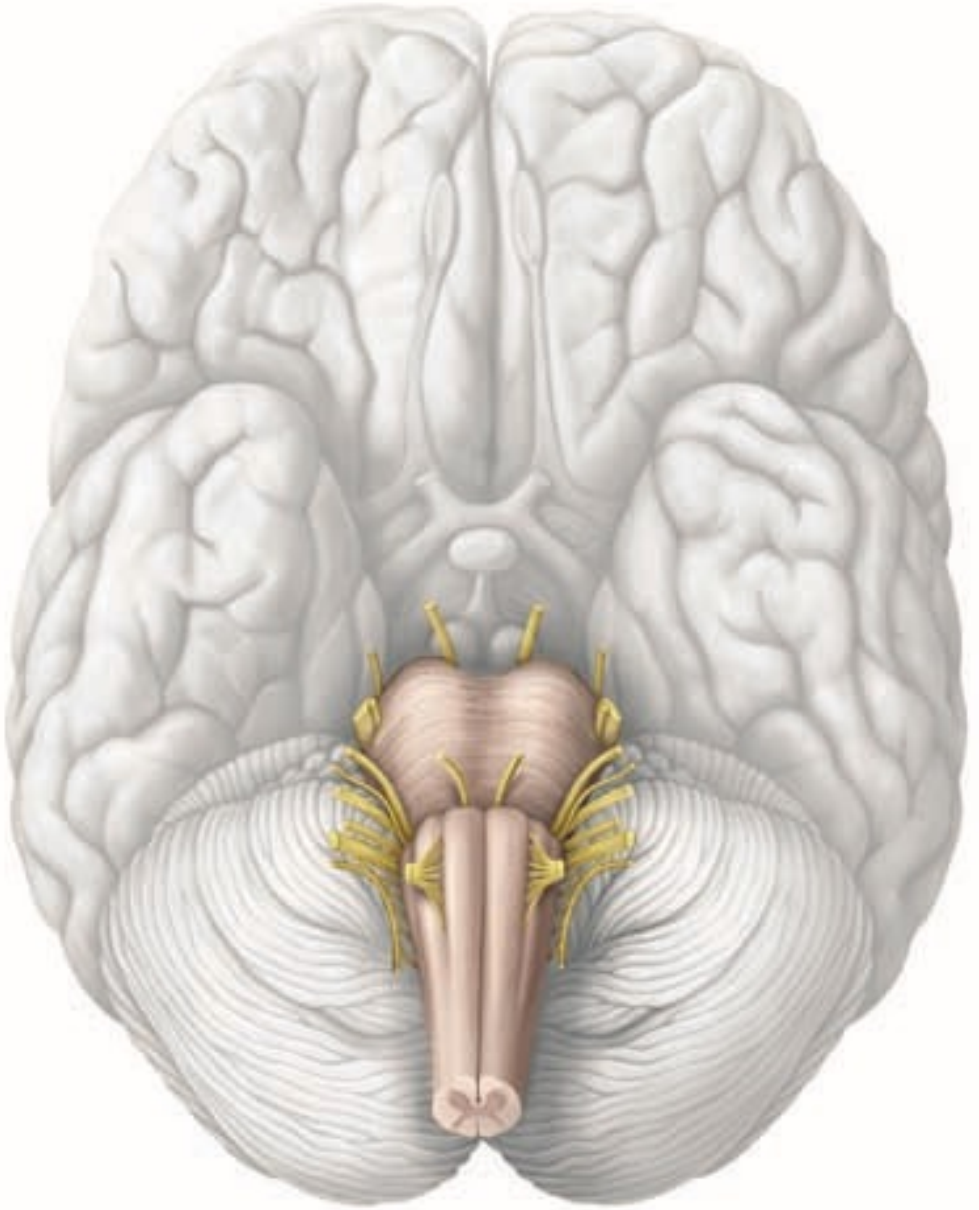
- **Medulla oblongata**
- **Pons Varoli**
- **Mesencefalon**
- ***continuation***
  - ***medulla spinalis, cerebellum a diencefalon***
- **Caudal edge**
- **Roots C1**
- **Decusatio pyramidum**
- **Rostral edge**
- **Crura mesencephali**
  - *(basis pedunculi cerebri)*
  - **tracts**

Grim M, Druga R, et al. Základy anatomie, Galén, Karolinum 2014

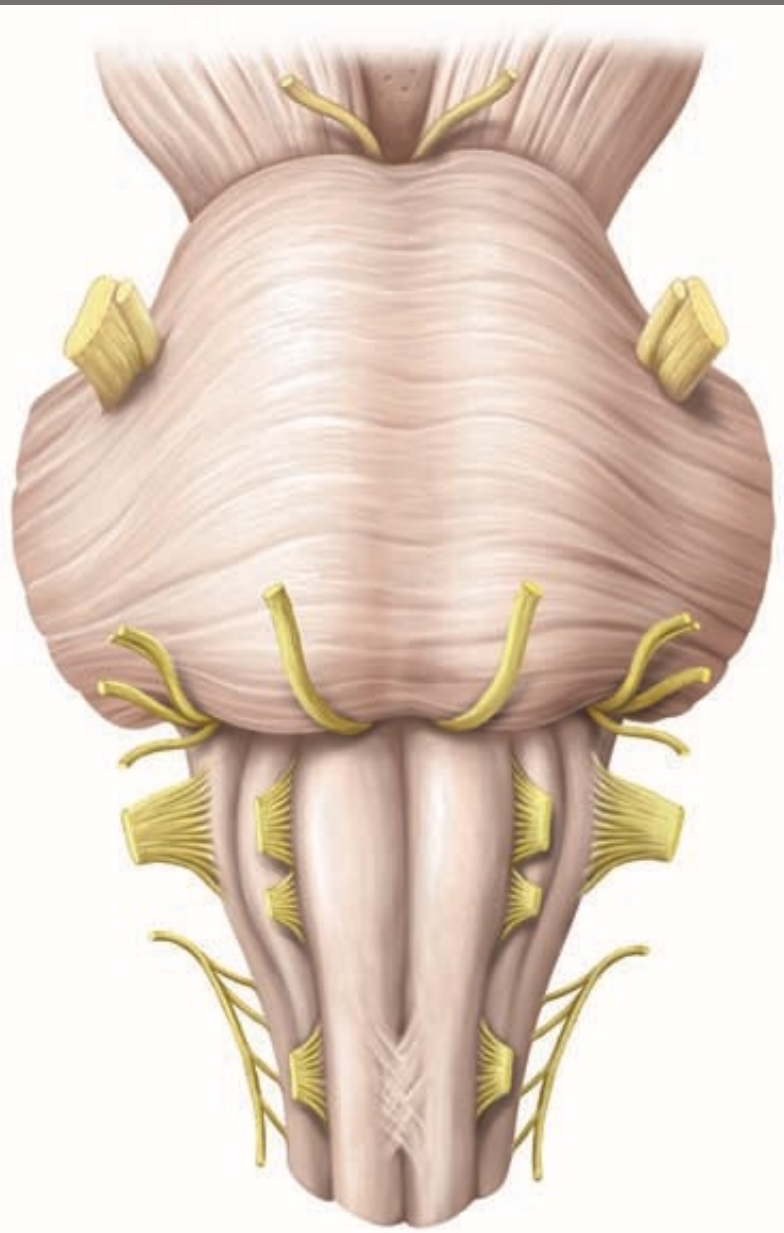


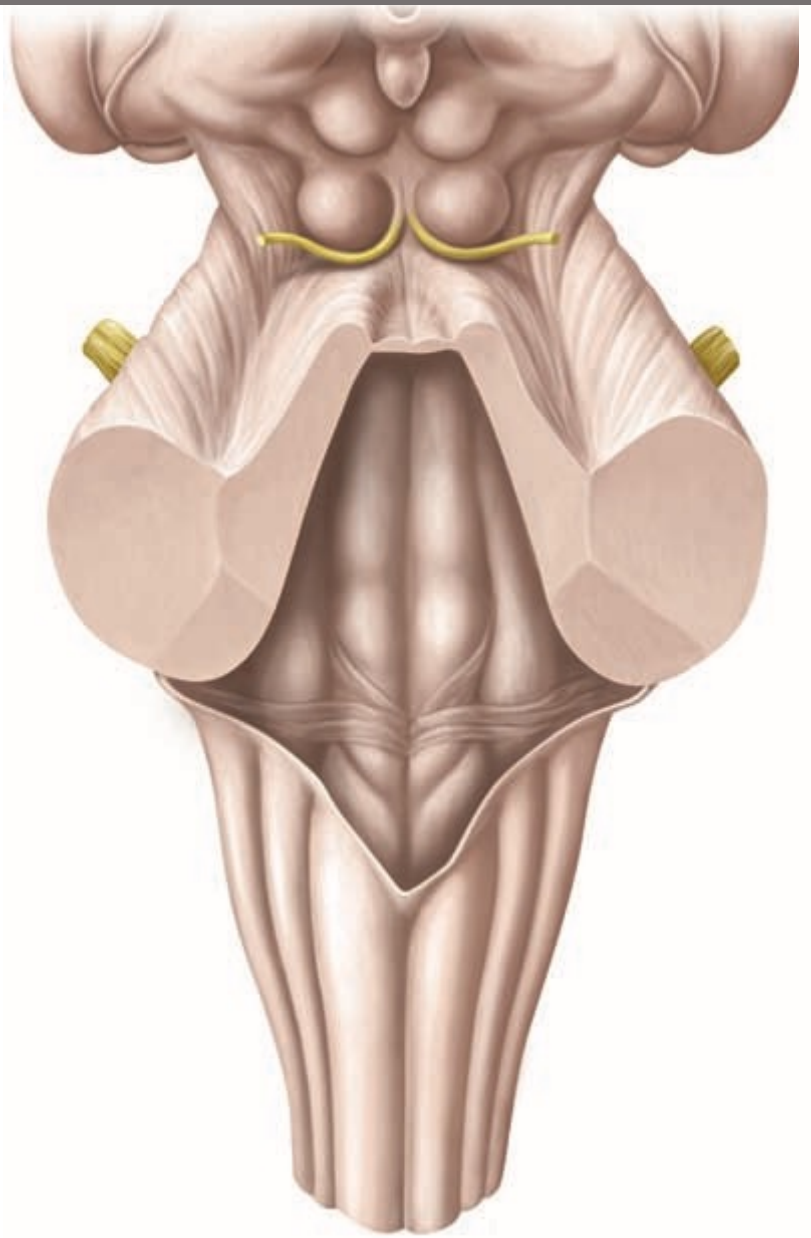
brain stem

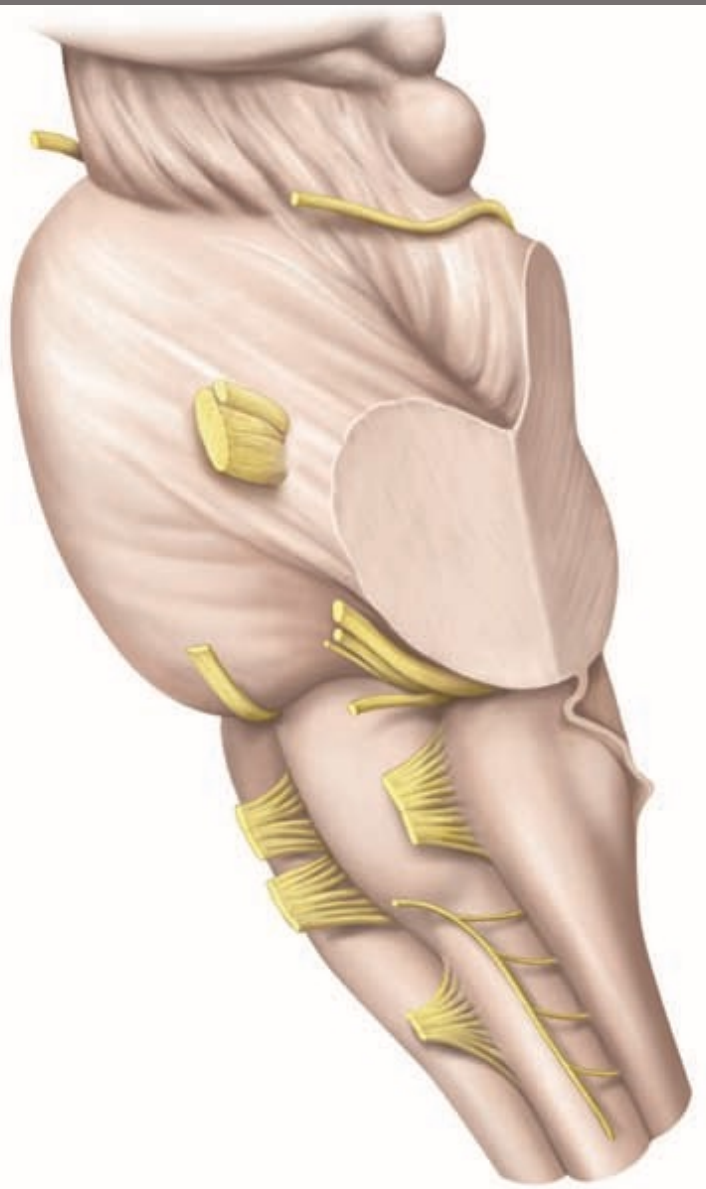




brain stem



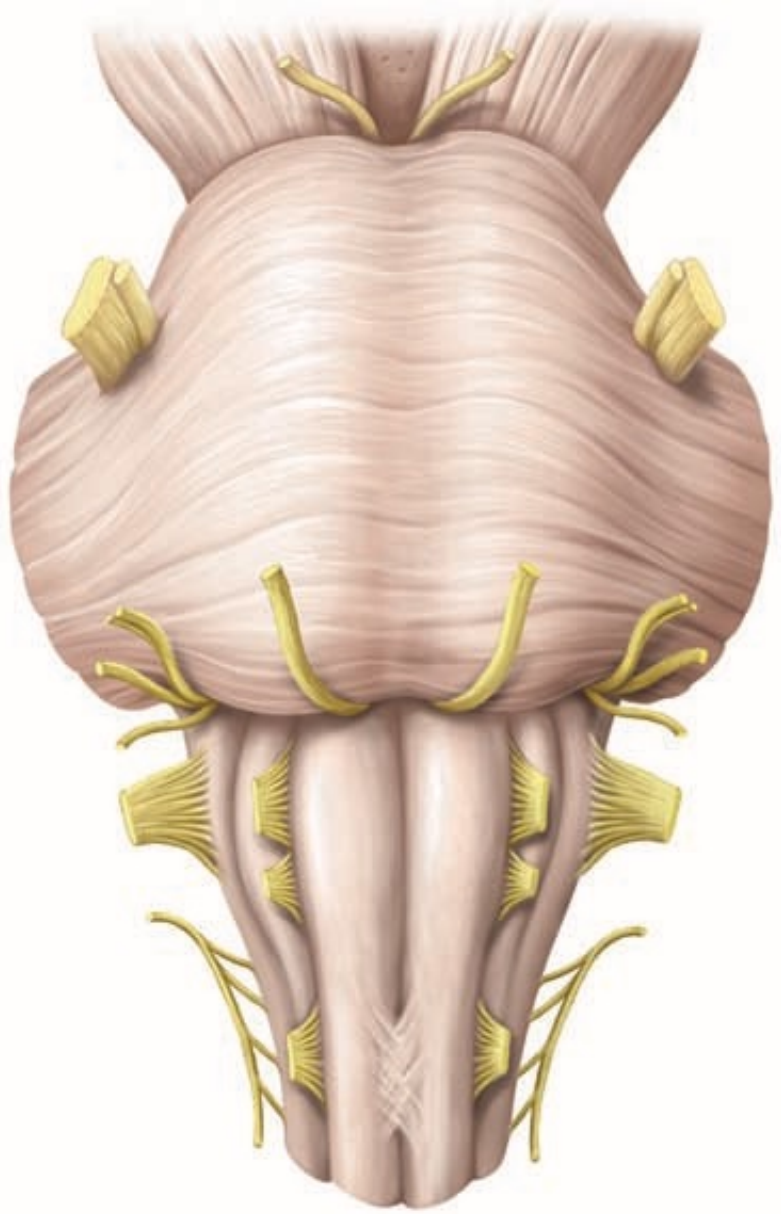




brain stem

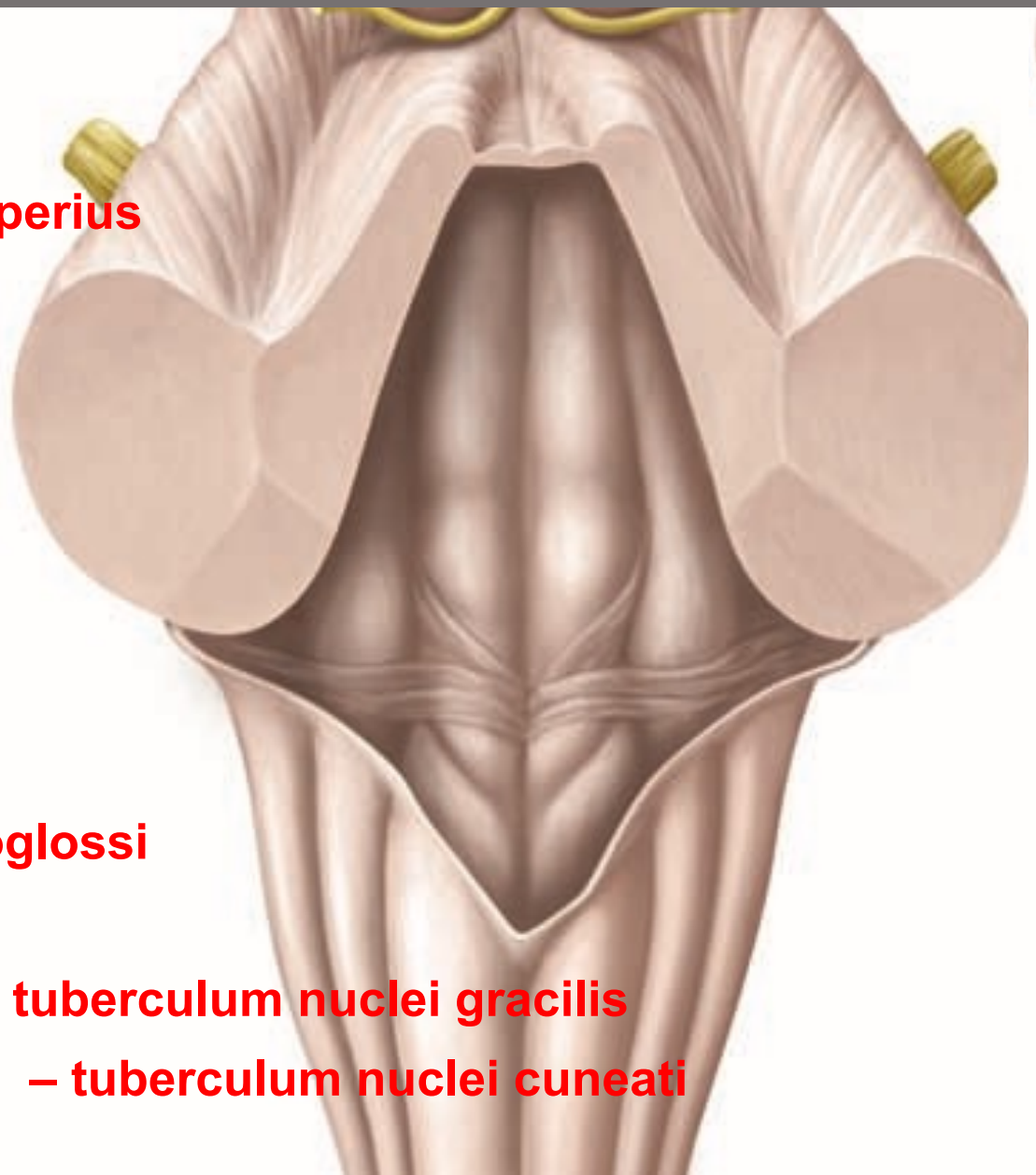
- Fissura mediana medullae
- Pyramis medullae oblongatae
- Decussatio pyramidum
- Oliva
- Pons Varolli
- Pedunculus cerebri
- Fossa interpeduncularis

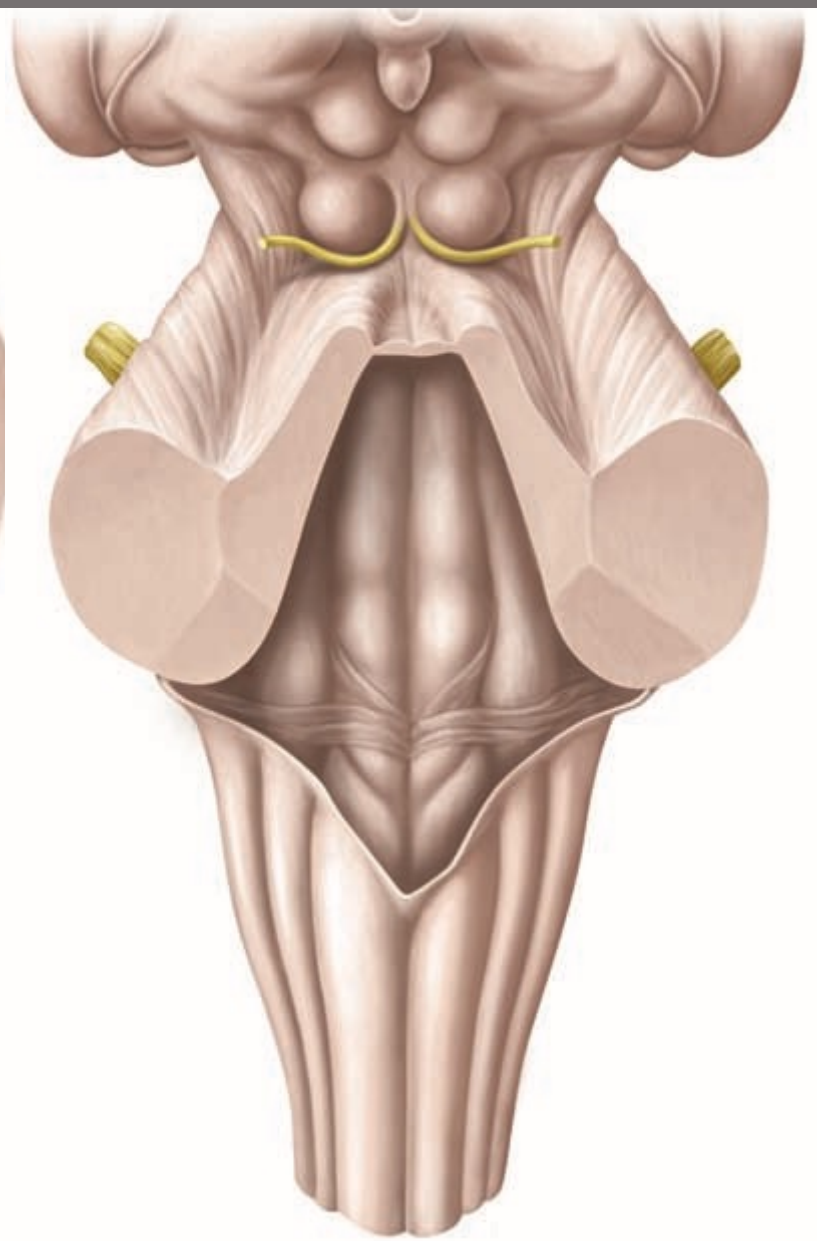
- Nervi craniales III. – XII.



Medulla oblongata

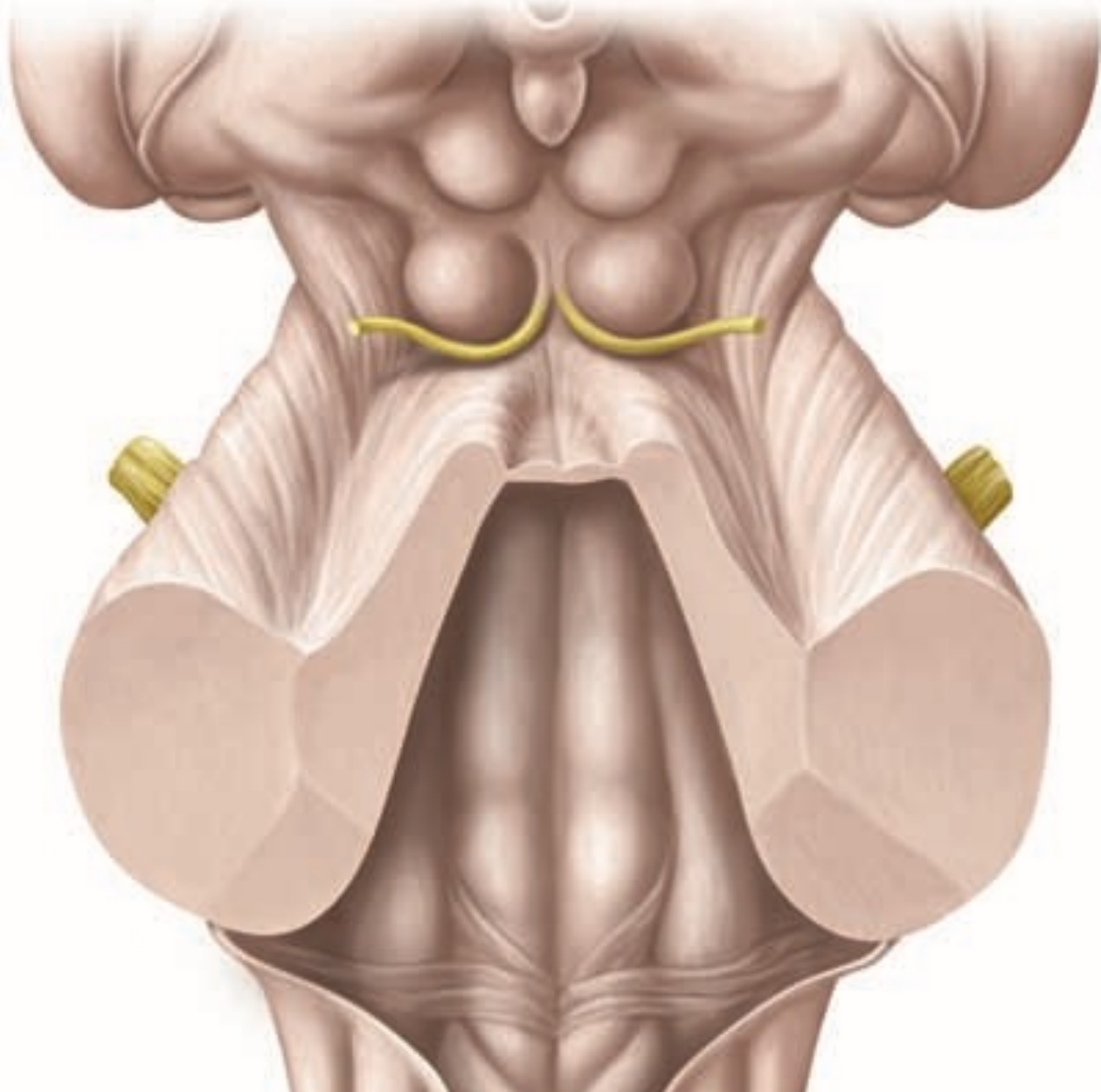
- Fossa rhomboidea
- Pedunculi cerebelli
- Vellum medullare superius
- Taenia cinerea
- Sulcus medianus
- Eminentia mediana
- Sulcus limitans
- Striae medullares
- Colliculus facialis
- Area vestibularis
- Trigonum nervi hypoglossi
- Trigonum nervi vagi
- Fasciculus gracilis – tuberculum nuclei gracilis
- Fasciculus cuneatus – tuberculum nuclei cuneati



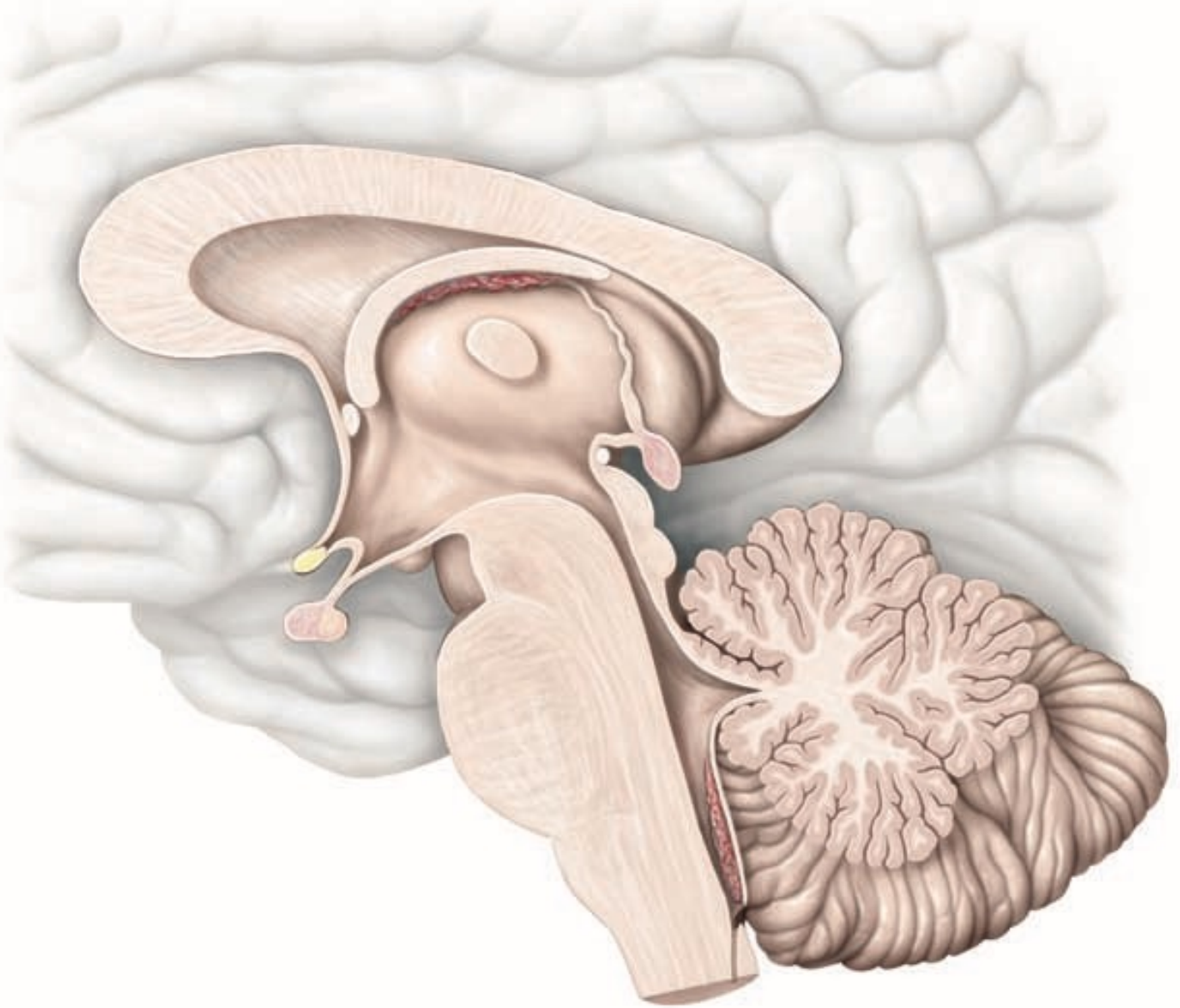


Pons Varoli et mesencefalon

- Pedunculus cerebelli inferior
- Pedunculus cerebelli medius
- Pedunculus cerebelli inferior
- Vellum medullare superius
- Frenulum velli
- Lamina qudrigeminalis (tectum mesencephali)
- Colliculus inferior
- Brachium colliculi inferioris
- Colliculus superior
- Brachium colliculi inferioris
- Nervus trochlearis (N. IV)

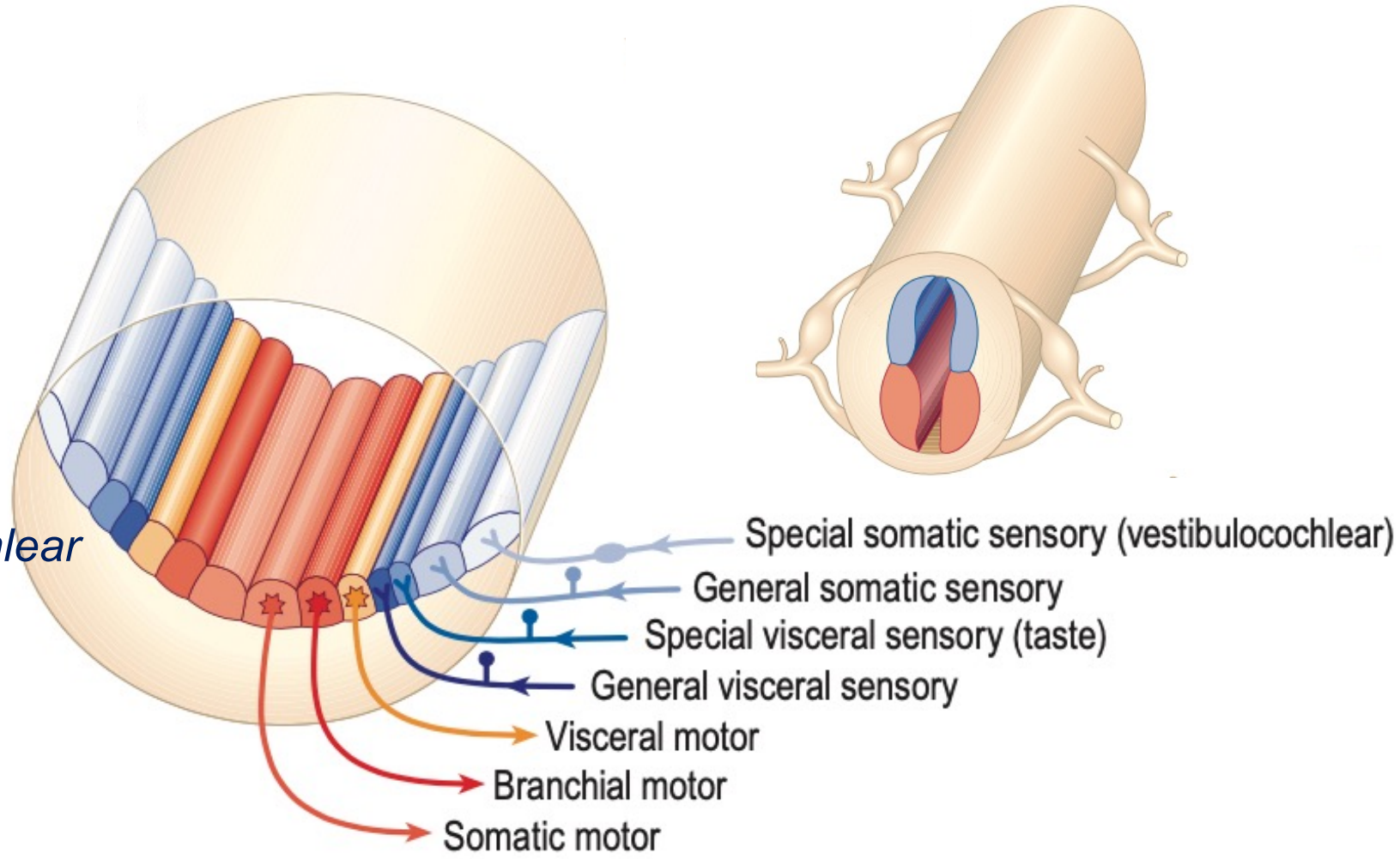


brain stem



Neural tube

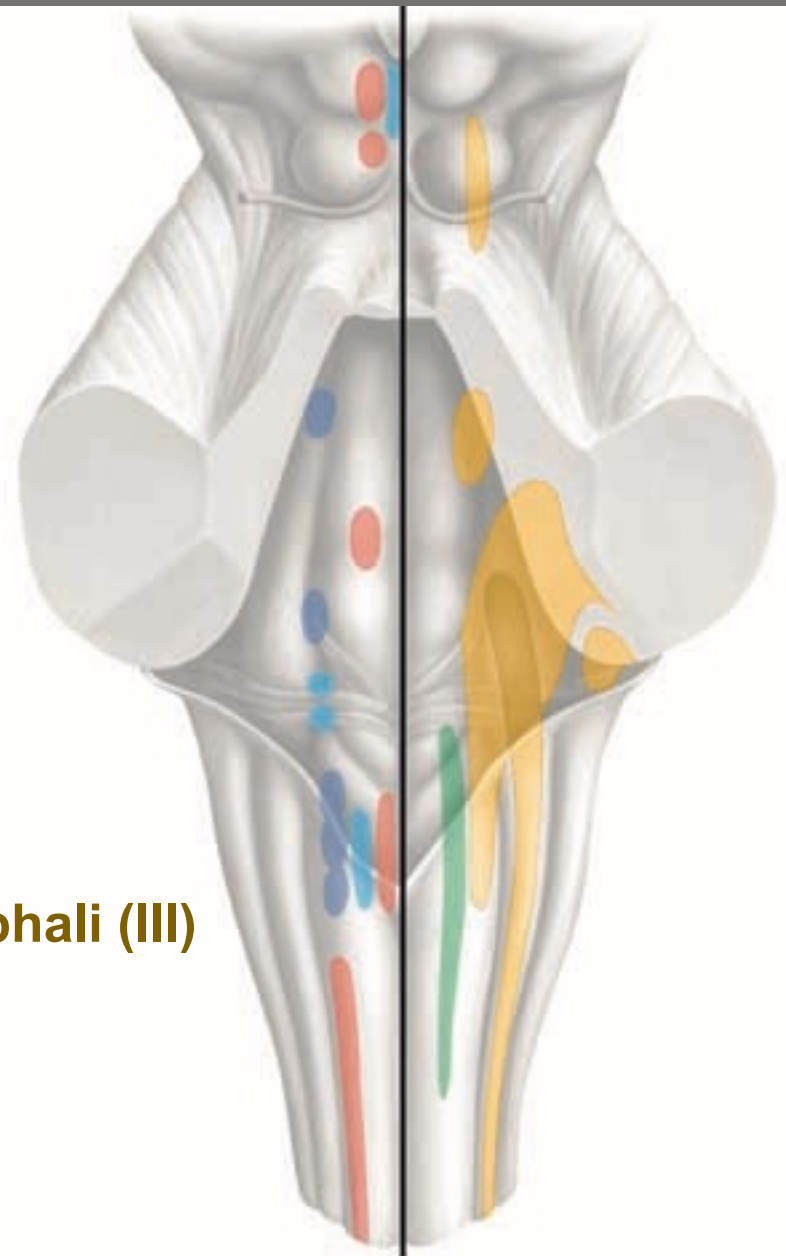
- **Basal plate**
  - *somatomotor*
  - *Branchial motor*
  - *Visceromotor*
- **Alar plate**
  - *viscerosensoric*
  - *taste*
  - *somatosensoric*
  - *special senses - vestibulocohlear*



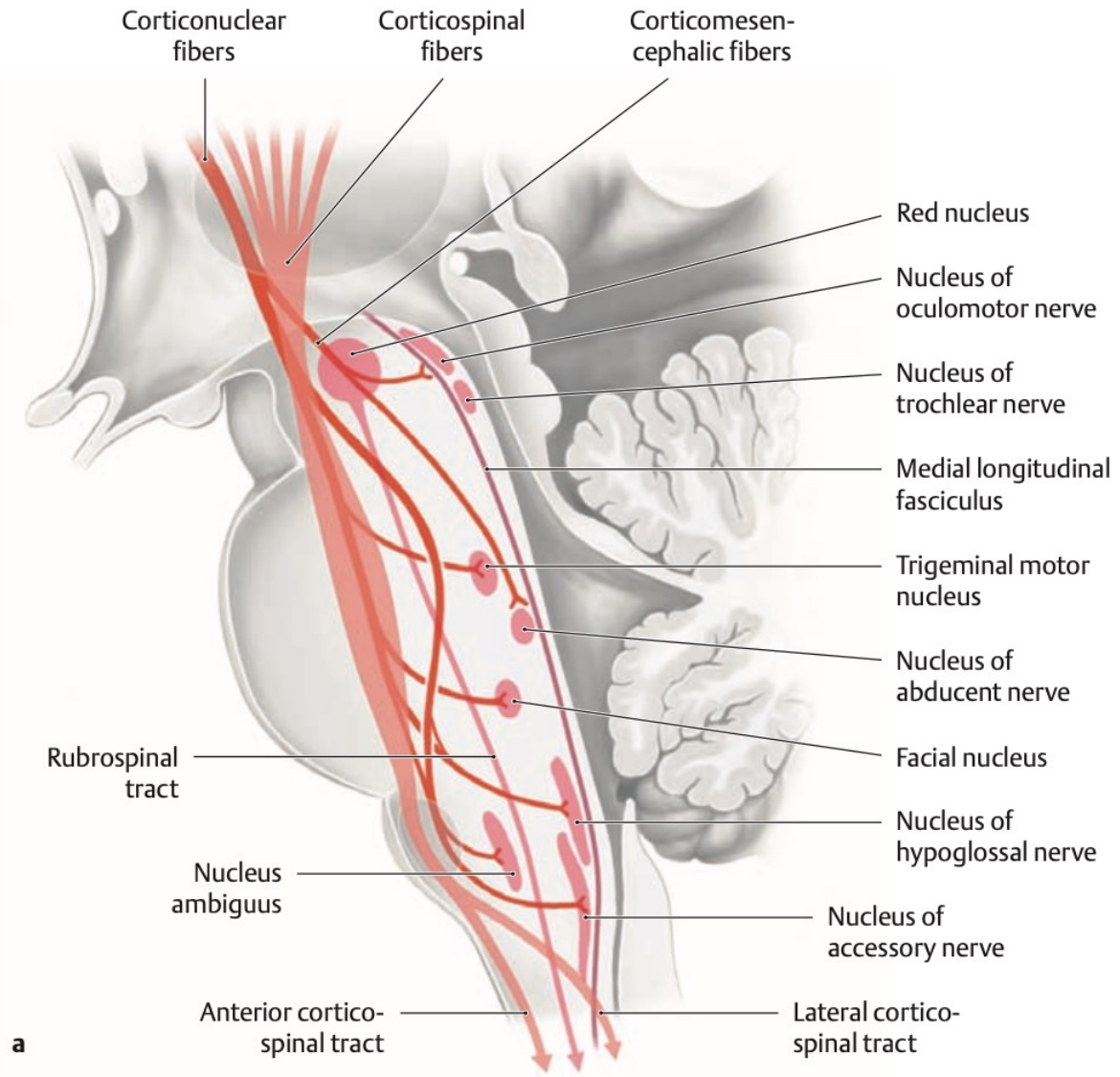
Strandring S et al.: Gray's Anatomy, 42th ed. Elsevier 2020

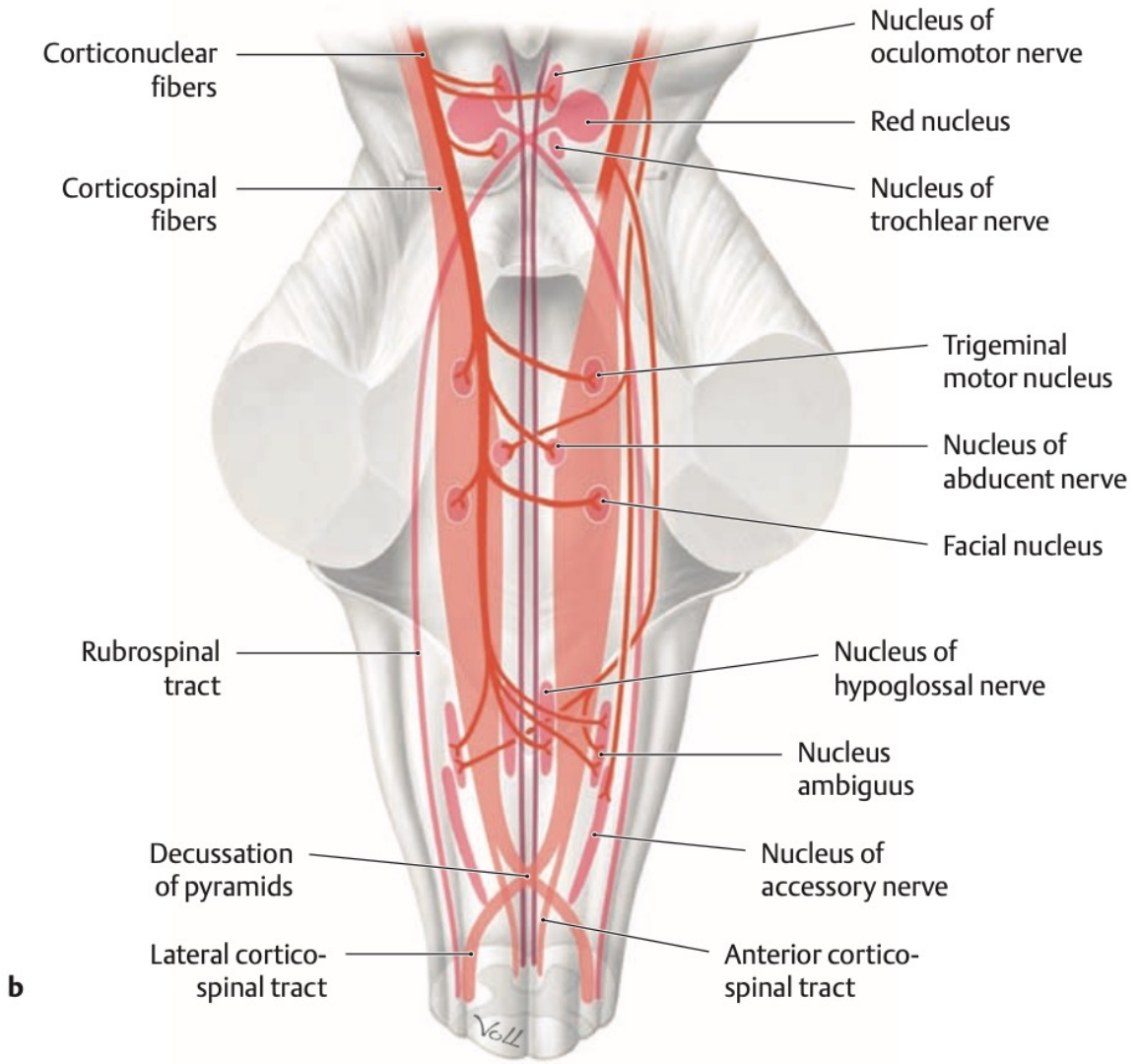
Motor nuclei

- *somites*
- **Nc. n. oculomotorii (III)**
- **Nc. n. trochlearis (IV)**
- **Nc. n. abducentis (VI)**
- **Nc. n. hypoglossi (XII)**
- **Nc. n. accesorii (XI)**
  - *branchial*
- **Nc. n. trigemini motorius**
- **Nc. n. facialis**
- **Nc. ambiguus (IX. + X.)**
  - *visceromotor*
- **Nc. n. oculomotrii accesorius (visceralis) Edingeri-Westphali (III)**
- **Nc. salivatorius superior (VII)**
- **Nc. salivatorius inferior (medulale oblongatae – IX, X)**
- **Nc. n. vagi dorsalis**



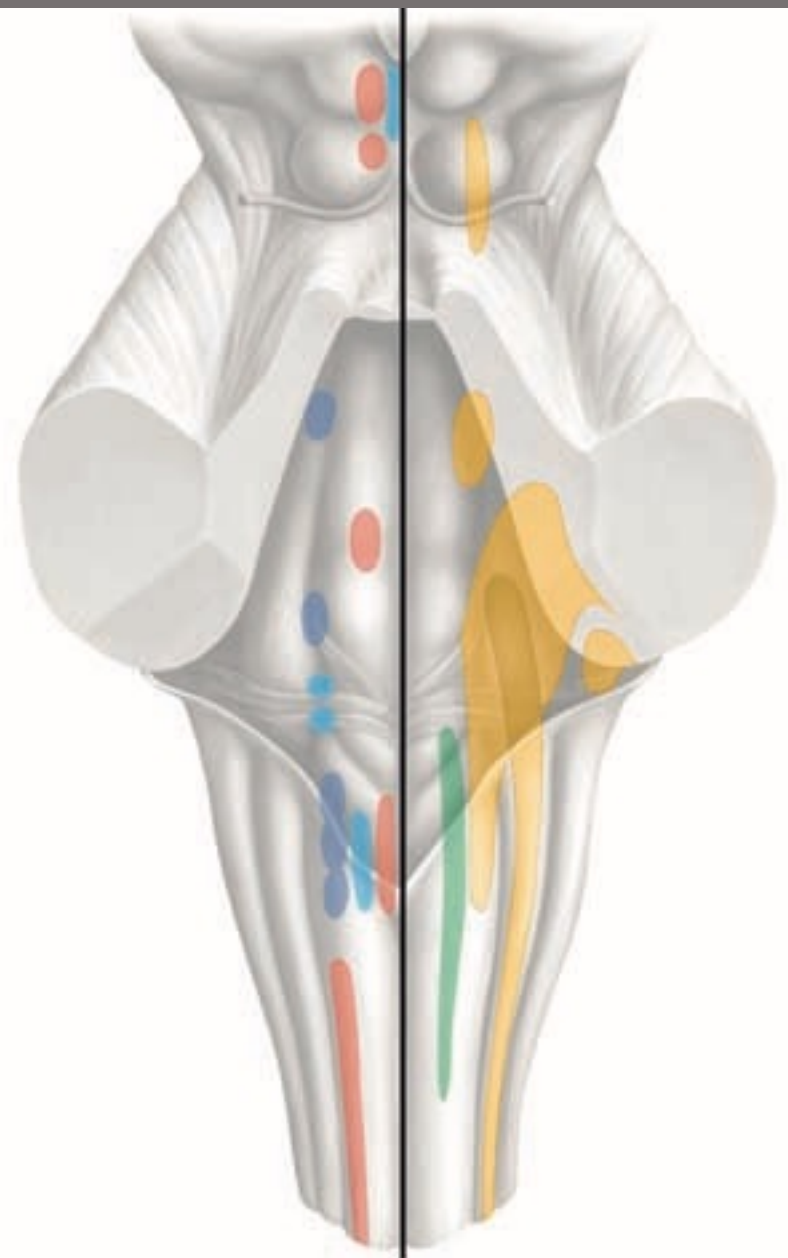
Descendent connections



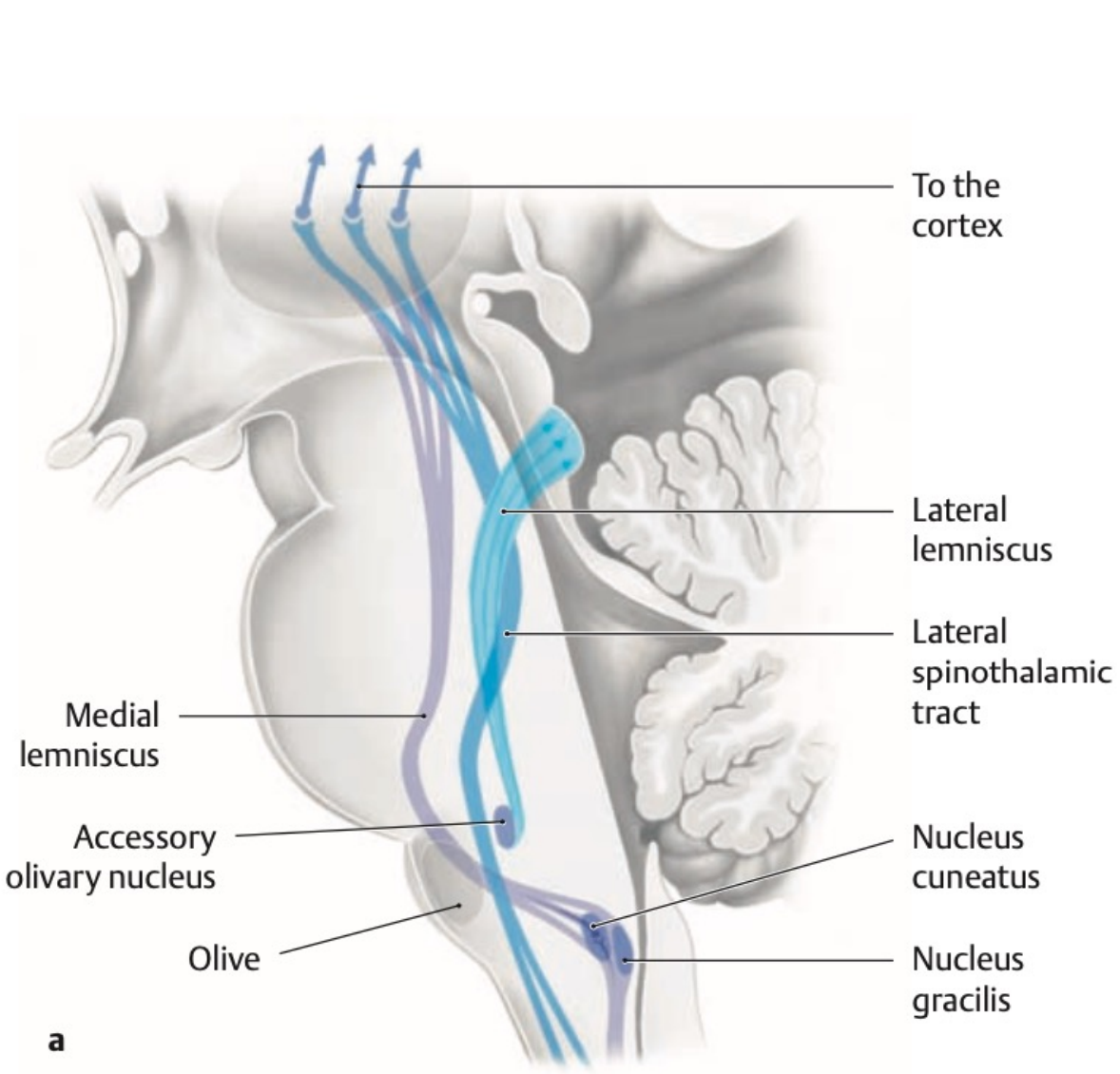


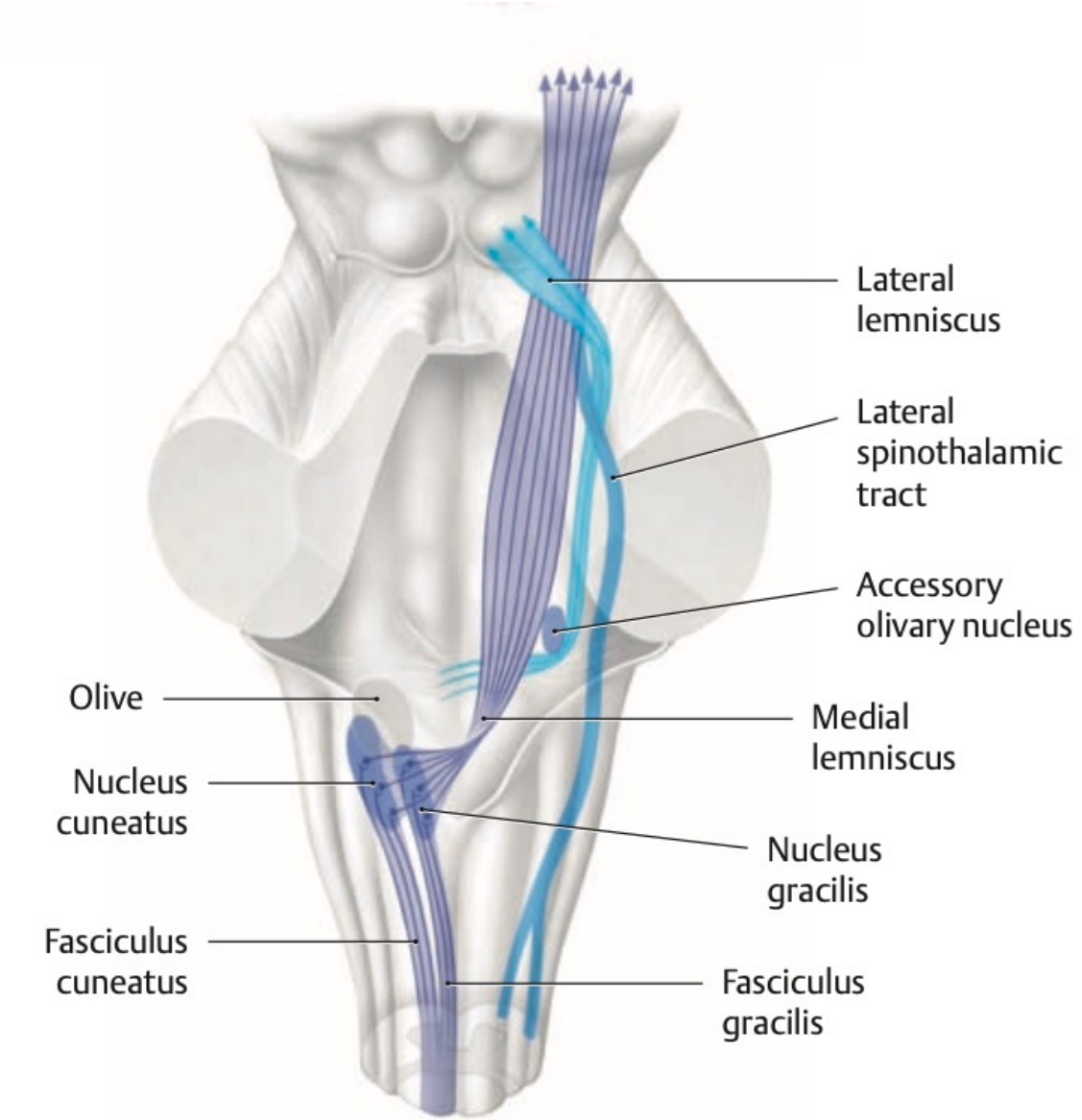
Sensoric nuclei

- **Nc. nervi trigemini mesencephali**
  - *Proprioception mastication muscles*
- **Nc. nervi trigemini pontinus (prinicipalis)**
  - *Tactile disctimination*
- **Nc. nervi trigemini spinalis**
  - *Pain, heat, cold, nociception*
- **Ncc. vestibulares**
  - *Cranialis – Bechterev*
  - *Lateralis - Deiters*
  - *Medialis – Schwalbe*
  - *Caudalis (spinalis) – Rollei*
- **Ncc. cochleares – anterior et posterior**
- **Nc. tractus solitarii (solitarius seu gustatorius)**
  - **taste VII, IX a X**
  - **Viscerosenistive nukleus IX + X**

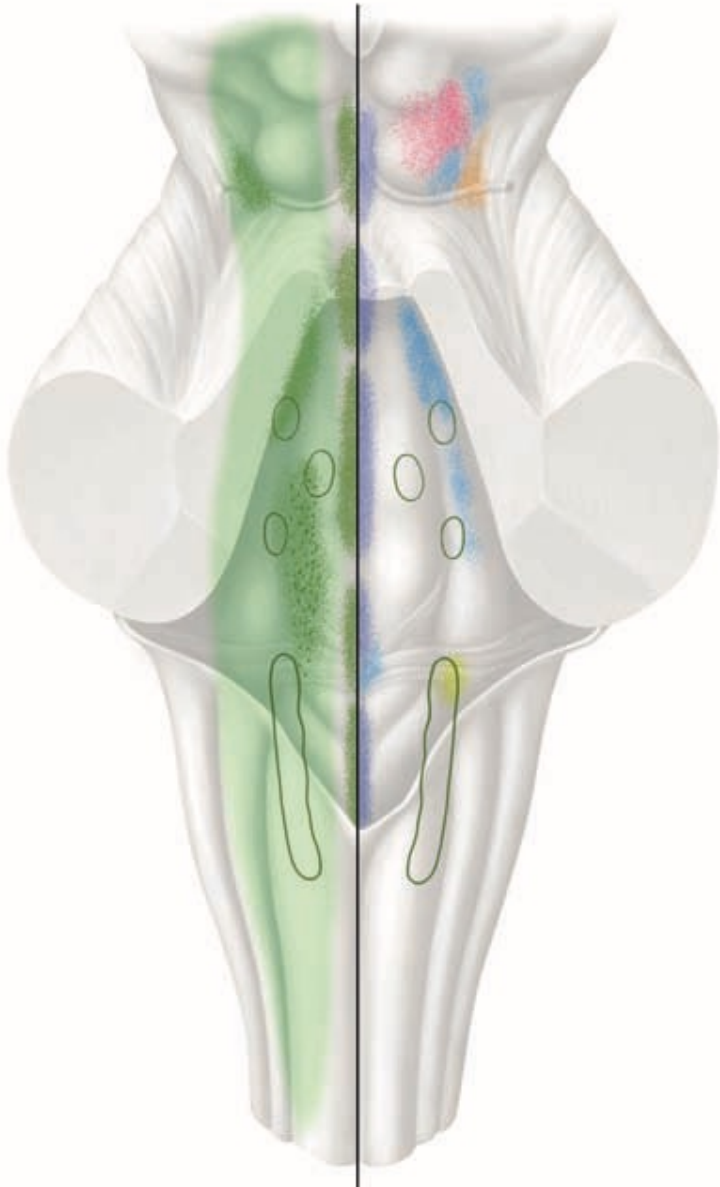


Ascendent connections





Formatio reticularis – reticular formation

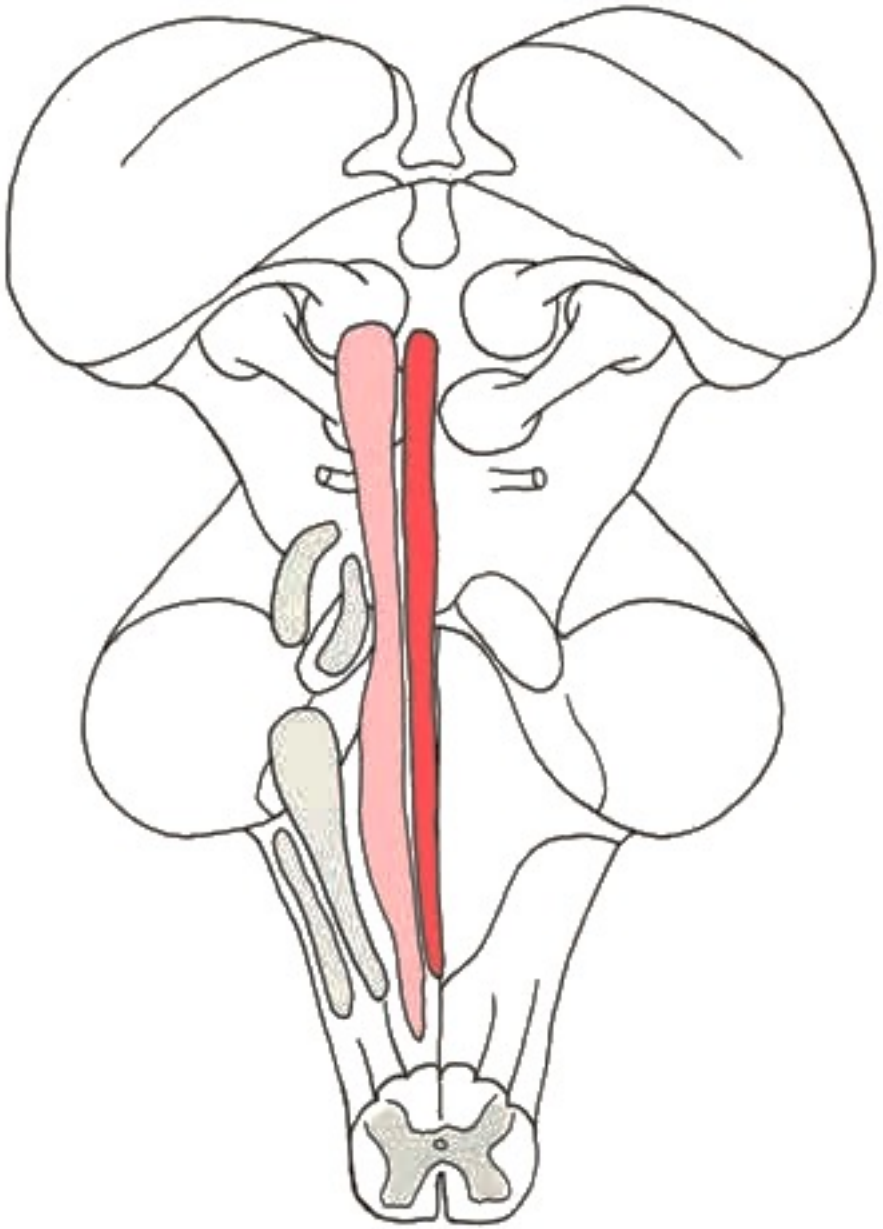


Formatio reticularis

Archaic systém in depth of brainstem

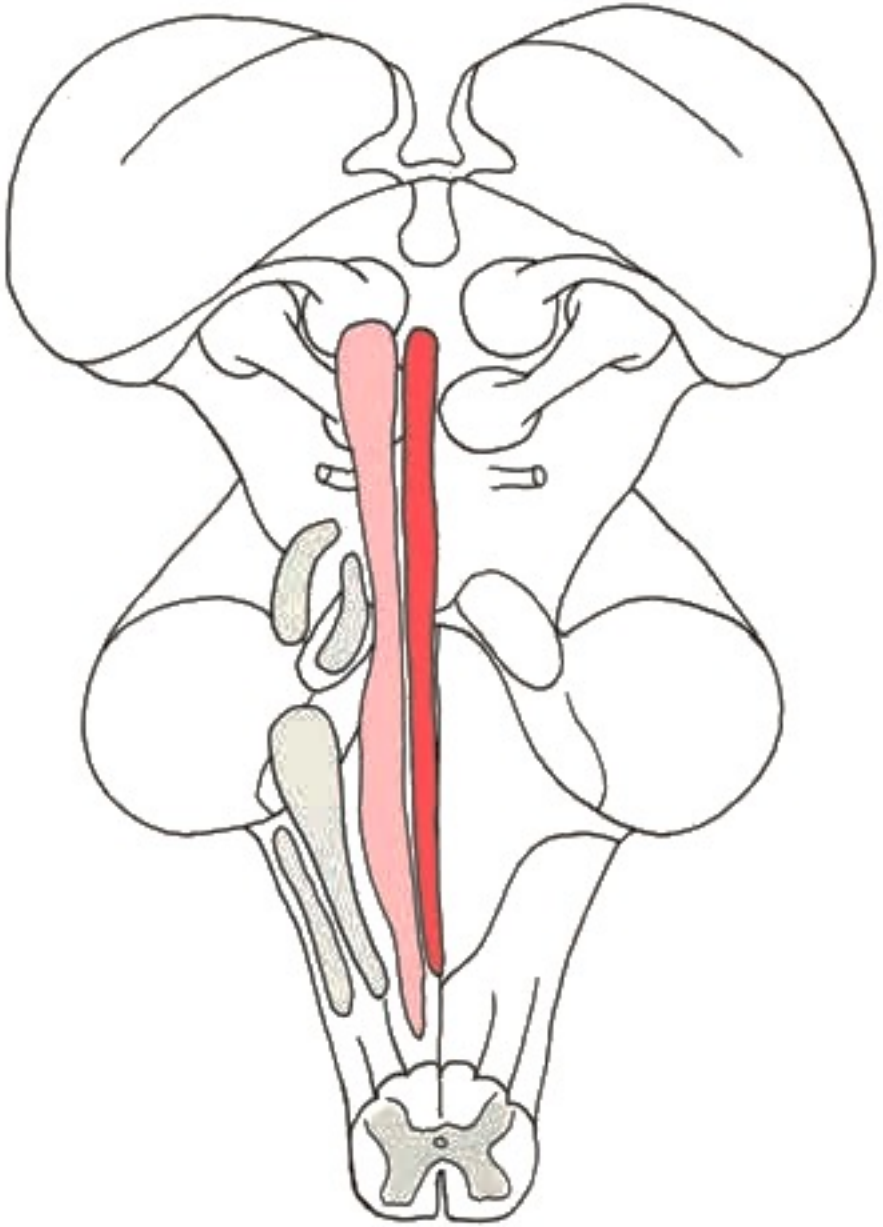
Three linear arrangements

- **Rapheal system**
  - *Unpired nucli*
  - *Serotonin*
  - *Polymorphous function*
- **Medial system**
  - *The largest*
  - *Large bodies*
  - *Long longitudinal connections*
- **Latral system**
  - *Medulla oblongata and pons Varoli*
  - *Small bodies*
  - *Short fibers ending in medial system*
- **Cerebellar system**
- **Monoaminegic system**
- **Cholinergnic system**



Formatio reticularis

- **function**
- **Reflex center betwen cranial nerves nuclei**
  - **Defensive reflexes - klinking, coughing, vomiting**
  - **Food intake reflexes - swallowing, sucking, salivation**
  - **Reflex oculocrdial**
- **Facilitation nad inhibition**
  - **Nc. pedunculopontinus**
  - *Postural function in stimmulation*
  - **Nc. cuneiformis**
  - *Decrease of postural muscles tonus*
  - **Relation to basal ganglia and substantia nigra**
- **Interconnection of pain**
- **Thalamus and cortex activation**
- **Centres of life functions**



Formatio reticularis

Life functions

Breathing centre

Instpiration an d exspirtation

Bottom of fossa rhomboidea

Pneumotactic centre

Center of higher order

Response to concetration of O_2 and CO_2 in blood

chemoreceptors glomus caroticum and IV. ventricle organ

Pressure and temperature of blood

Center of hrart frequency regulation

By nc. dorsalis n. vagi

Two parts – for acceleration and deceleration

Preganglionic fibers of autonomous nerves

Vazomotor centre

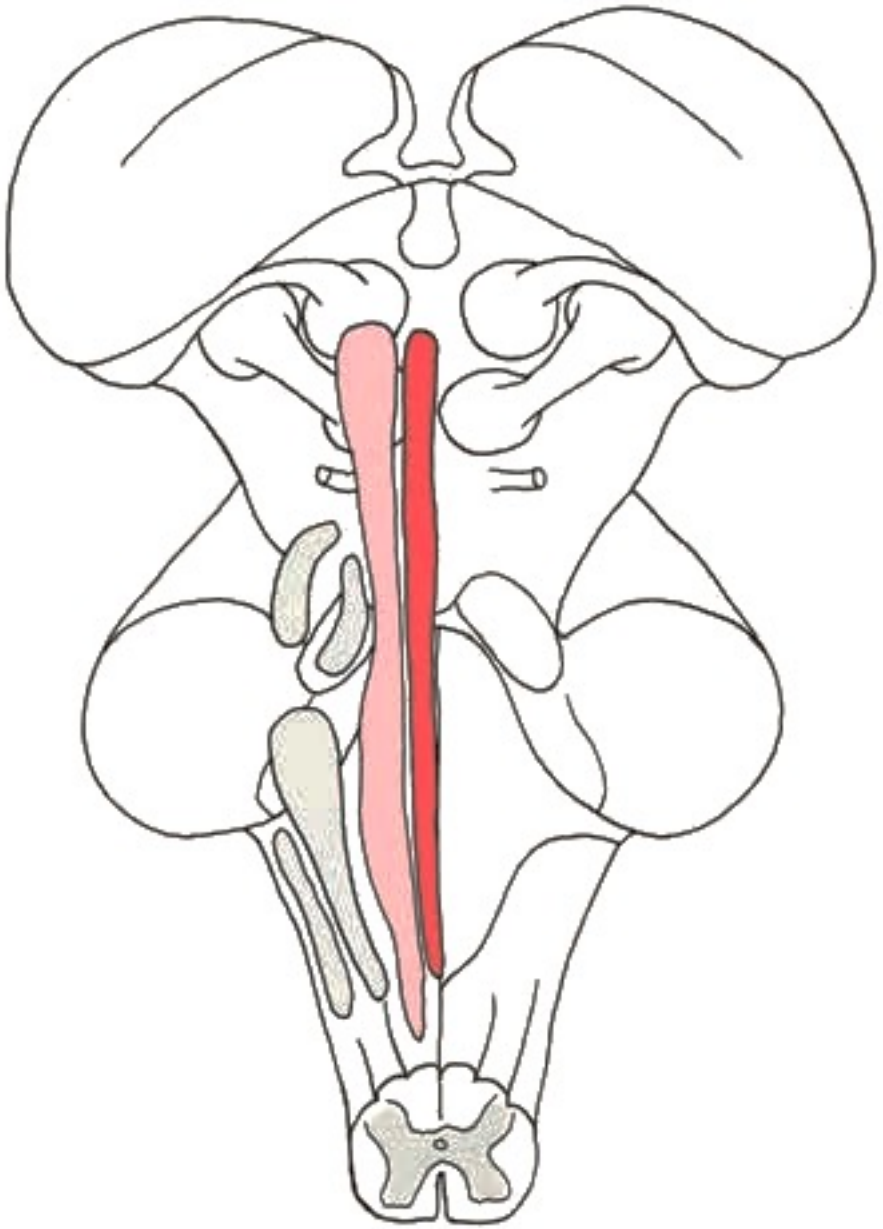
below trigonum n. vagi

Lumen od arterioles and precapillaria

Vomiting centre

Bilaterally connected to nc. dorsalis nervi vagi and nc. solitarius

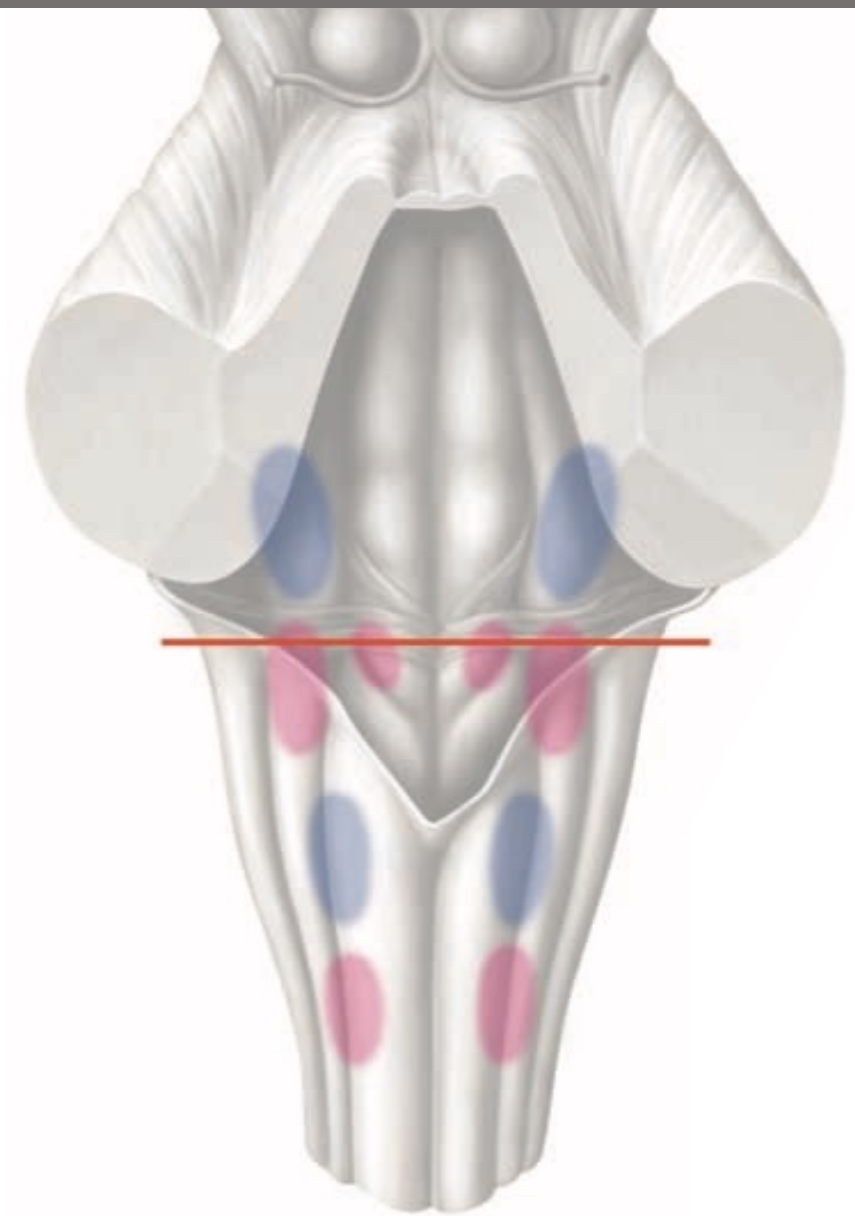
Reaction to pressure in IV. ventricle and intracranial pressure



Formatio reticularis

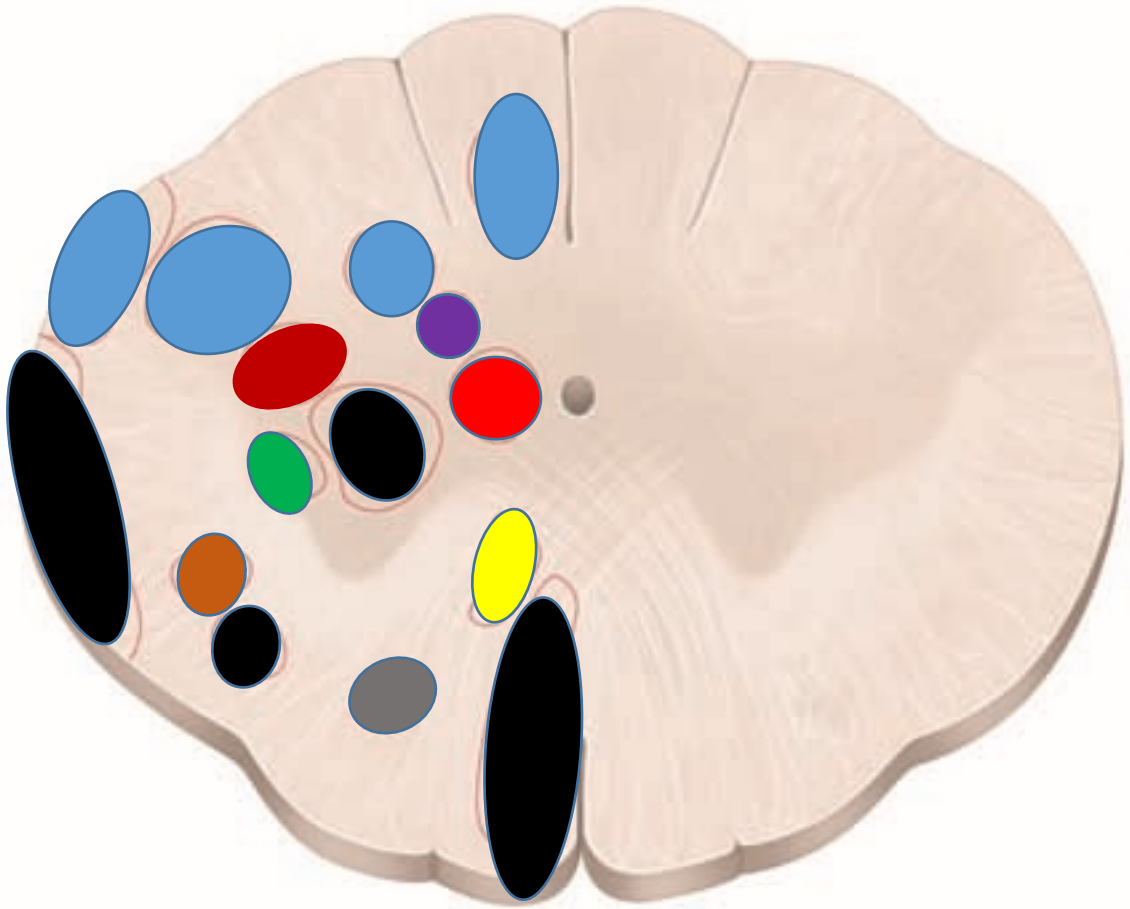
- inspirium
- Expirium

- Sleep apnoe



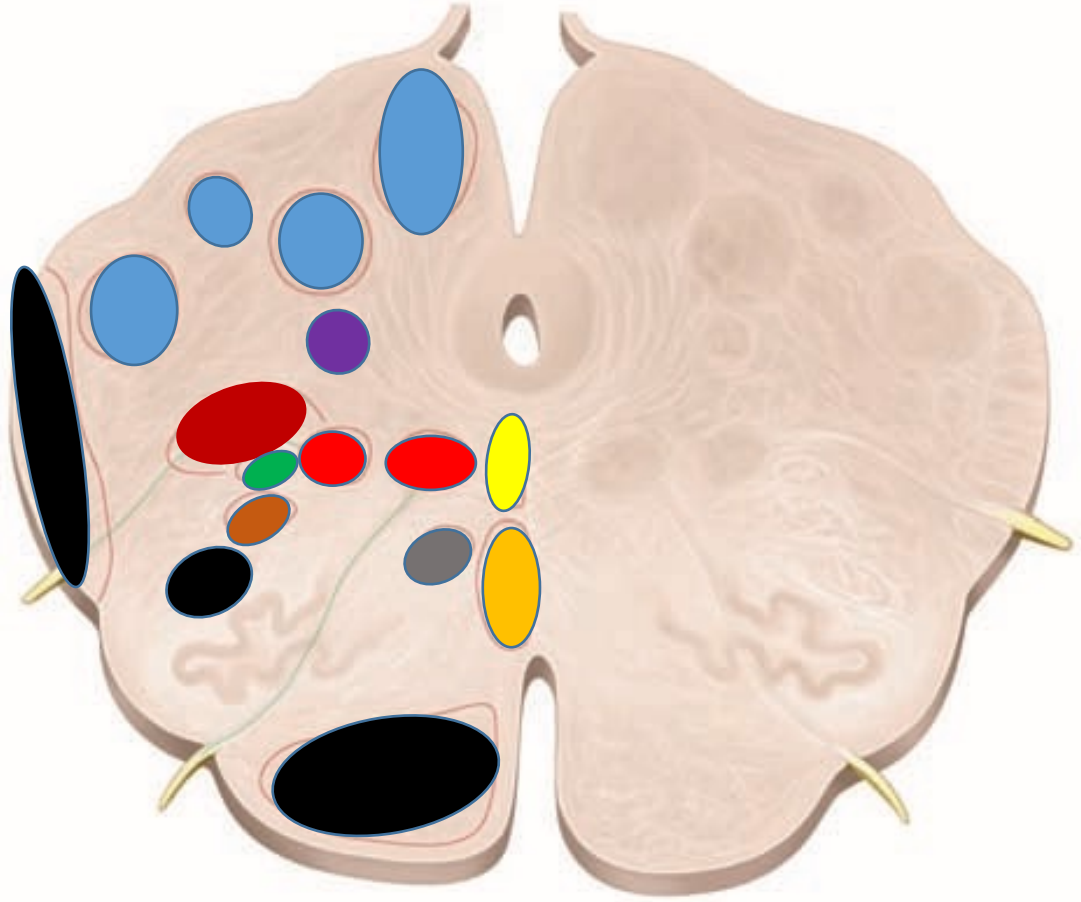
Medulla oblongata

- Nc. nervi accesorii
- Nc. nervi trigemini spinalis
- Substantia gelatinosa
- Nc. cuneatus
- Nc. gracilis
- Formatio reticularis
- Tractus solitarius
- Tractus pyramidalis lateralis
- Tractus pyramidalis anterior
- Tractus tectospinalis
- Tractus spinocerebellaris posterior
- Tractus rubrospinalis
- Tractus spinothalamicus lateralis
- Tractus sympathicus centralis
- Fasciculus longitudinalis mediqlis



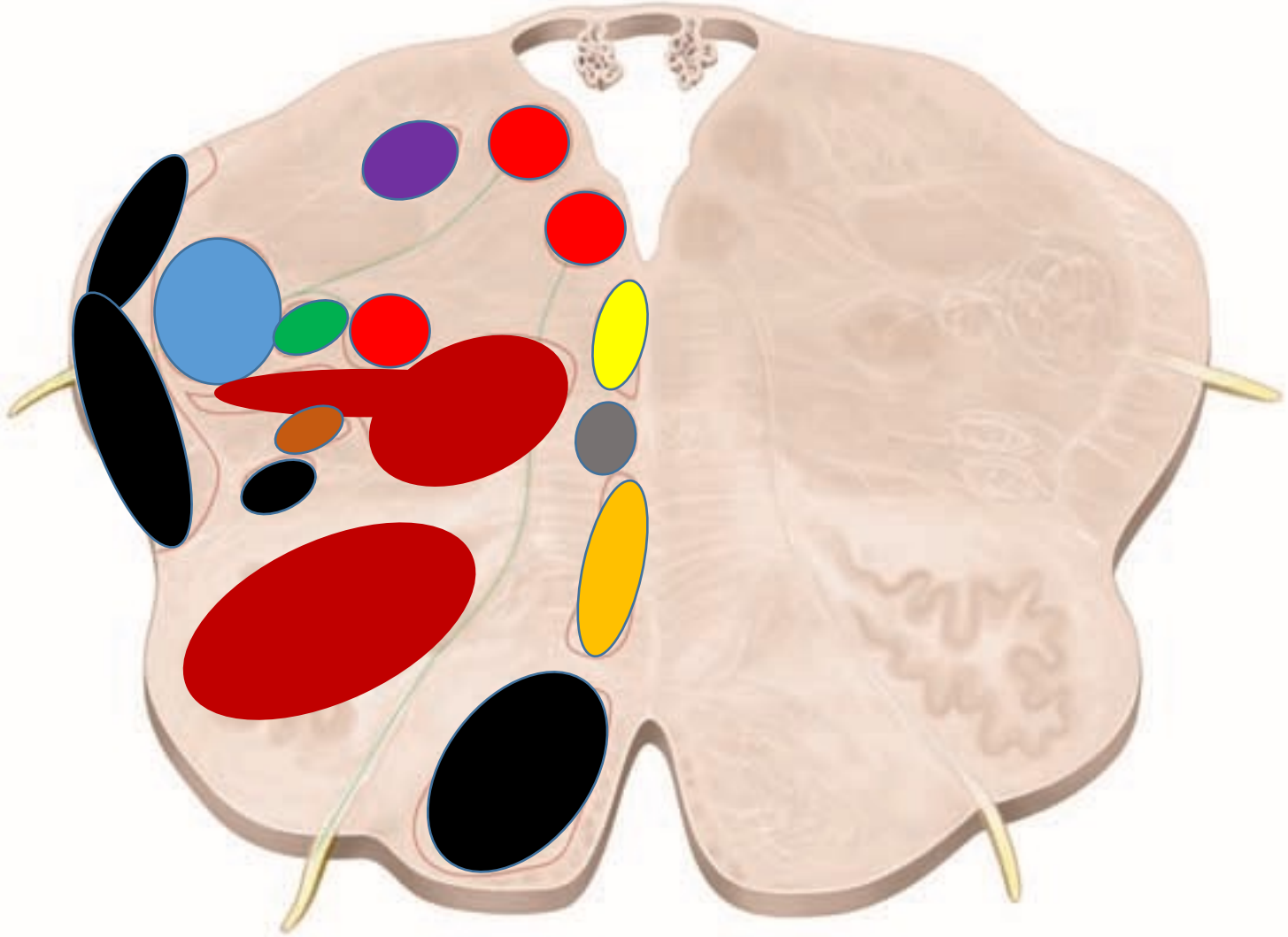
Medulla oblongata

- Nc. nervi accesorii
- Nc. nervi hypoglossi
- Nc. nervi trigemini spinalis
  - Nc. cuneatus accesorius
- Nc. cuneatus
- Nc. gracilis
- Nc. olivarius inferior
- Formatio reticularis
- Tractus solitarius
- Tractus pyramidalis lateralis
- Lemniscus medialis
- Tractus tectospinalis
- Tractus spinocerebellaris posterior
- Tractus rubrospinalis
- Tractus spinothalamicus lateralis
- Tractus sympathicus centralis , Fasciculus longitudinalis mediqlis



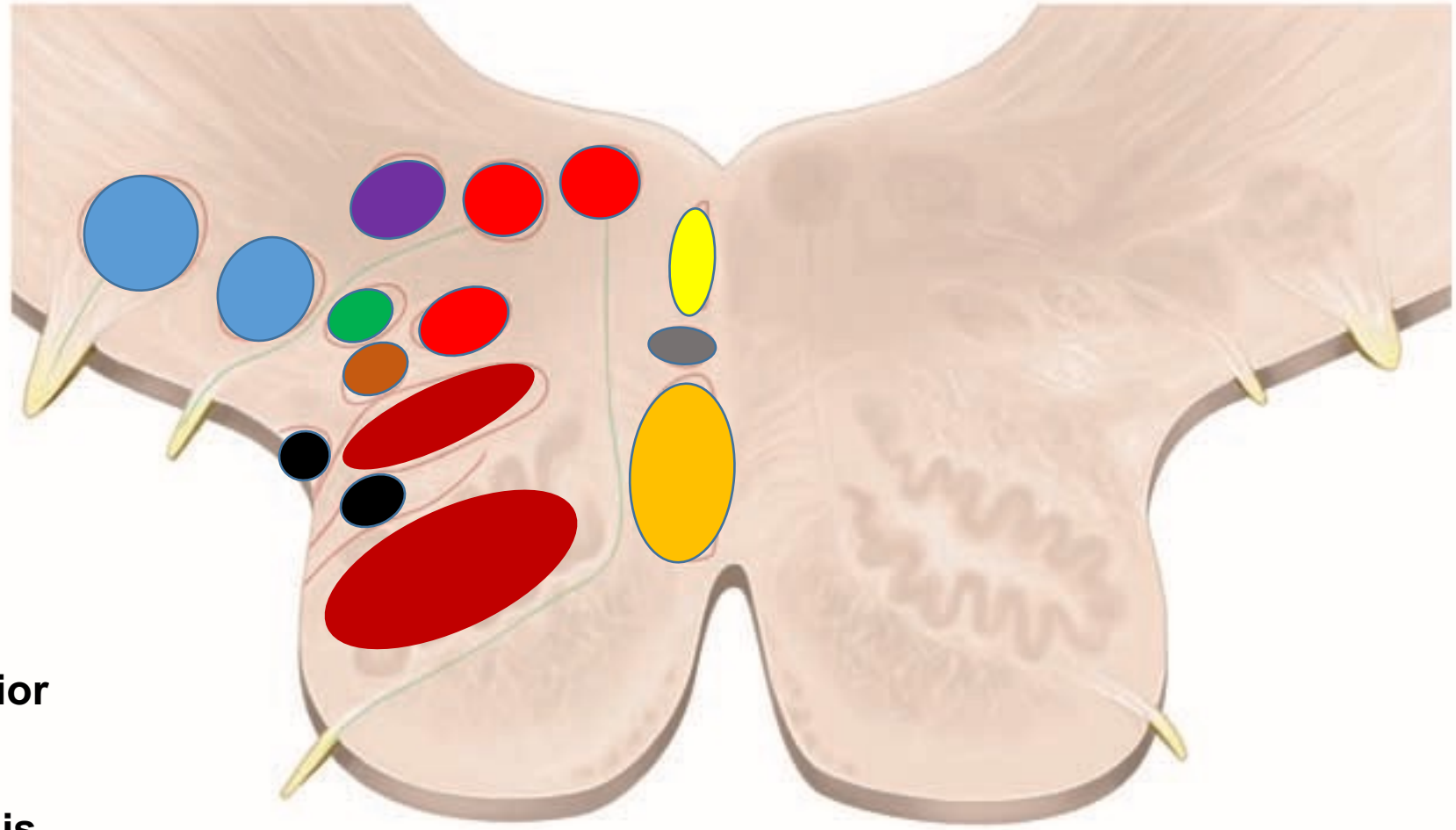
Medulla oblongata

- Vellum medullare inferius + plexus choroideus
- Nucleus nervi hypoglossi
- Nucleus nervi vagi dorsalis
- Nc. ambiguus
- Nc. nervi trigemini spinalis
- Nucleus olivarius inferior
- Formatio reticularis
- Tractus solitarius
- Tractus tectospinalis
- Lemniscus medialis
- Tractus pyramidalis
- Tractus spinocerebellaris posterior
- Tractus rubrospinalis
- Tractus spinothalamicus lateralis
  - Tractus sympathicus centralis
  - Fasciculus longitudinalis mediqlis



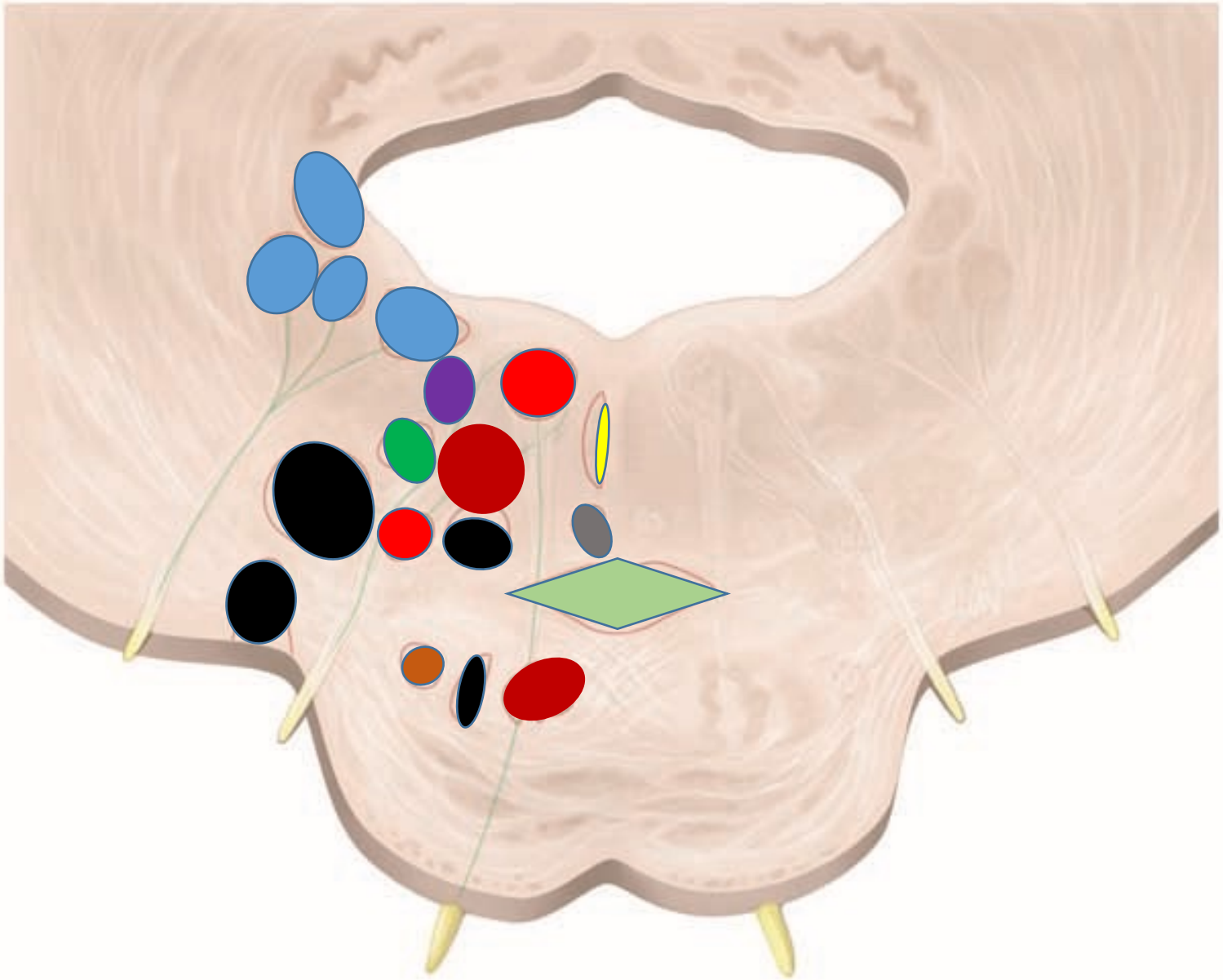
Medulla oblongata

- Nucleus nervi hypoglossi
- Nucleus nervi vagi dorsalis
- Nc. ambiguus
- Nc. nervi trigemini spinalis
- Nc. cochlearis anterior
- Formatio reticularis
- Nucleus olivarius inferior
- Tractus solitarius
- Tractus tectospinalis
- Lemniscus medialis
- Tractus pyramidalis
- Tractus spinocerebellaris anterior
- Tractus rubrospinalis
- Tractus spinothalamicus lateralis
  - Tractus sympathicus centralis
  - Fasciculus longitudinalis medialis



Pons

- Cerebellum
- Nucleus nervi abducentis
- Nucleus nervi facialis
- Nuclei vestibulares
- Formatio reticularis
- Nucleus olivarius superior
- Corpus trapesoideum – auditory fibers
- Tractus solitarius
- Tractus tectospinalis
- Tractus pyramidalis
- Tractus tegmenti centralis
- Tractus rubrospinalis
- Trasctus spinocerebellaris anterior
- Tractus spinothalamicus lateralis
  - Tractus sympathicus centralis
  - Fasciculus longitudinalis mediqlis



Nc. nervi facialis and n. abducentis

- **Nucleus nervi facialis (VII)**
  Mimic muscles, m. platysma
  m. digastricus (venter posterior), m. stylohyoideus, m. stapedius
- **Sling around nucleus nervi abducentis (VI)**
- **Klička podmiňuje**
  - **Colliculus facialis**
  - **floor IV. ventricle**

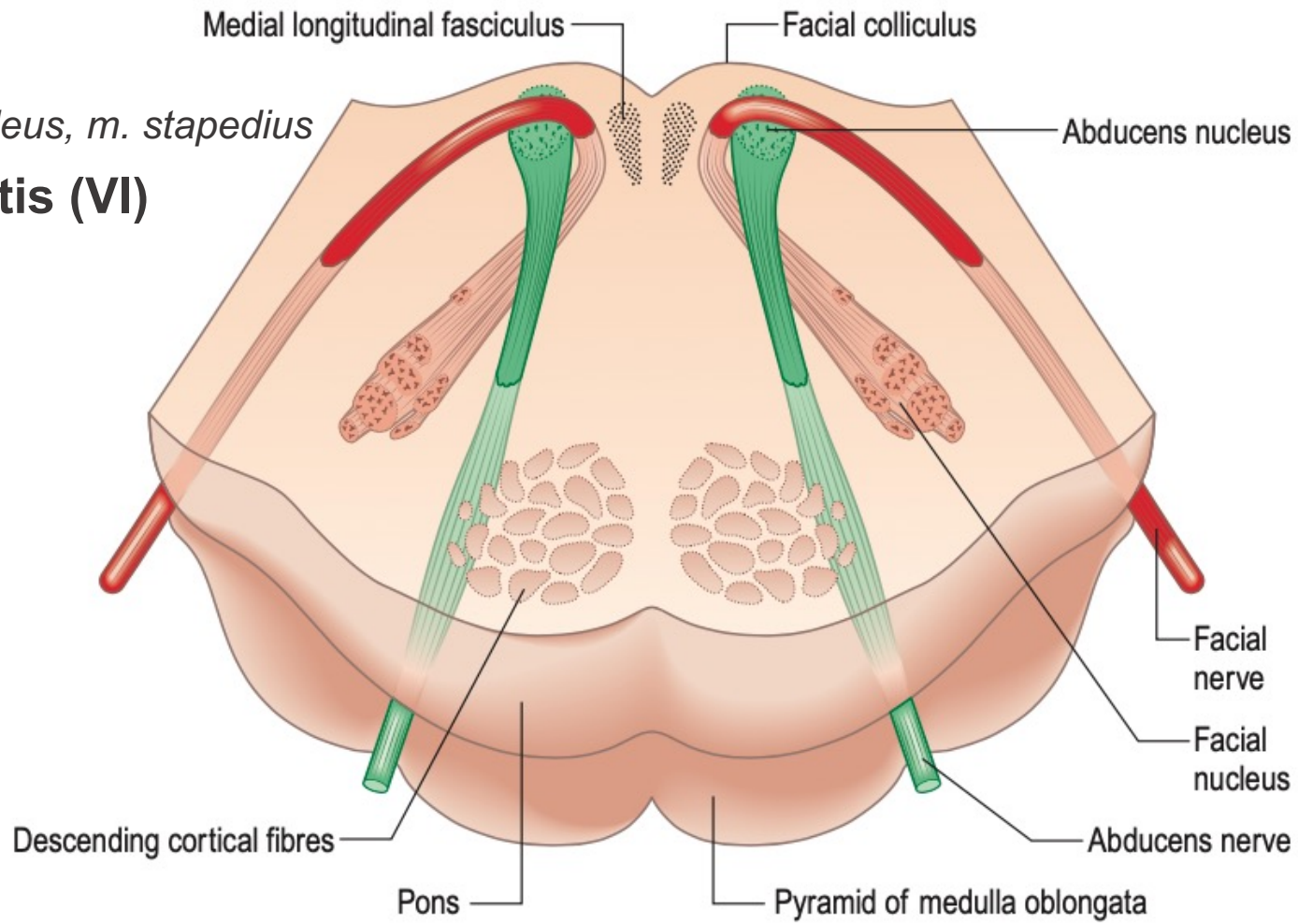
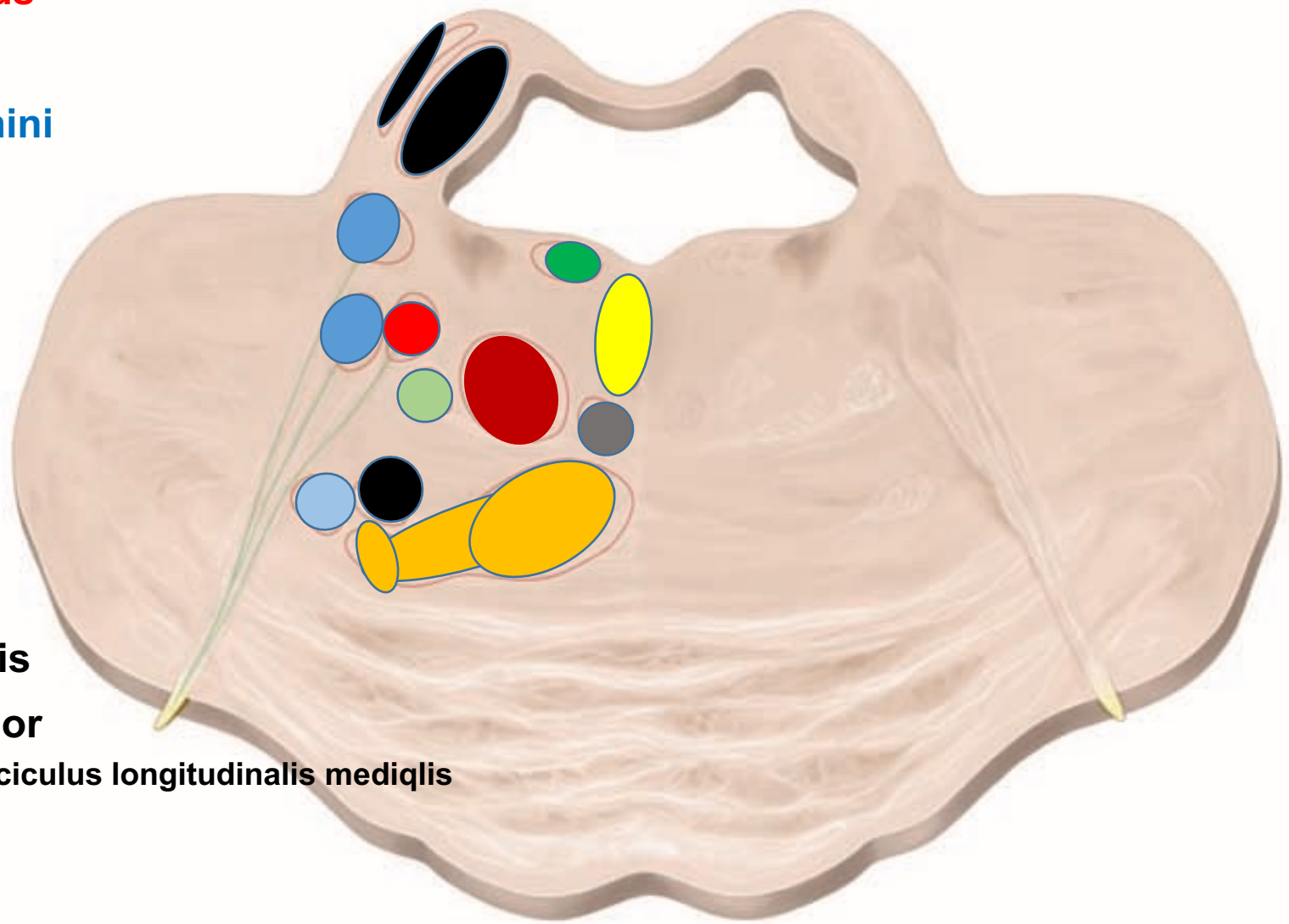


Fig. 21.13 A transverse section of the pons, viewed from the rostral aspect, showing the central course of fibres of the facial nerve.

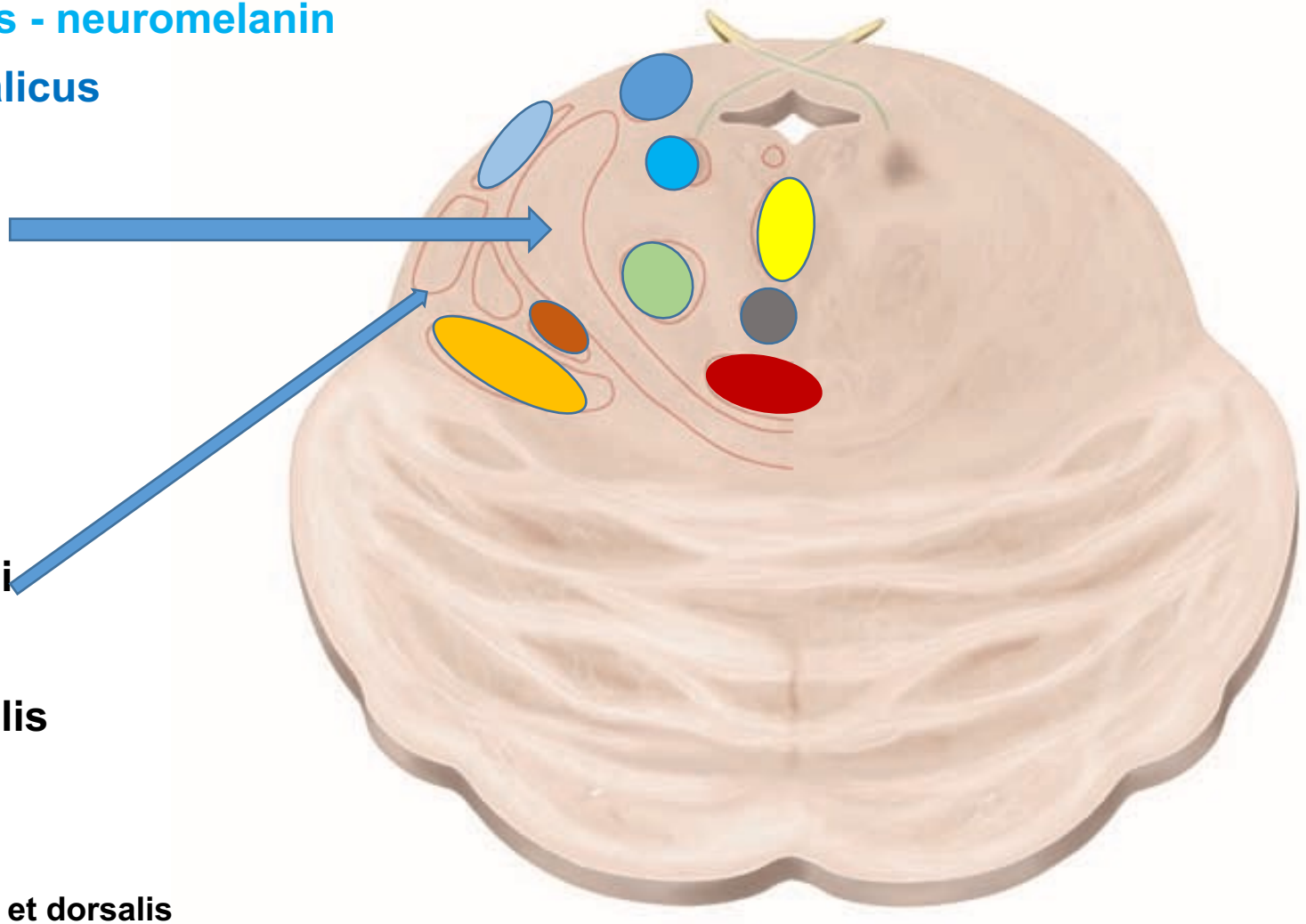
pons

- Nucleus nervi trigemini motorius
- Nucleus spinalis nervi trigemini
- Nucleus principalis nervi trigemini
- Formatio reticularis
- Pedunculus cerebelli superior
- Tractus tectospinalis
- Tractus pyramidalis
- Tractus tegmenti centralis
- Lemniscus medialis
- Lemniscus lateralis
- Tractus spinothalamicus lateralis
- Tractus spinocerebellaris anterior
  - Tractus sympathicus centralis, Fasciculus longitudinalis mediqlis



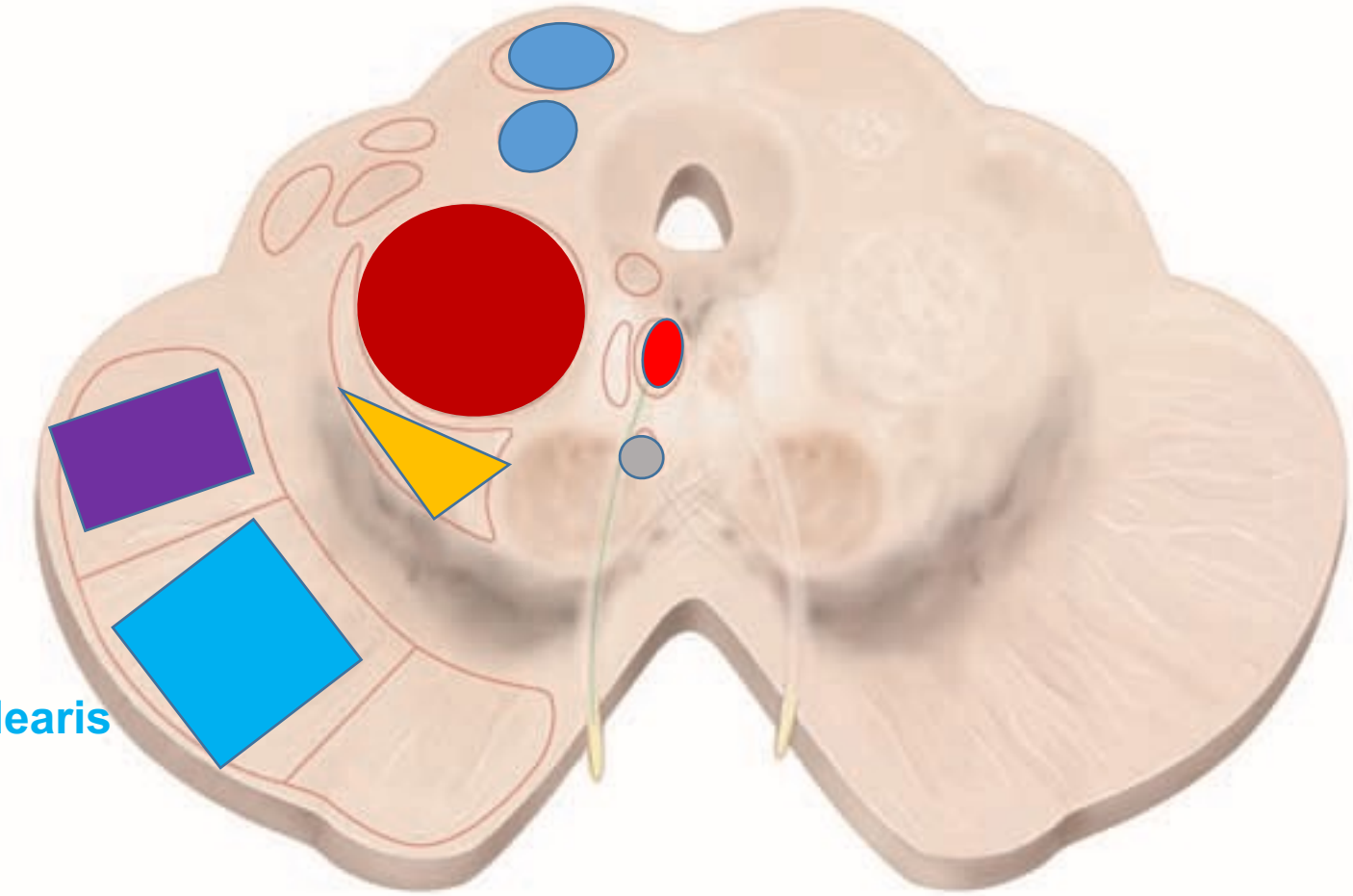
Pons

- Nucleus nervi abducentis
- Locus coeruleus – noradrenalis - neuromelanin
- Nucleus trigemini mesencephalicus
- Formatio reticularis
- Pedunculus cerebelli superior
- Tractus tectospinalis
- Tractus pyramidalis
- Tractus tegmenti centralis
- Lemniscus medialis
- Lemniscus lateralis n. trigemini
- Leniscus lateralis
- Tractus spinothalamicus lateralis
- Tractus rubrospinalis
- Pedunculus cerebelli superior
  - Fasciculus longitudinalis mediqlis et dorsalis



mesencephalon

- Nucleus nervi oculomotorii
- Nucleus trigemini mesencephalicus
- Nucleus colliculi superior
- Formatio reticularis
- Nucleus riber
- Substantia nigra
- Tractus tectospinalis
- Tractus spinothalamicus lateralis
- Brachium colliculi inferioris
- Tractus tegmenti centralis
- Lemniscus medialis
- Tractus corticospinalis, corticonuclearis
- Tractus corticopontinus
  - temporoparietal
- Tractus tectospinalis

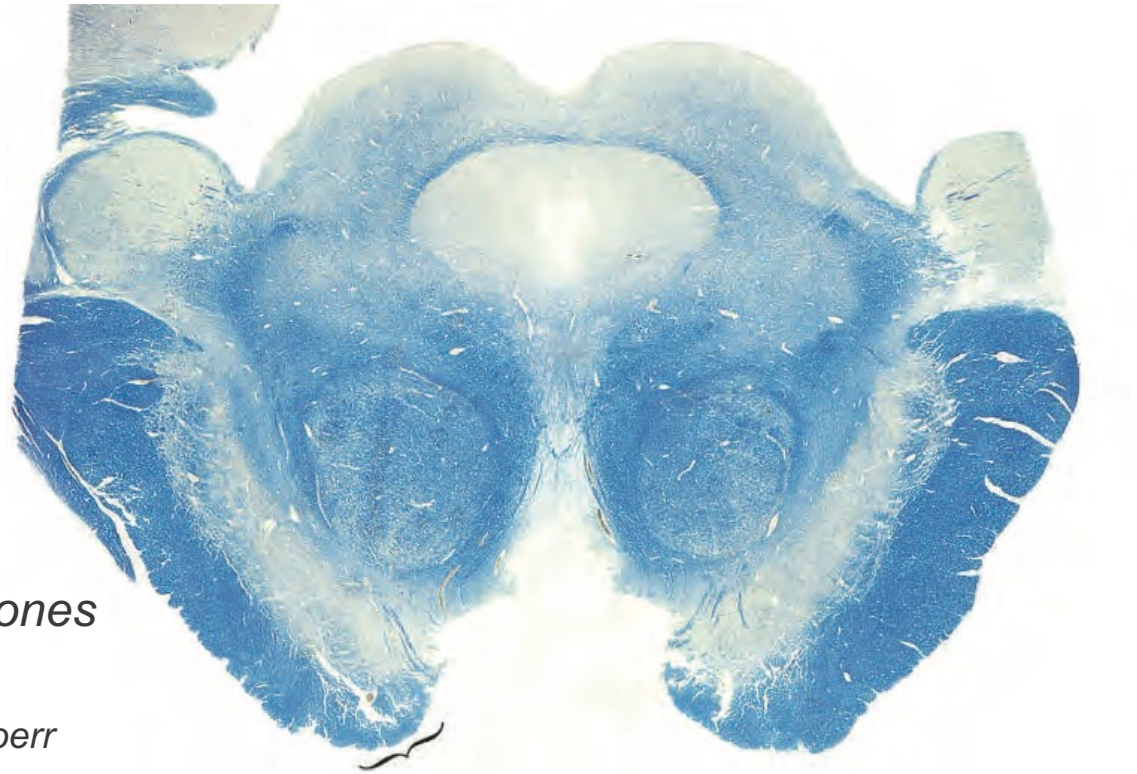


Tectum - tegmentum

- Tectum – dorsal – lamina quadrigeminalis
  - Colliculus superior
  - Colliculus inferior
- Tegmentum – ventral – nc. ruber, substantia nigra
  - In pontu and medulla oblongta dorsal
- Anterior long descending connections

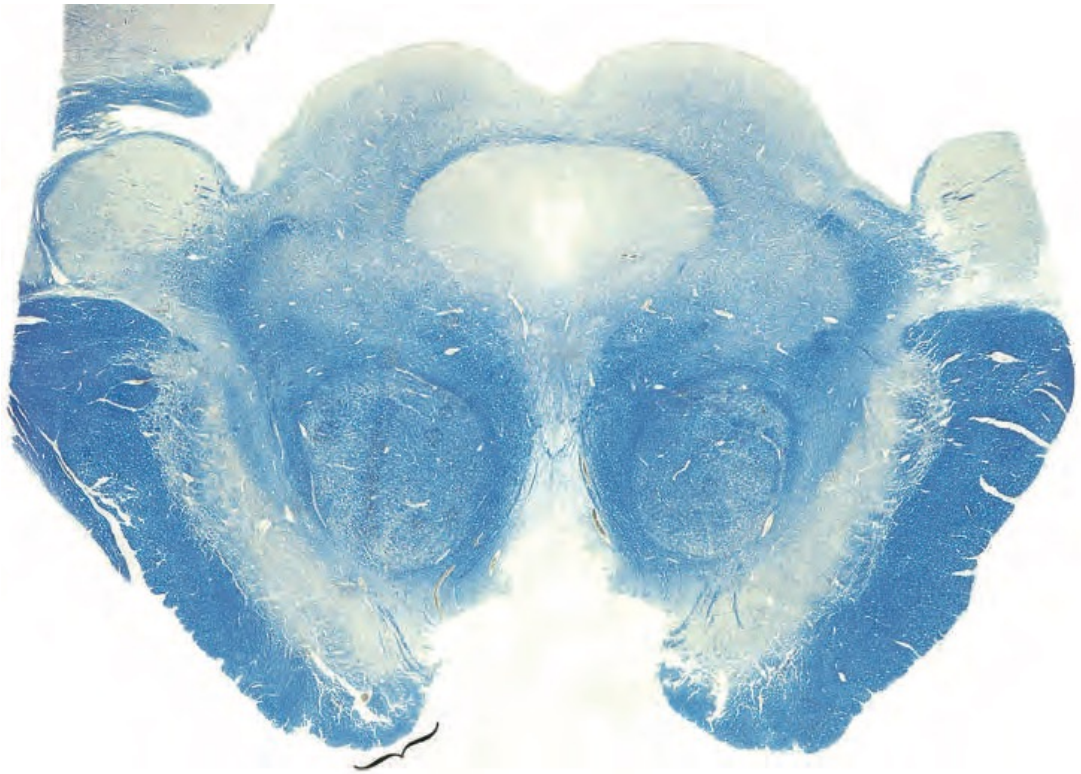
Substantia nigra

- **Pars compacta**
  - *Nigrosome*
  - *Neuromelanin - dom‘pamine synthesis side product*
  - ***Efferent connections pars compacta***
  - *Dopaminergic projections*
  - *to striatum, amygdala, older cortex and enocortex*
- **Pars reticulata**
  - ***Afferent connections pars reticulata***
  - *Striatonigral fibers – ending in pars reticulata*
  - *GABA – inhibitory of spontaneous activity of nigral neurones*
  - *Disorders of dopamine production*
    - *Striatopallidal disordes – parkinsonian, hypokinesis, rigiditiy, tremoerr*
    - *Parkinsonský syndrom – hypokineza, rigidita, třes*
    - *L-DOPA - therapy*
  - ***Eferentní*connections of pars reticulata**
  - *GABAergic to thalamus, colliculus superior*
  - *Reticular formation (nc. pedunculopontinus a cuneiformis) – postural muscles*
  - *Projection analogous to globus pallidus*



Nucleus ruber

- **Nucleus ruber**
  - *Ovoid pinky*
  - *Tegmentum mesencephali*
  - *Caudal large cells*
  - *Rostral small cells*
  - *nc. oculomotorius (III) passes through it*
  - **Corticorubral connections**
  - **Cerebellorubral connections**
  - **from nc. globosus and emboliformis, less nc. dentatus**
  - **Tractus rubrospinalis**
    - **Laterla funicles**
    - **Flexors of proximal limbs**
    - **Automated motions**
  - **Tractus rubrobulbaris**
    - **To motor nuclei of cranial nerves**
  - **Tractus rubroolivaris**



nucleus ruber, substantia nigra

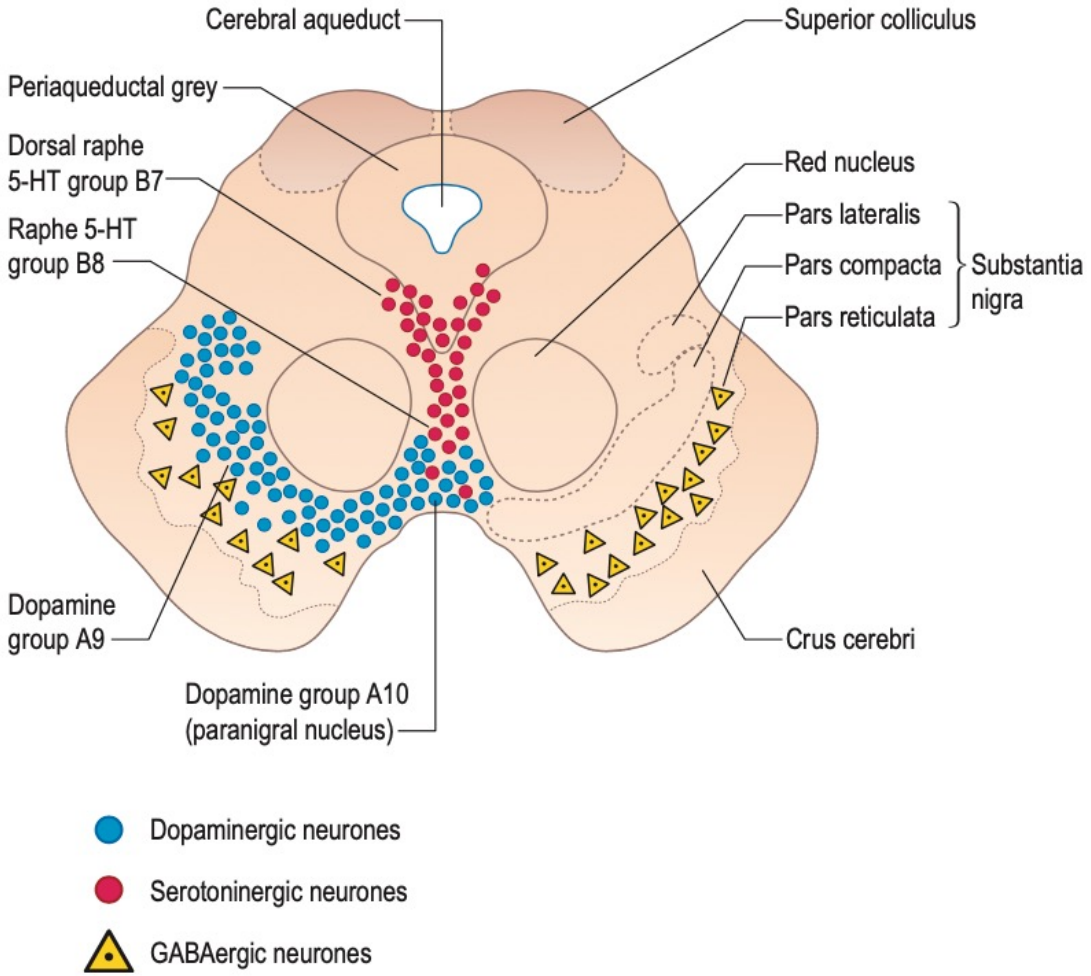
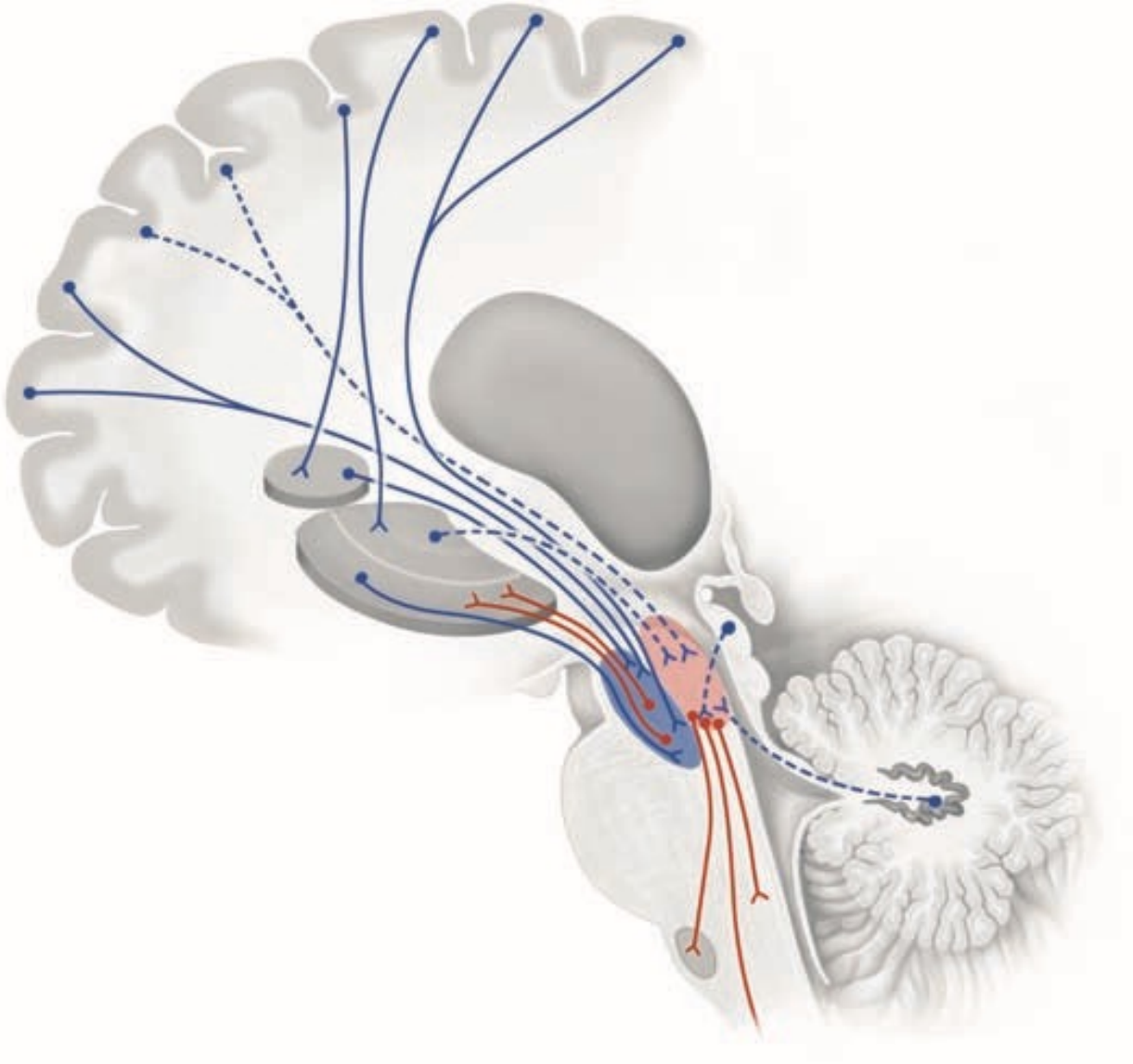


Fig. 21.17 A transverse section through the midbrain to show the arrangement of dopaminergic cell groups A9 and A10 in the substantia nigra (left) and serotoninergic cell groups B7 and B8 in the raphe.



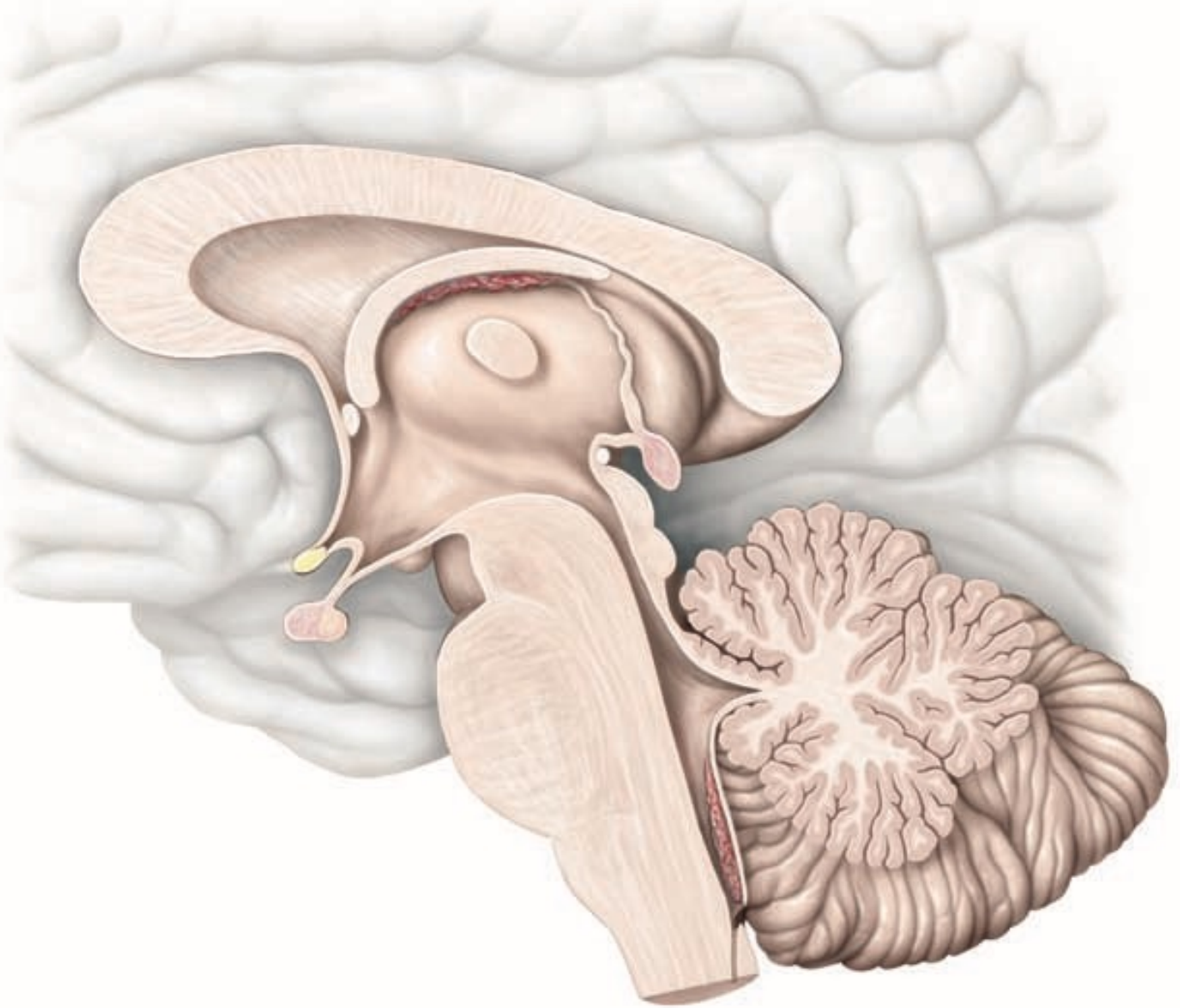
cerebellum

- **Vermis**
- **Haemispherae**

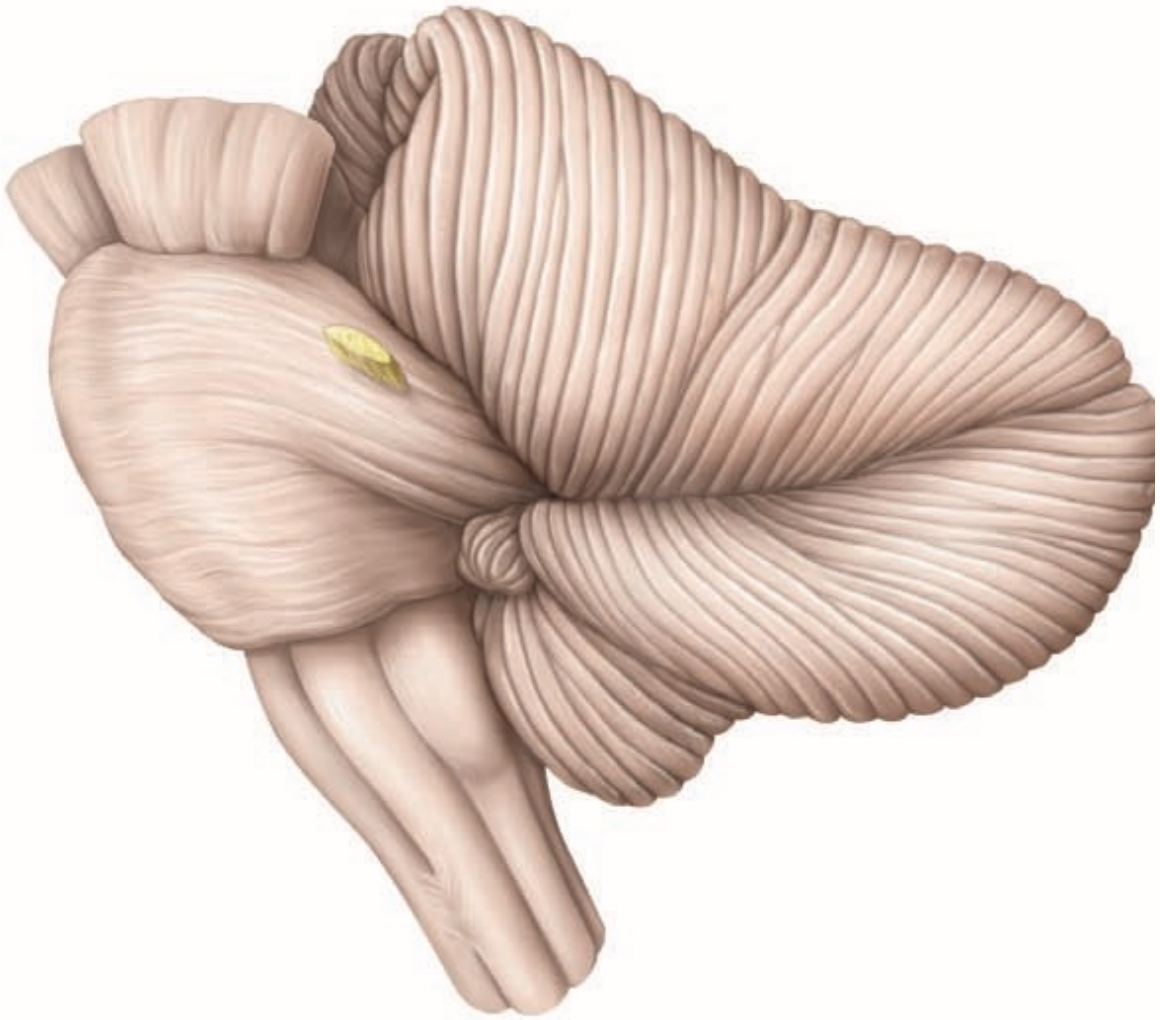
- **Arbor vitae**

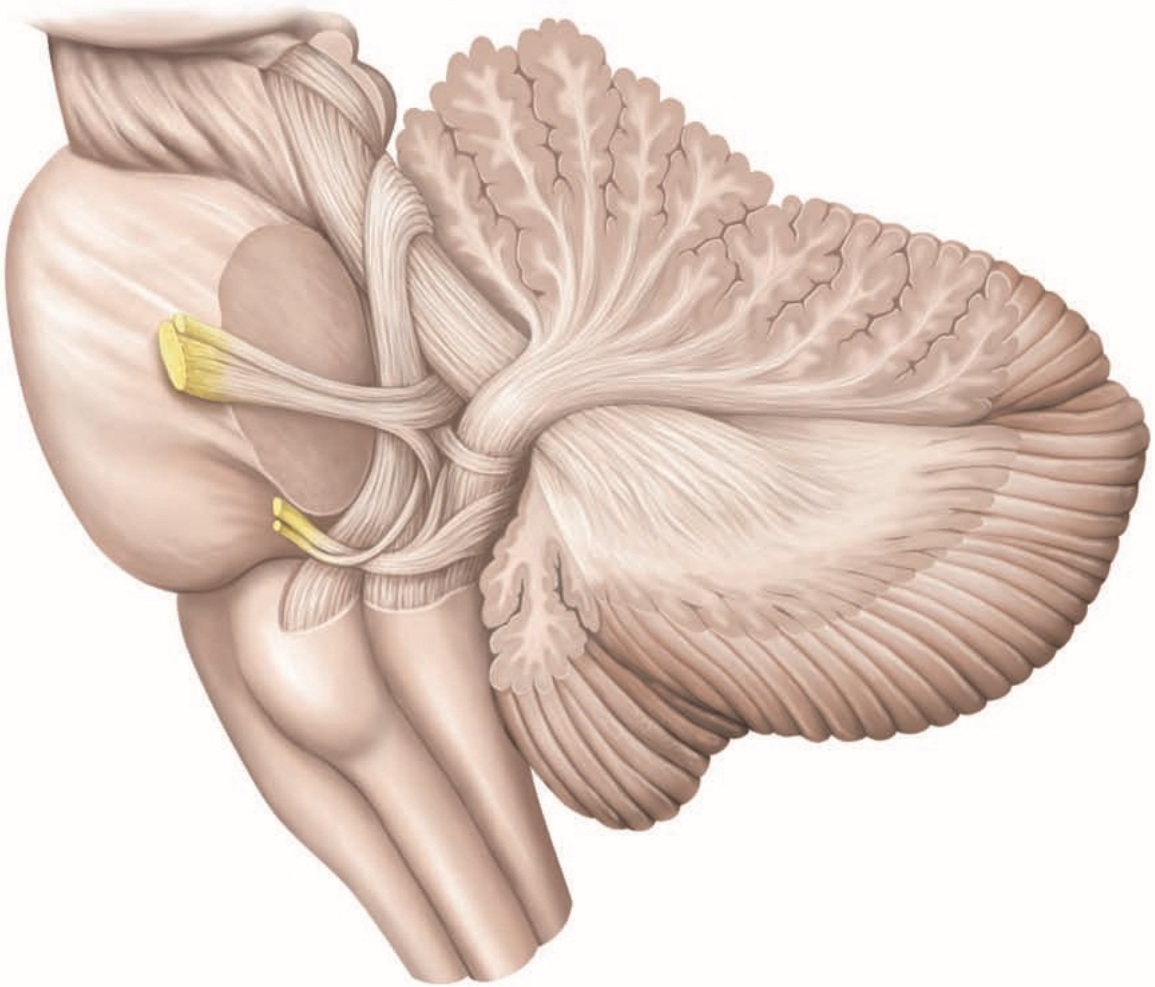
- **Substantia grissea**
- *Cortex*
- *Nuclei*

- **Substantia alba**
- *Corpus medullare*

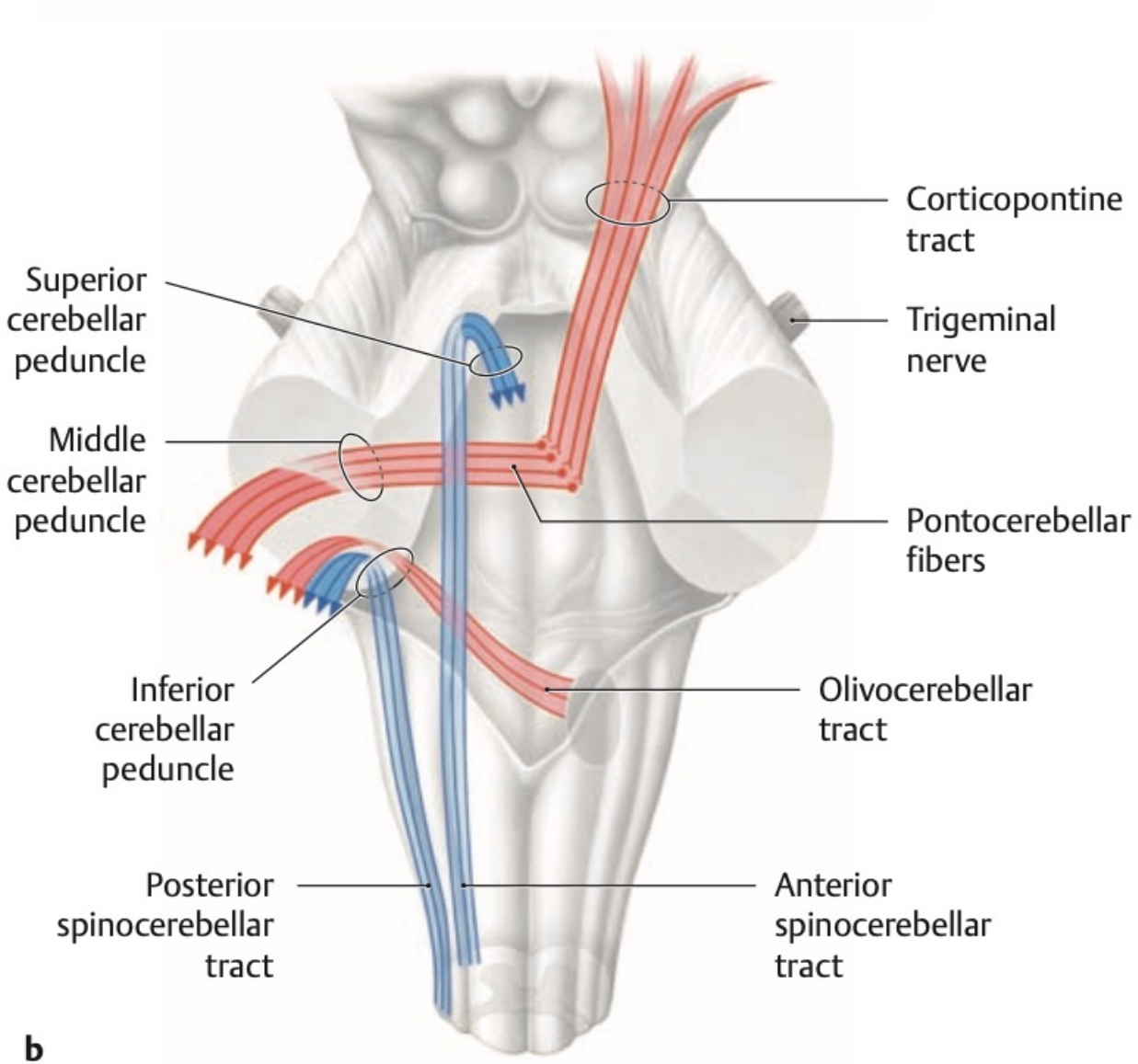


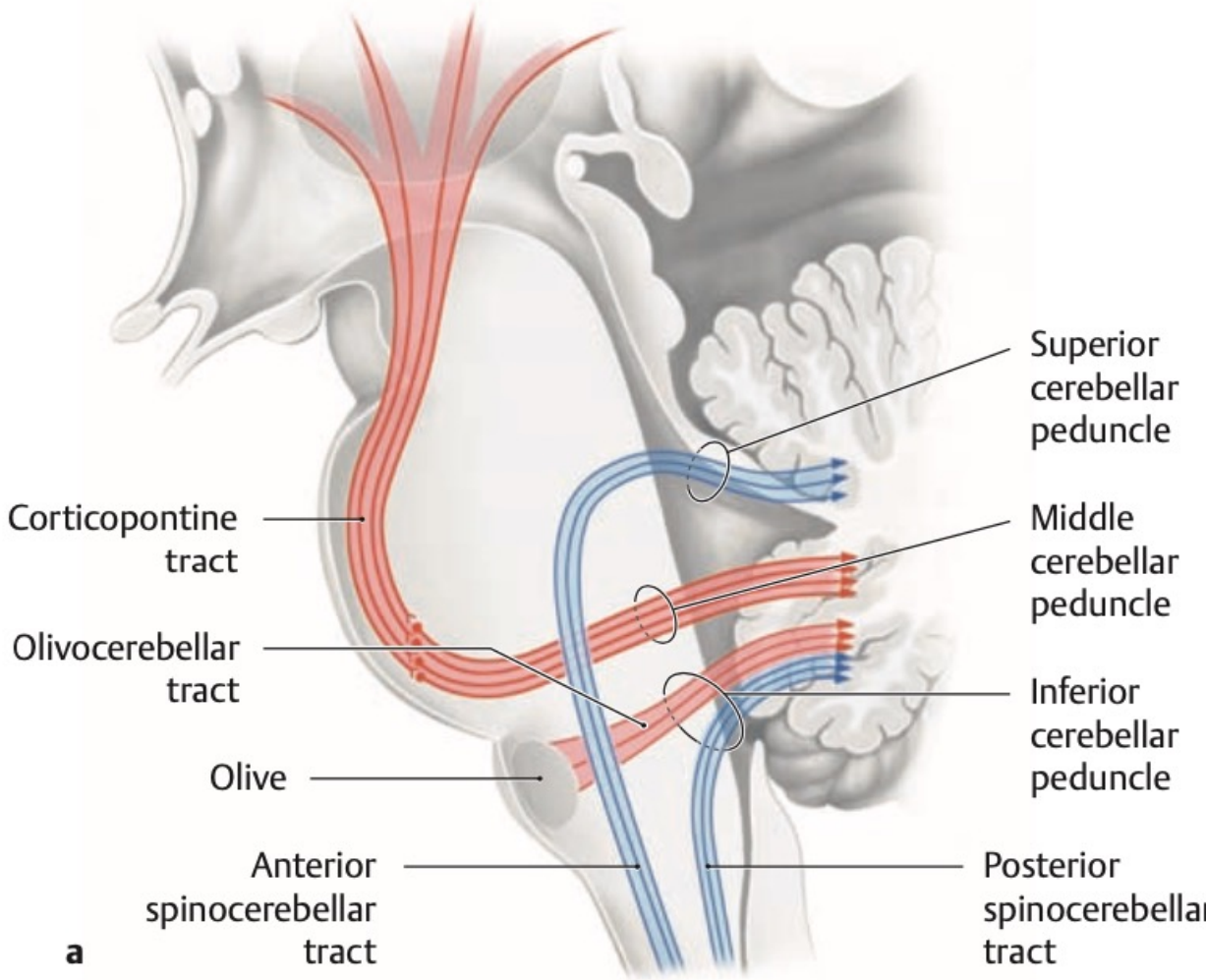
Pedunculi cerebelli





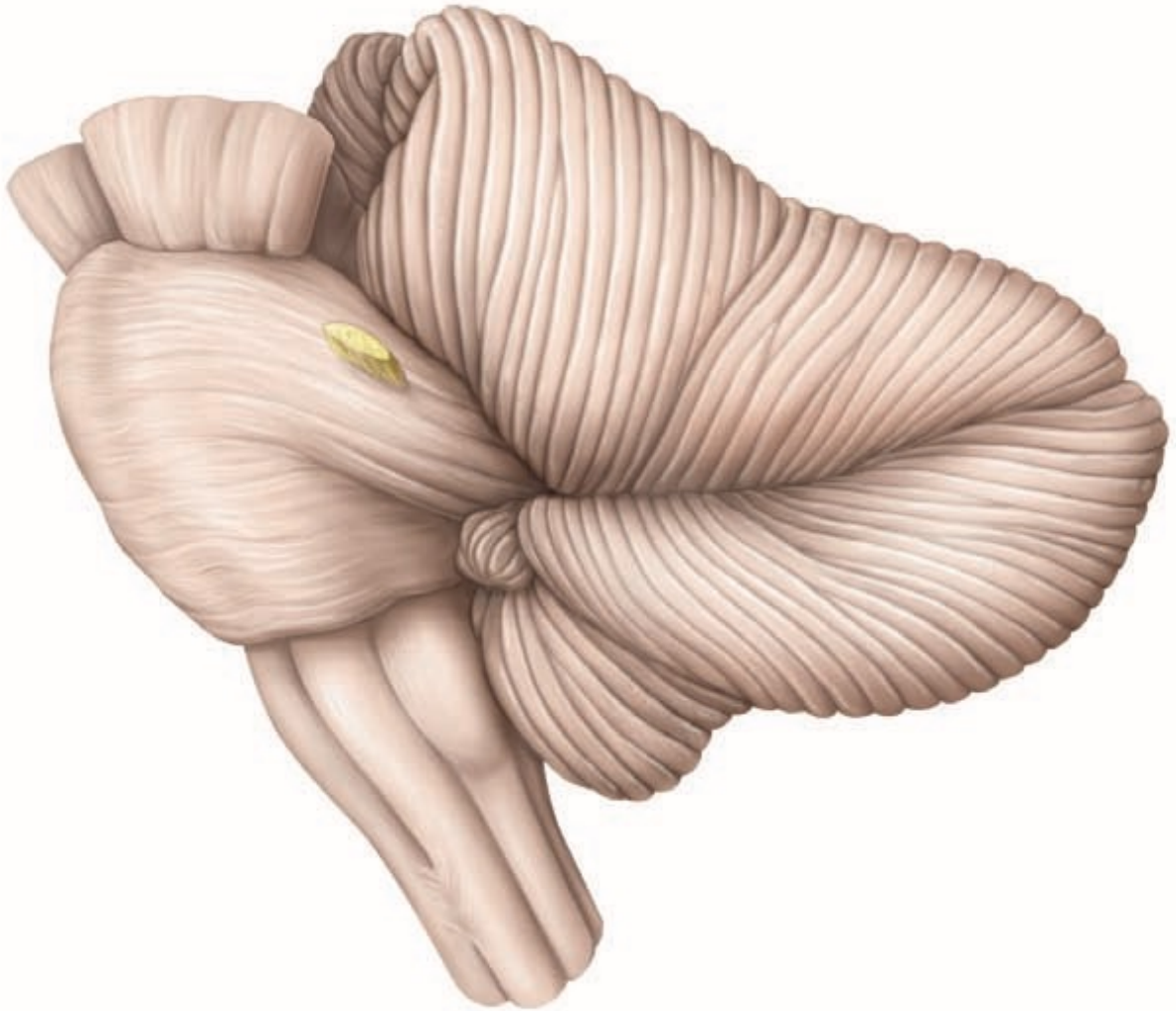
Cerebellum - spojení





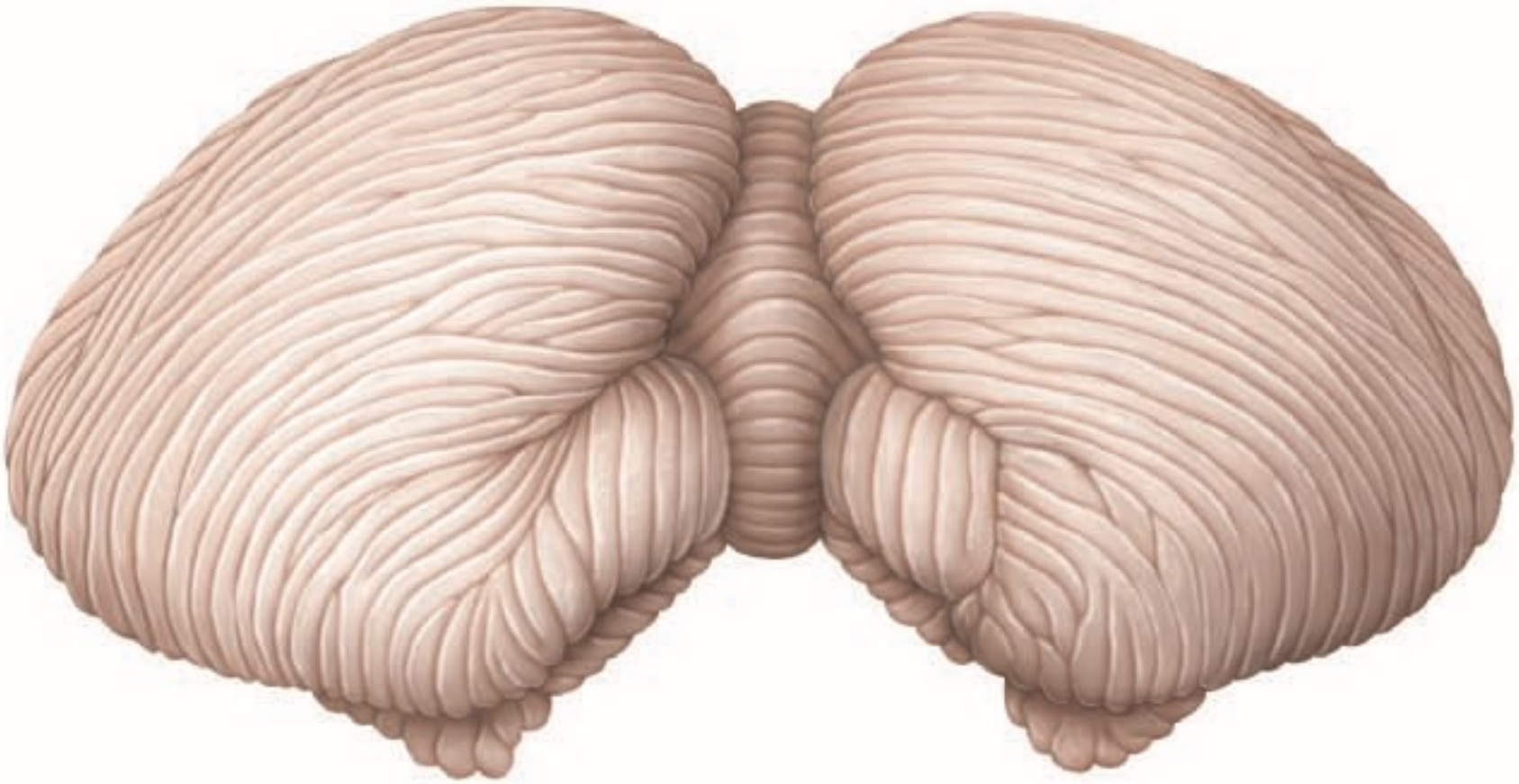
cerebellum

- Lobus anterior
- Fissura horizontalis
- Lobus posterior
- Fissura posterolateralis



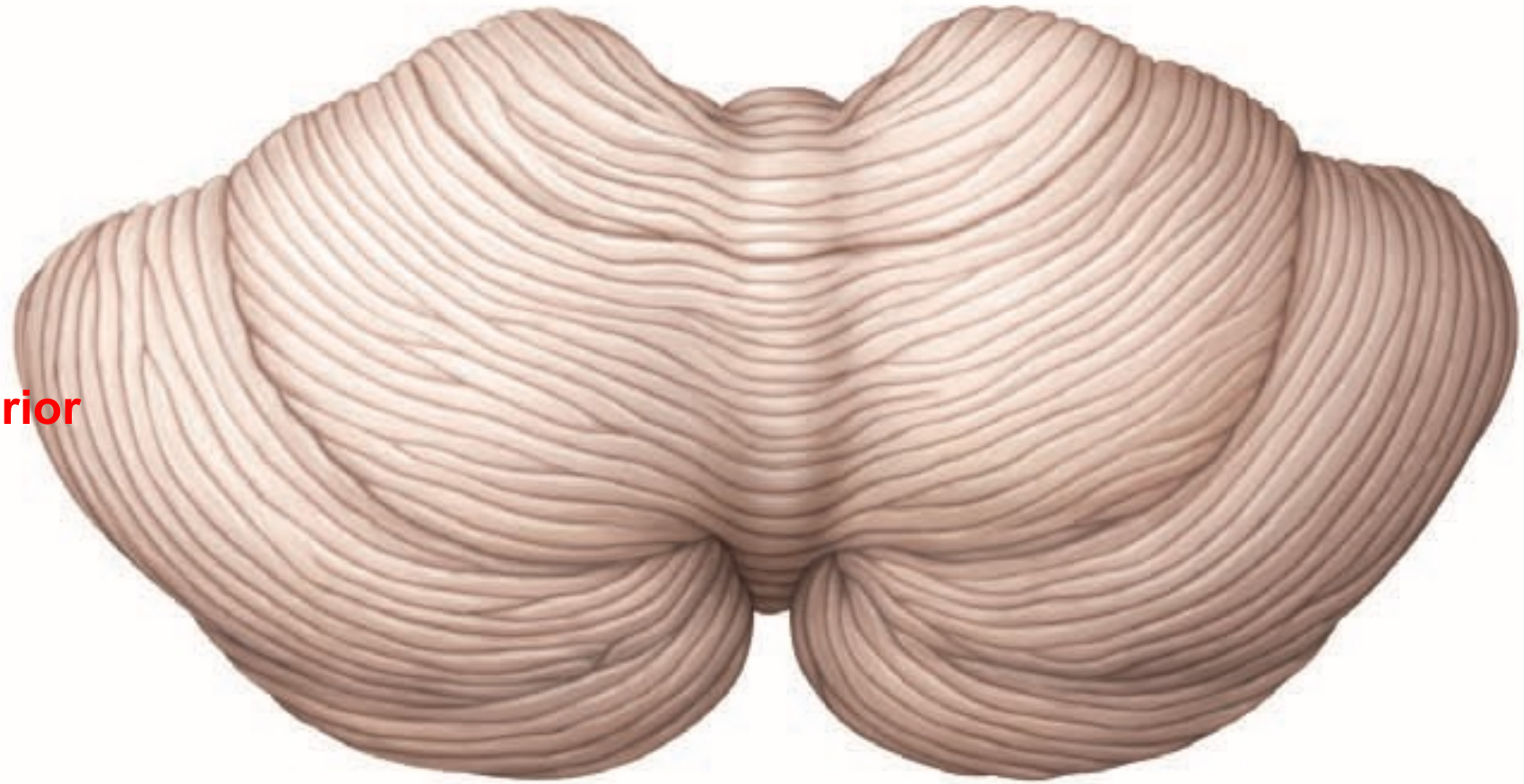
cerebellum

- Vermis
- Valecula vermis
- Uvula vermis
- Haemisphera
- Flocculus



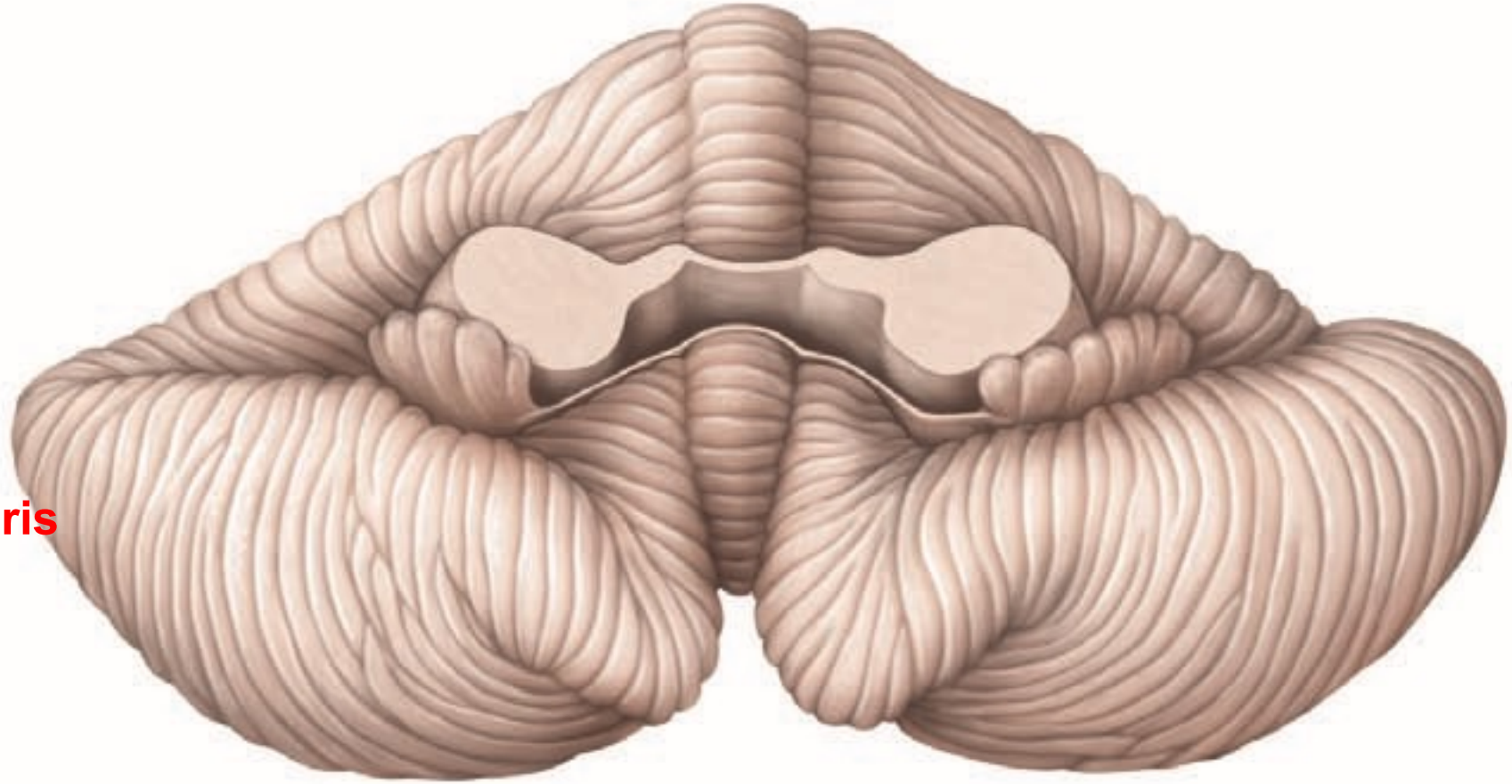
cerebellum

- Vermis
- Culmen vermis
- Folia vermis
- Haemisphera
- Fissura horizontalis
- Lobulus quadrangularis
- Lobulus simplex
- Lobulus semilunaris superior



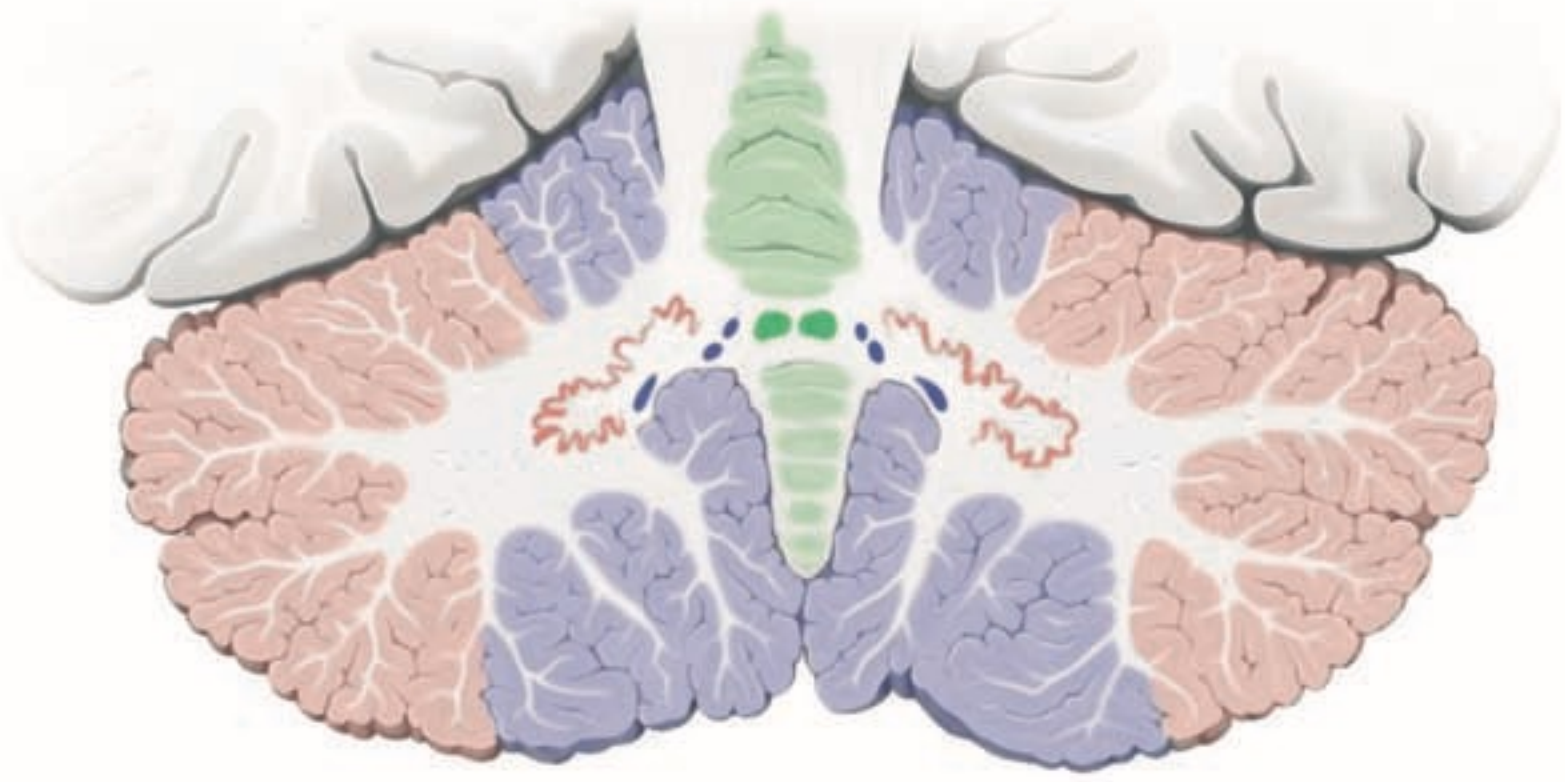
cerebellum

- Vermis
- Lobulus centralis
- Ventriculus
- Pyramis
- Pyramis vermis
- Valecula vermis
- Nodulus
- Flocculus
- Lobulus flocculonodularis
- Haemisphera
- Fissura horizontalis
- Tonsilla cerebelli



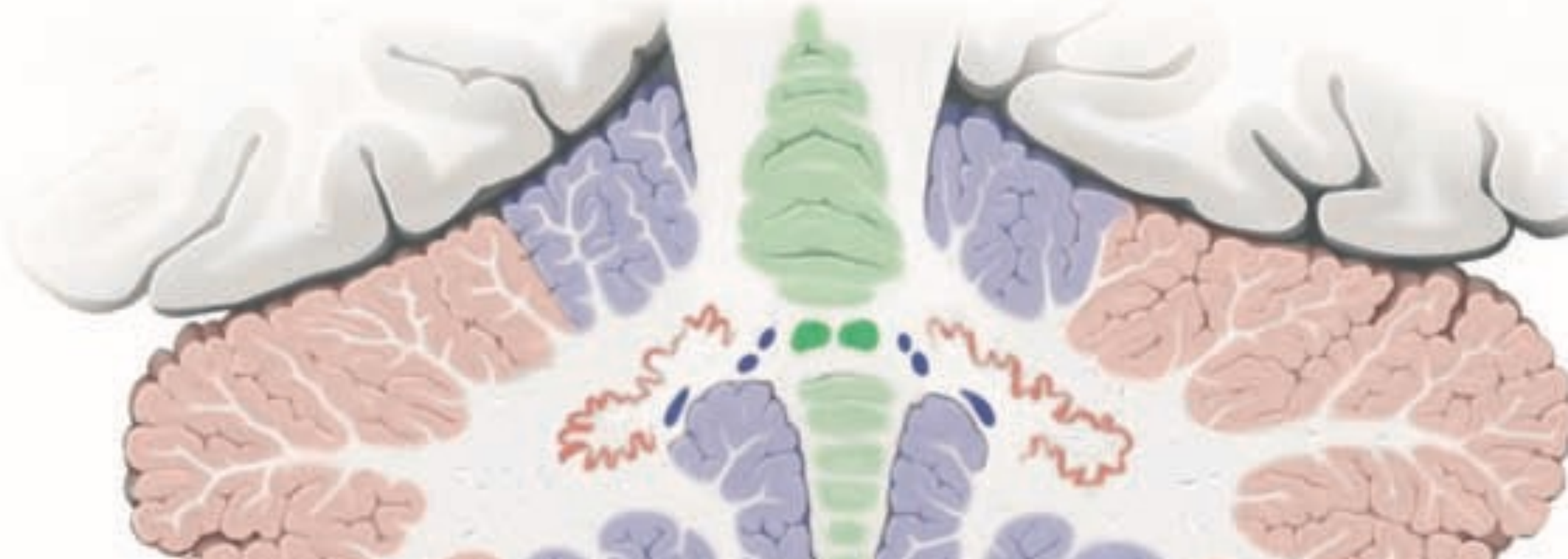
cerebellum

- **Vestibulocerebellum / archaeocerebellum**
  - nc. vestibulares
  - ballance
- **Spinocerebellum / paleocerebellum**
  - medulla spinalis, medulla oblongata, pons, mesencephalon
  - Muscular tonus maintenance
- **Neocerebellum**
  - Hemisférrs of telencefalon
  - Measuring and coordination of mot

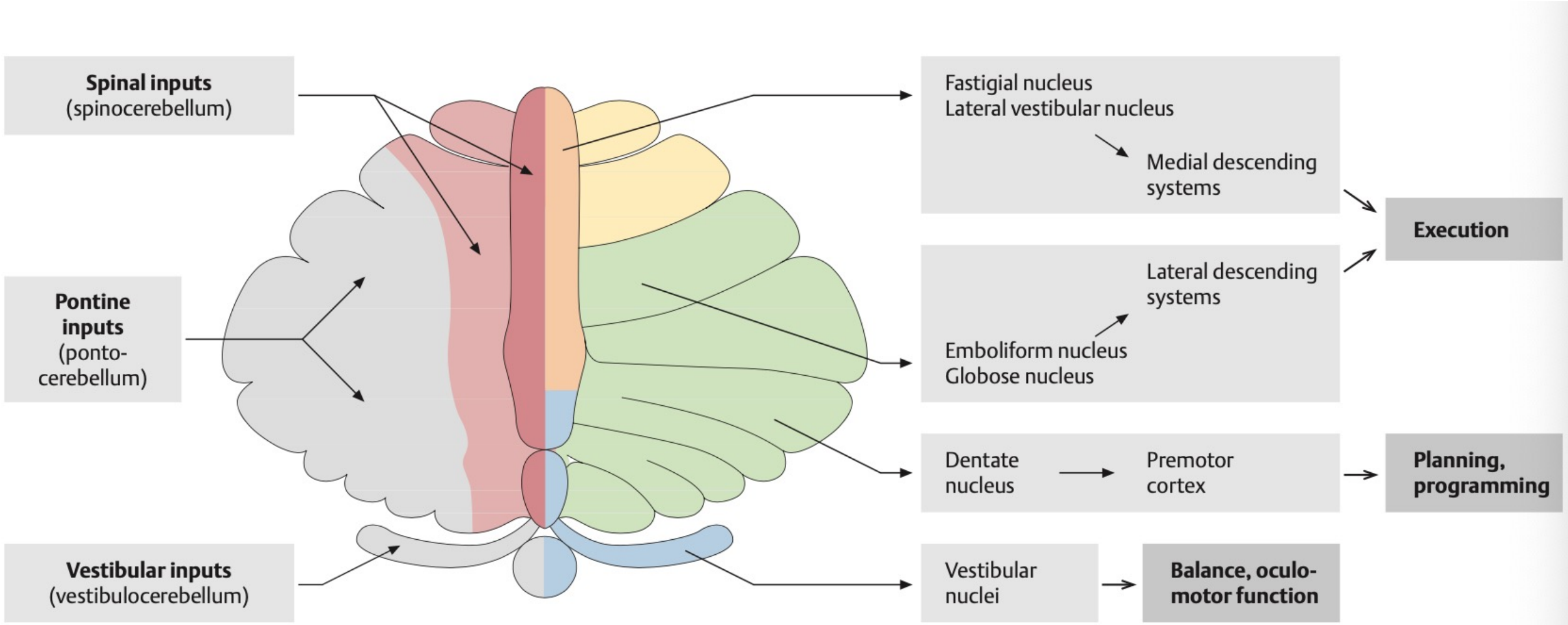


Cerebellum - nuclei

- Nucleus fastigii
- Nuclei globosi
- Nucleus emboliformis
- Nucleus dentatus



Cerebellum


Spinal inputs
(spinocerebellum)
Pontine inputs
(ponto-cerebellum)
Vestibular inputs
(vestibulocerebellum)
Fastigial nucleus
Lateral vestibular nucleus
Medial descending systems
Emboliform nucleus
Globose nucleus
Lateral descending systems
Dentate nucleus
Premotor cortex
Vestibular nuclei
Execution
Planning, programming
Balance, oculo-motor function

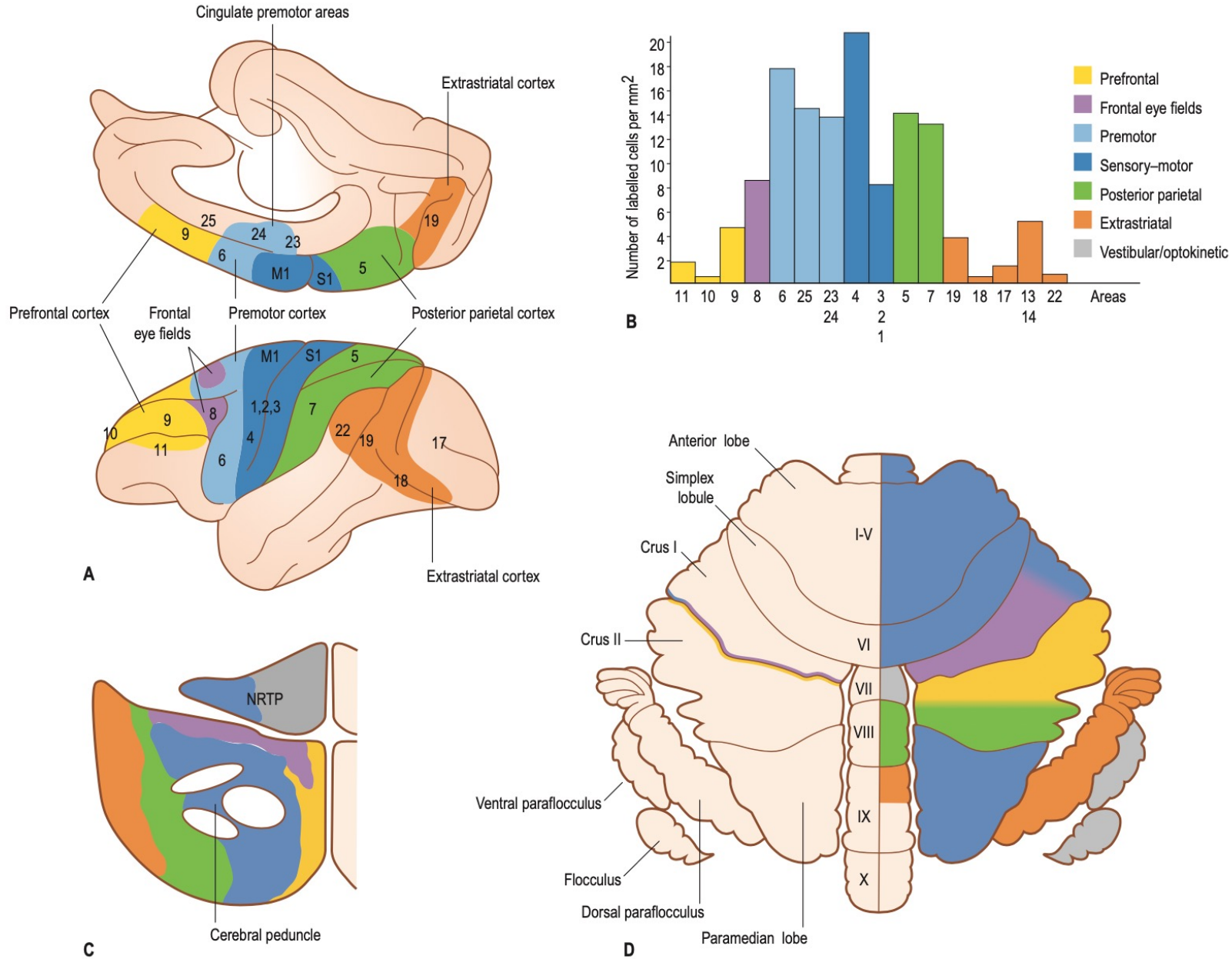
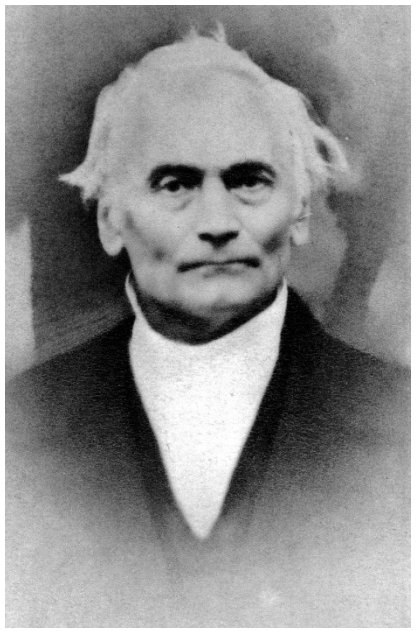
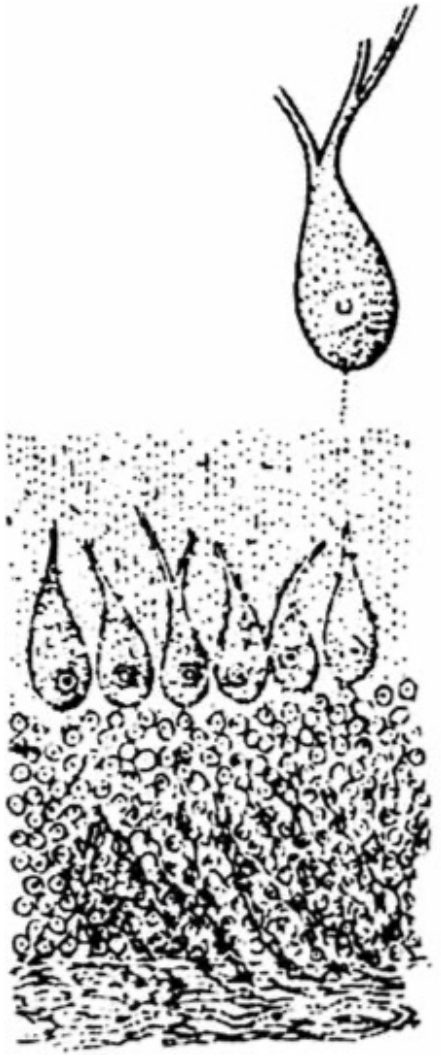


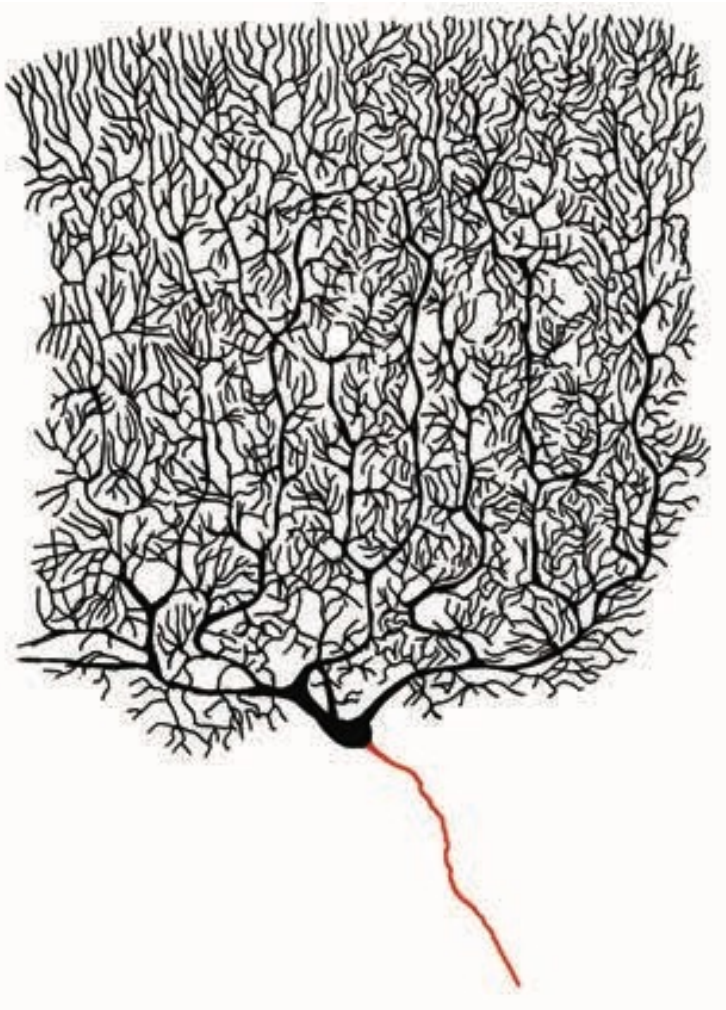
Fig. 22.22 The corticopontocerebellar system. **A**, The origin of corticopontine fibres from the cerebral cortex in the monkey (macaque). **B**, The relative proportions of corticopontine neurones in different areas of the cerebral cortex of the monkey, indicated in panel A. **C**, A transverse section through the pons showing the distribution of corticopontine fibres in the pontine nuclei and the nucleus reticularis tegmenti pontis (NRTP). **D**, The flattened cortex of the monkey cerebellum showing the distribution of pontocerebellar mossy fibres. (B, Modified from Glickstein M, May JG, 3rd, Mercier BE 1985 Corticopontine projection in the macaque: the distribution of labelled cortical cells after large injections of horseradish peroxidase in the pontine nuclei. J Comp Neurol 235:343–359.)

Purkinje cells

- **Jan Evangelista Purynĕ - descriptions of “large cell“s in 1837**
- **Integration functions**
- **Paralel fibers less lsynapses**
  - **Monitoring of the state**
  - *Proprioreceptors, skin. - cortex*
  - *Thinking of a motion*
- **Climbing fibers – hundred of synaplses**
  - **Information integration**
  - *Mistakes in motions*
  - *Disturbing influence of a motion*







medulla oblongata, pons, mesencephalon, cerebellum

Prof. MUDr. Jiří Ferda, Ph.D.

Images – Thieme Atlas of Anatomy, Gray‘s Anatomy, Základy Anatomie