

DIENCEPHALON

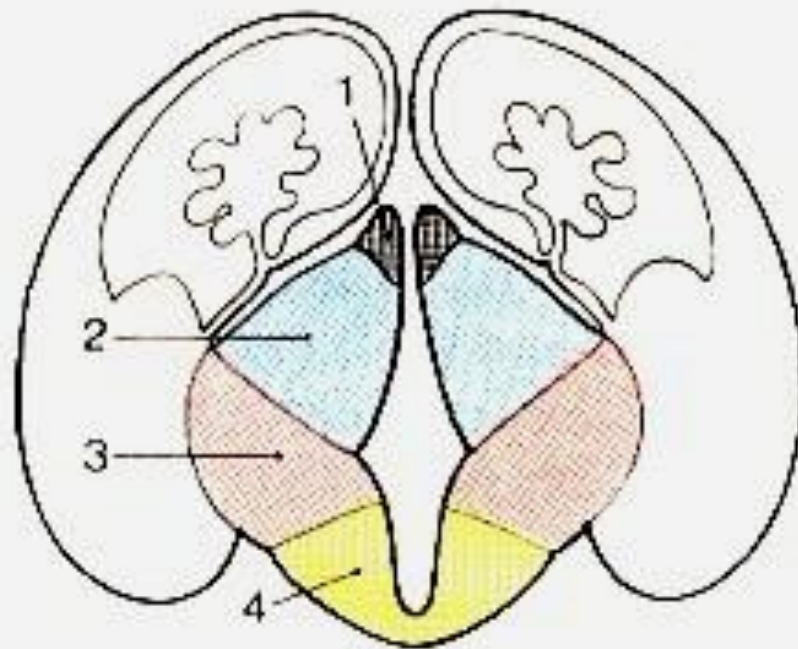
Ústav anatomie 2. LF

Rastislav Druga



DIENCEPHALON

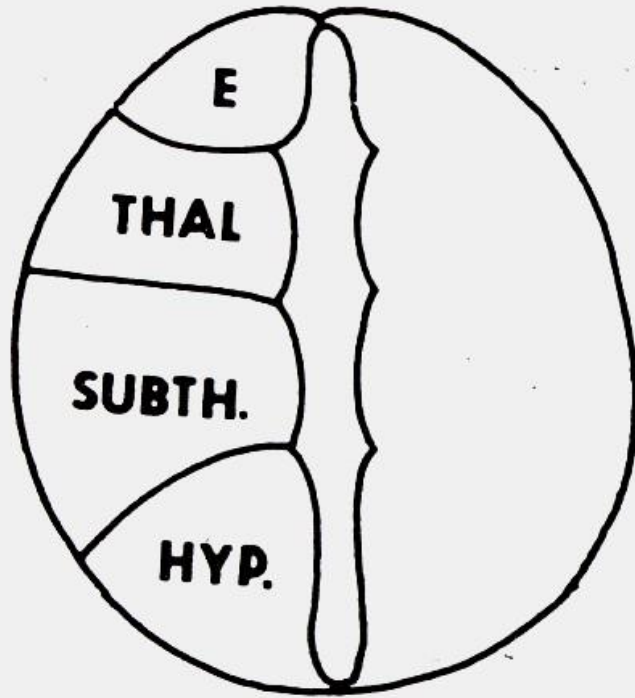
- EPITHALAMUS
- THALAMUS
- SUBTHALAMUS
- HYPOTHALAMUS



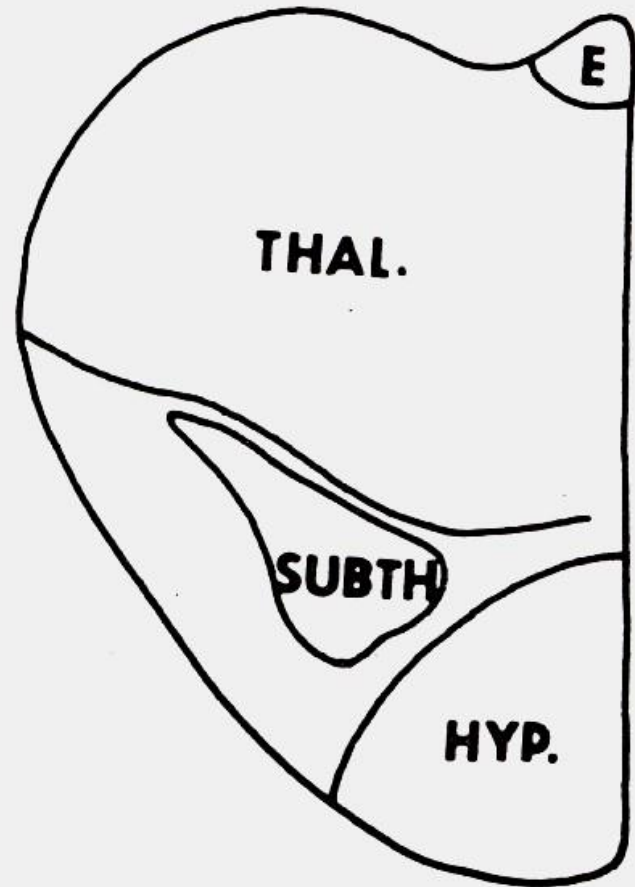
B Structure of the diencephalon in an embryonic brain

AMPHIBIANS

MAMMALS



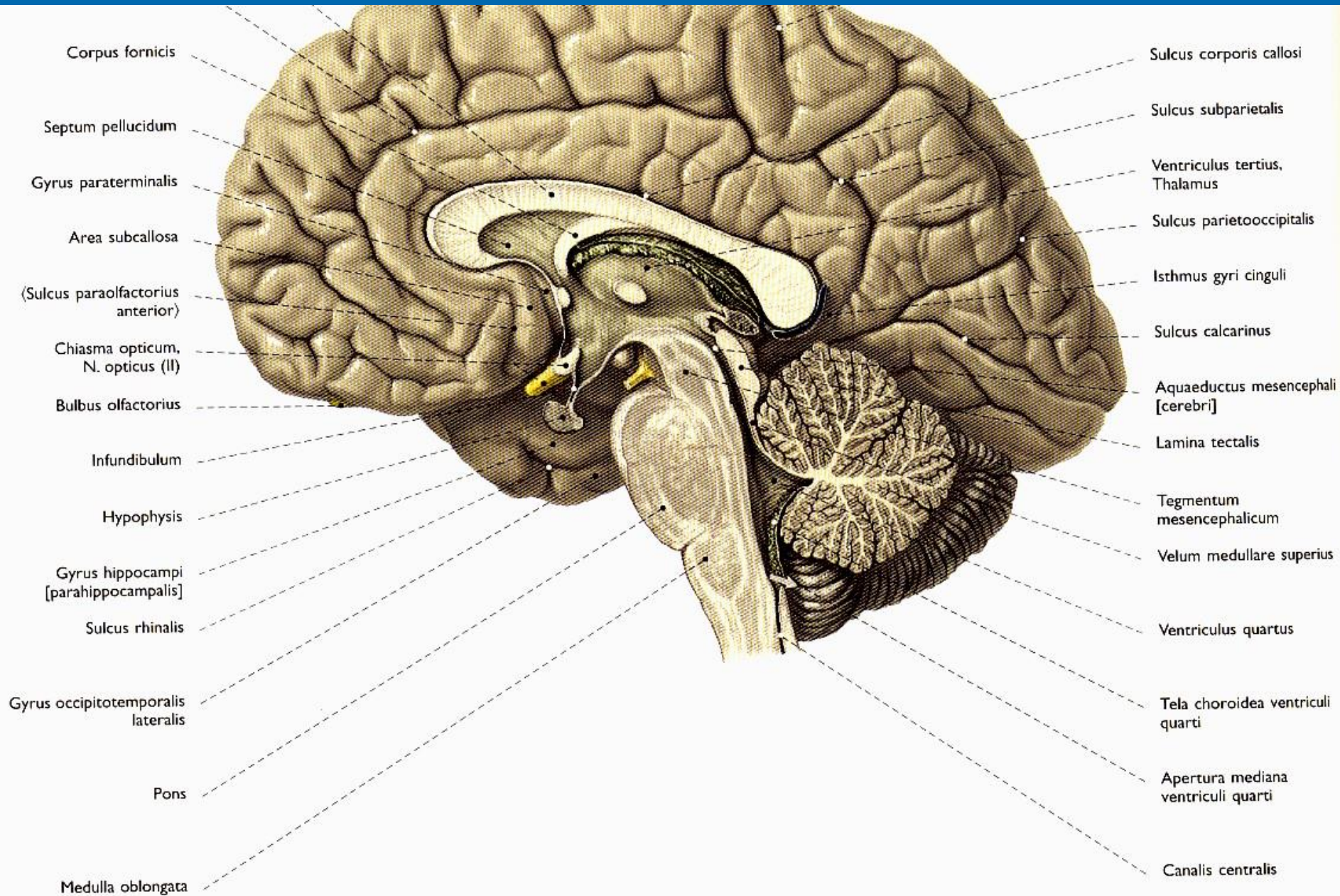
a



b

AMFIBIA

MAMMALIA



DIENCEPHALON – medial aspect

Truncus corporis callosi

Fella choroidea ventriculi tertii

Corpus fornicis

Thalamus

Plexus choroideus ventriculi tertii

Septum pellucidum, aramen interventriculare

Columna fornicis

Corpus callosum
Genu –
Rostrum –

(Recessus triangularis)

Commissura anterior

Adhaesio interthalamica

Sulcus hypothalamicus

Lamina terminalis

Hypothalamus

Recessus opticus

Chiasma opticum

Recessus infundibuli

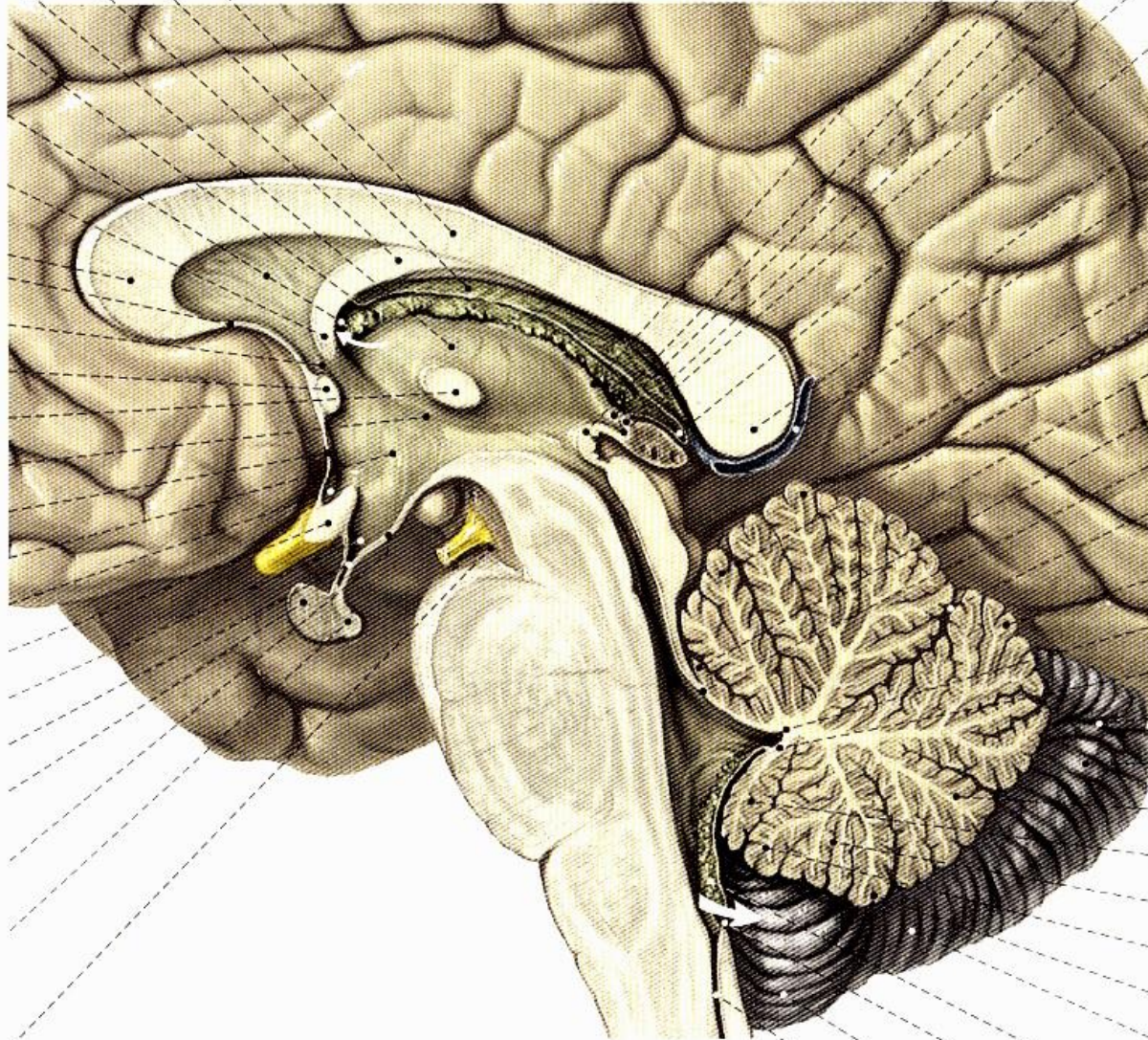
Infundibulum

Adenohypophysis

Tuber cinereum

Neurohypophysis

Fossa interpeduncularis



Stria medullaris thalami

Commissura epithalamica

Habenula

Commissura habenularum

Recessus pinealis

Recessus suprapinealis

Splenium corporis callosi

V. magna cerebri

Culmen

Lobulus centralis

Declive

Lingula

Velum medullare superius

Fissura prima

Folium vermis

(Fastigium)

Velum medullare inferius

Fissura horizontalis

Lobulus semilunaris inferior

Tuber vermis

Nodus

Fissura secunda

Uvula vermis

Pyramis vermis

Lobulus biventer

BRAIN STEM AND DIENCEPHALON

Superior aspect

Pulvinar - cushion

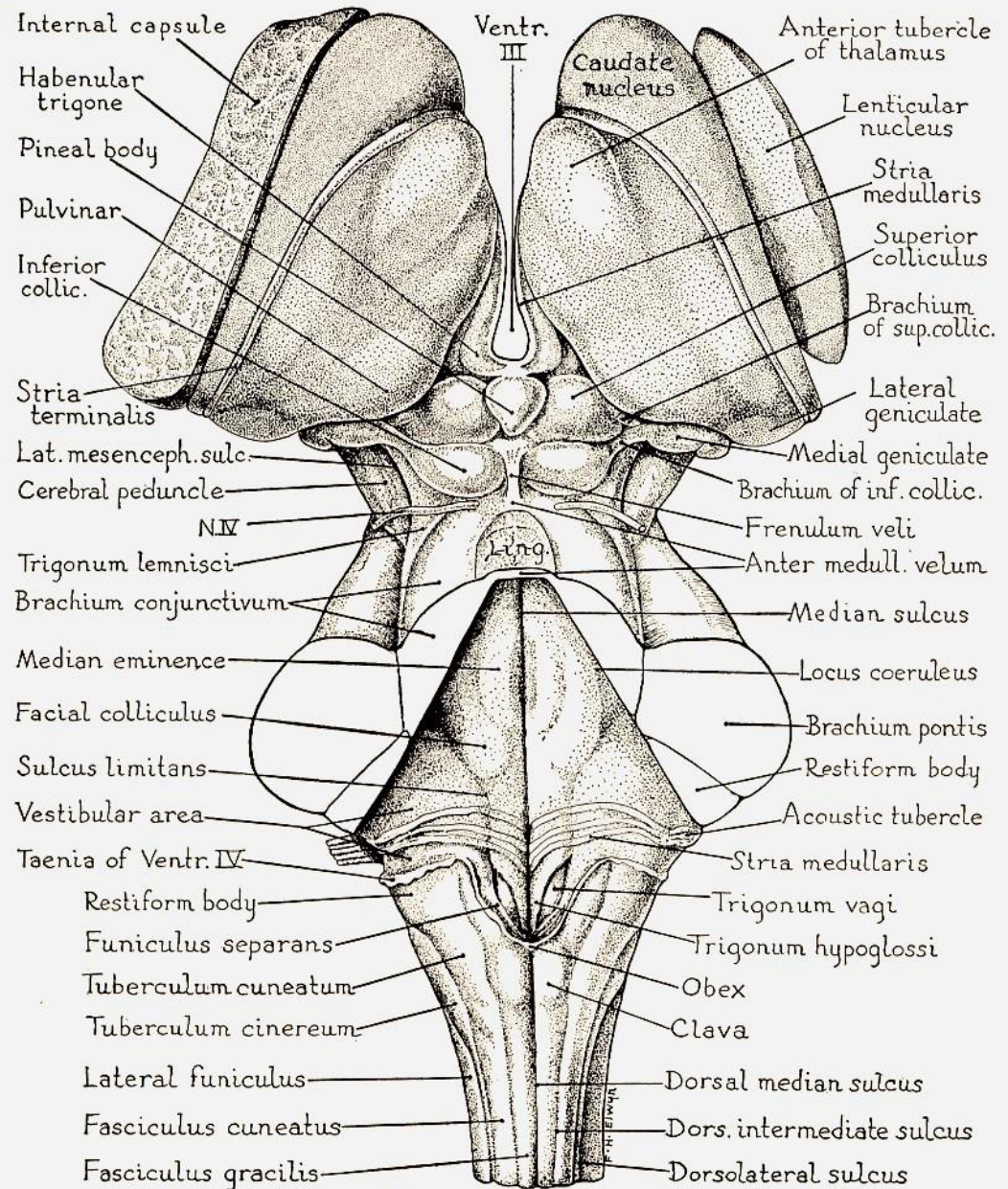


FIG. 260. Dorsal view of the brain stem. *Ling.*, lingula

later found a fiber bundle known as the *stria terminalis* or *stria semicircularis* (Figs. 260, 15). At first the corpus striatum appears as

cortex. These fibers increase in number and finally form a massive bundle, the *internal capsule*, containing all the projection fibers

Truncus corporis callosi

Ventriculus lateralis
Cornu frontale [anterior]

Plexus choroideus
ventriculi lateralis

Stria terminalis,
V. thalamostriata superior

Plexus choroideus
ventriculi tertii

Commissura anterior

Ventriculus tertius

Lamina medullaris externa,
Lamina medullaris interna

Capsula interna

Capsula extrema,
Capsula externa

Lamina medullaris lateralis,
Lamina medullaris medialis

Fasciculus
mamillothalamicus

Capsula interna
Pars sublentiformis

Ventriculus lateralis
Cornu temporale [inferius]

Pes hippocampi

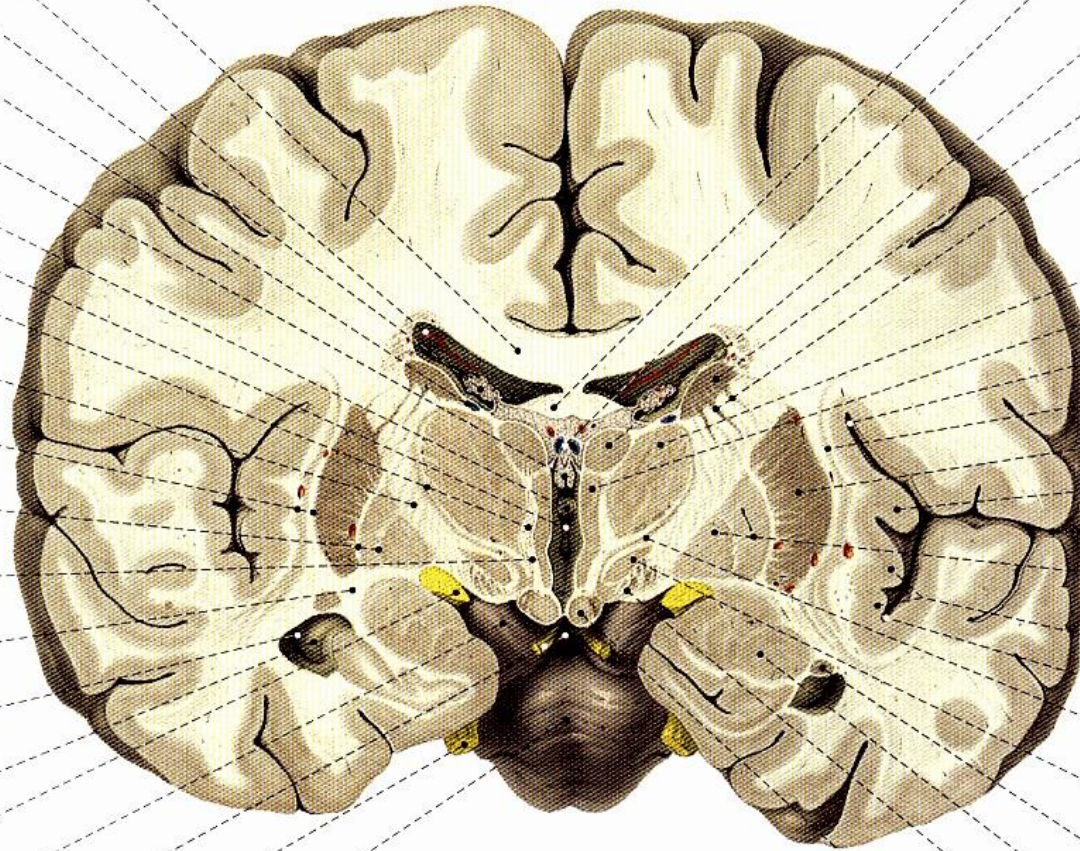
Tractus opticus

Pedunculus cerebri

N. oculomotorius (III),
Fossa interpeduncularis

N. trigeminus (V)

Pons
Sulcus basilaris



Corpus fornicis

Tela choroidea
ventriculi tertii
with/mit
Vv. internae cerebri

Thalamus
Nuclei anteriores

Corpus nuclei caudati

Connections between/
Verbindungen zwischen
Nucleus caudatus and/und
Putamen

Thalamus
- Nuclei dorsales et
ventrales
- Nuclei mediales

Sulcus circularis insulae

Clastrum

Putamen

Gyri breves insulae

Sulcus lateralis

Globus pallidus medialis,
Globus pallidus lateralis

Gyrus longus insulae

Sulcus circularis insulae

Thalamus
Nucleus reticularis

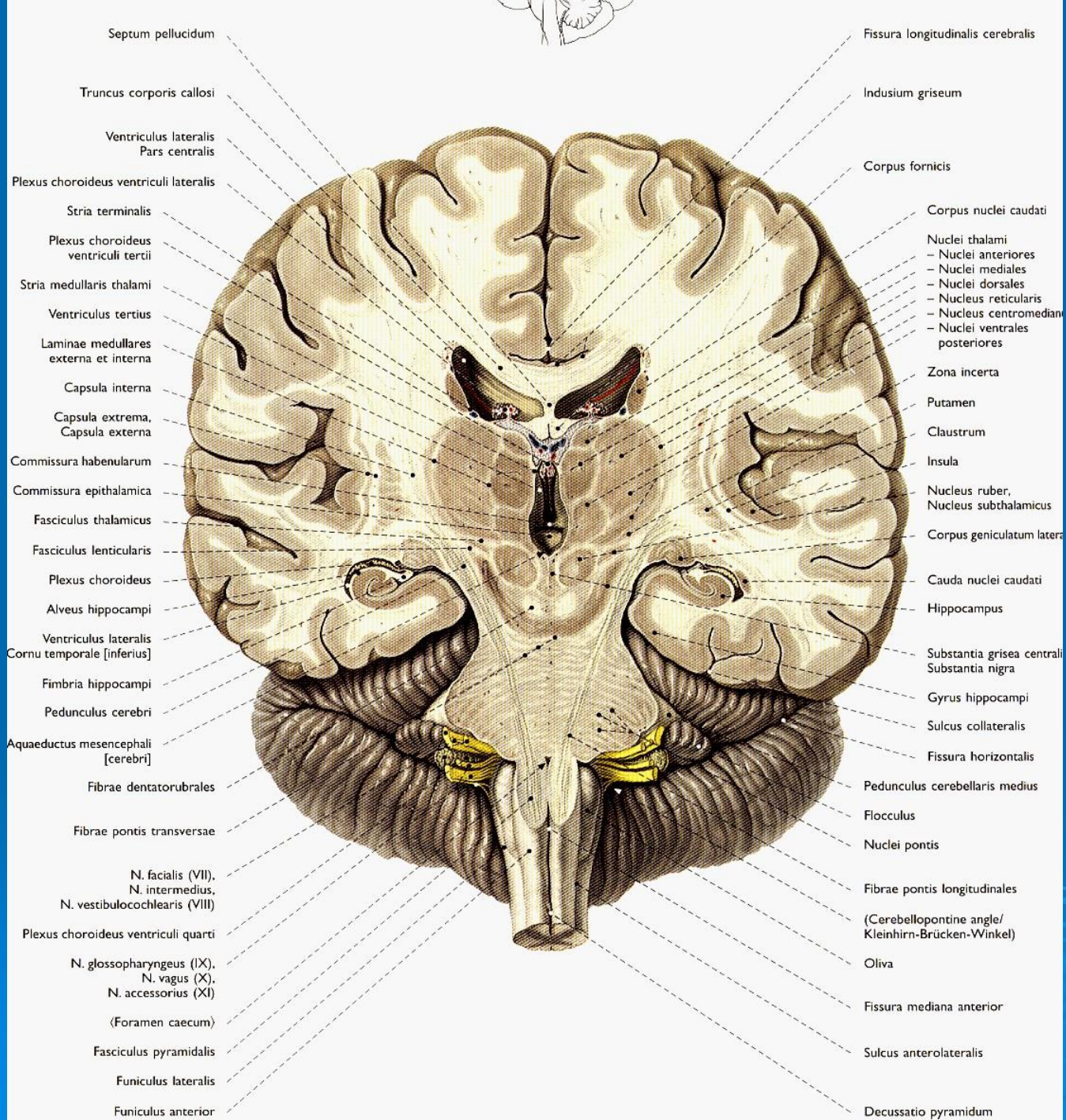
Nucleus subthalamicus

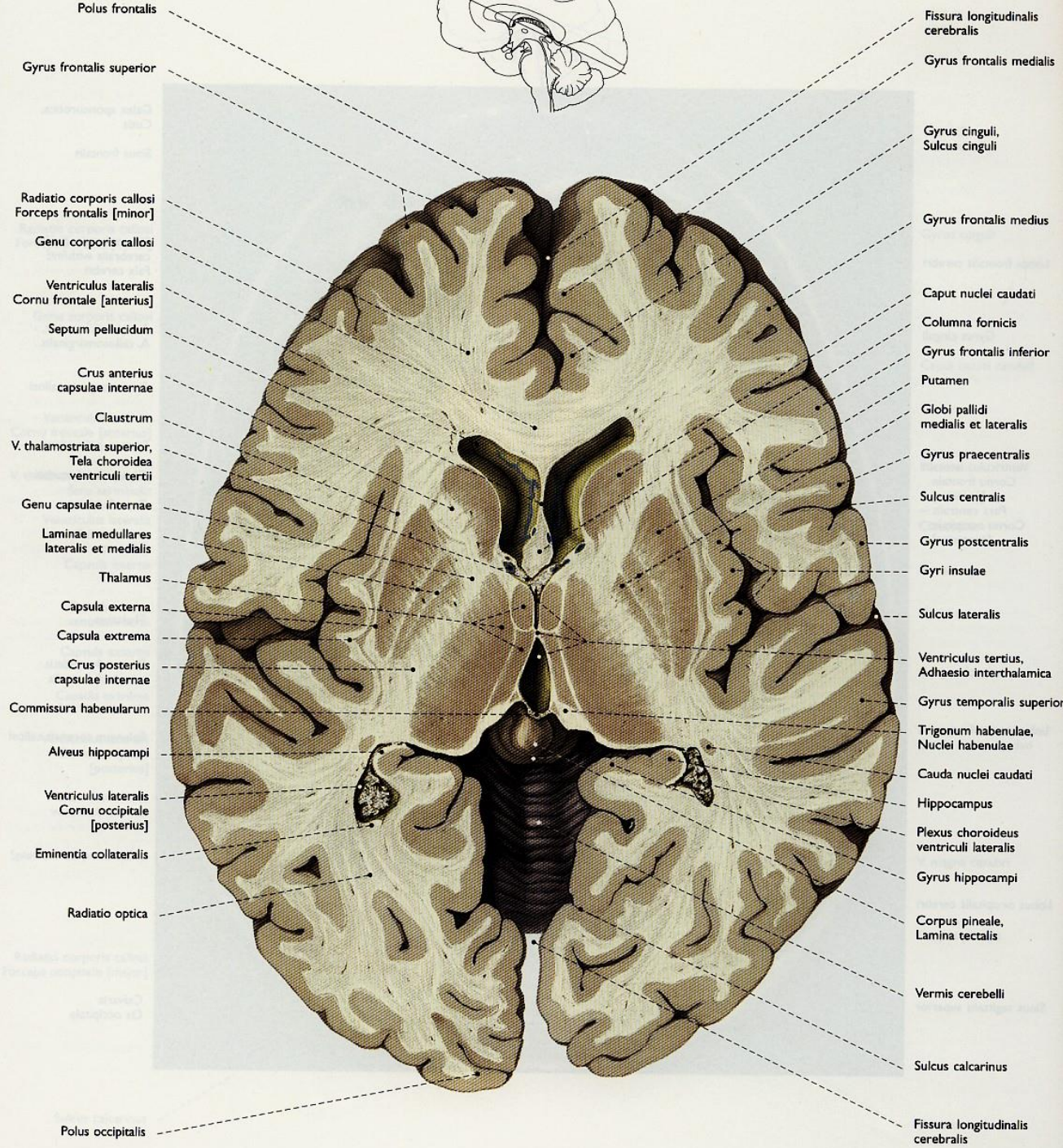
Cauda nuclei caudati

Corpus amygdaloideum

Substantia nigra

Corpus mamillare





a

Lobus frontalis cerebri

Genu corporis callosi

Septum pellucidum

Caput nuclei caudati

Crus anterius capsulae internae

Putamen

Thalamus

Crus posterius capsulae internae

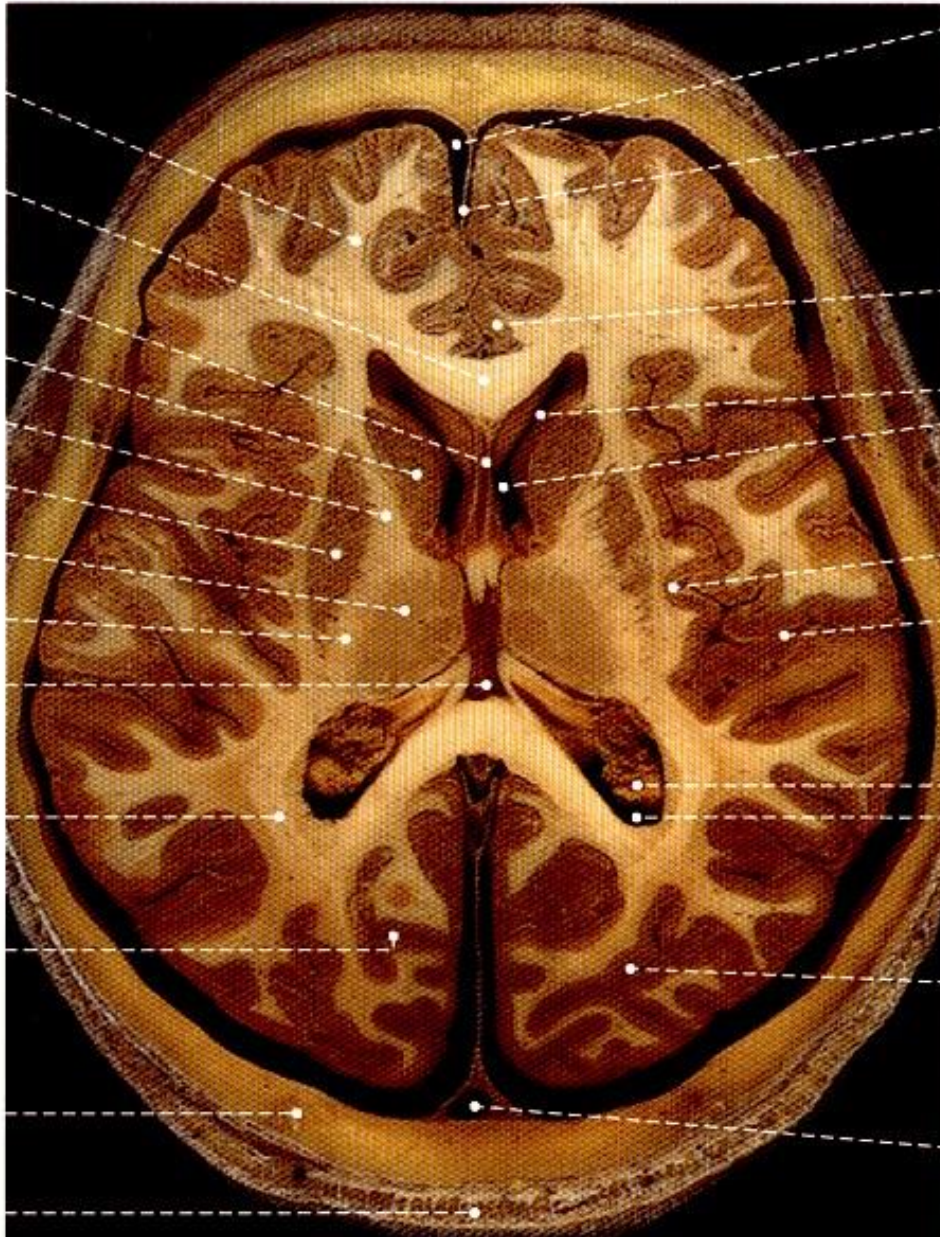
Ventriculus tertius

Radiatio optica

Sulcus calcarinus

Calvaria
Os occipitale

Galea aponeurotica



Fissura longitudinalis cerebri

Falx cerebri

Gyrus cinguli

Ventriculus lateralis

– Cornu frontale [anterius]

– Pars centralis

Insula

Sulcus lateralis

Ventriculus lateralis

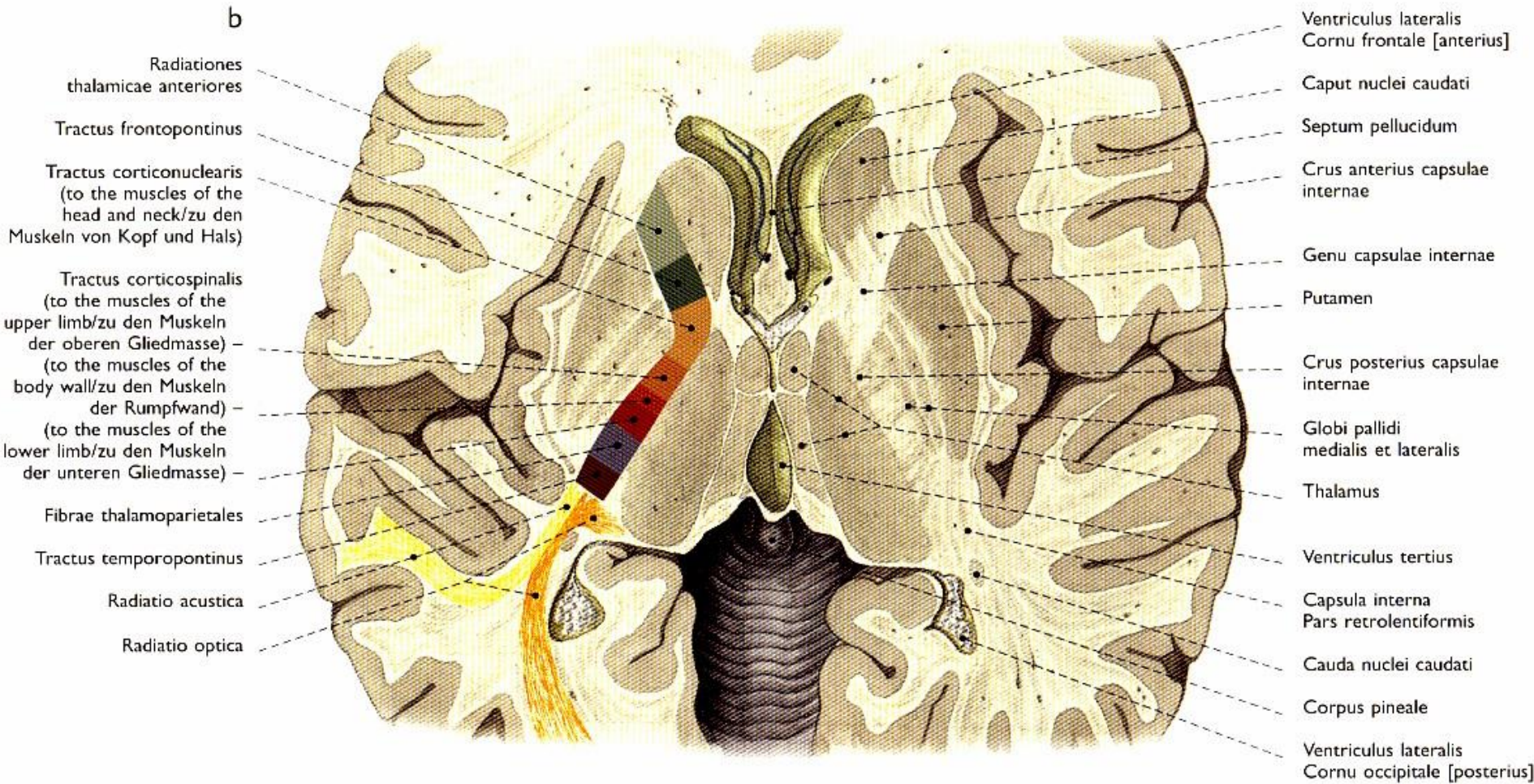
– Plexus choroideus ventriculi latera

– Cornu occipitale [posterius]

Lobus occipitalis cerebri

Sinus sagittalis superior

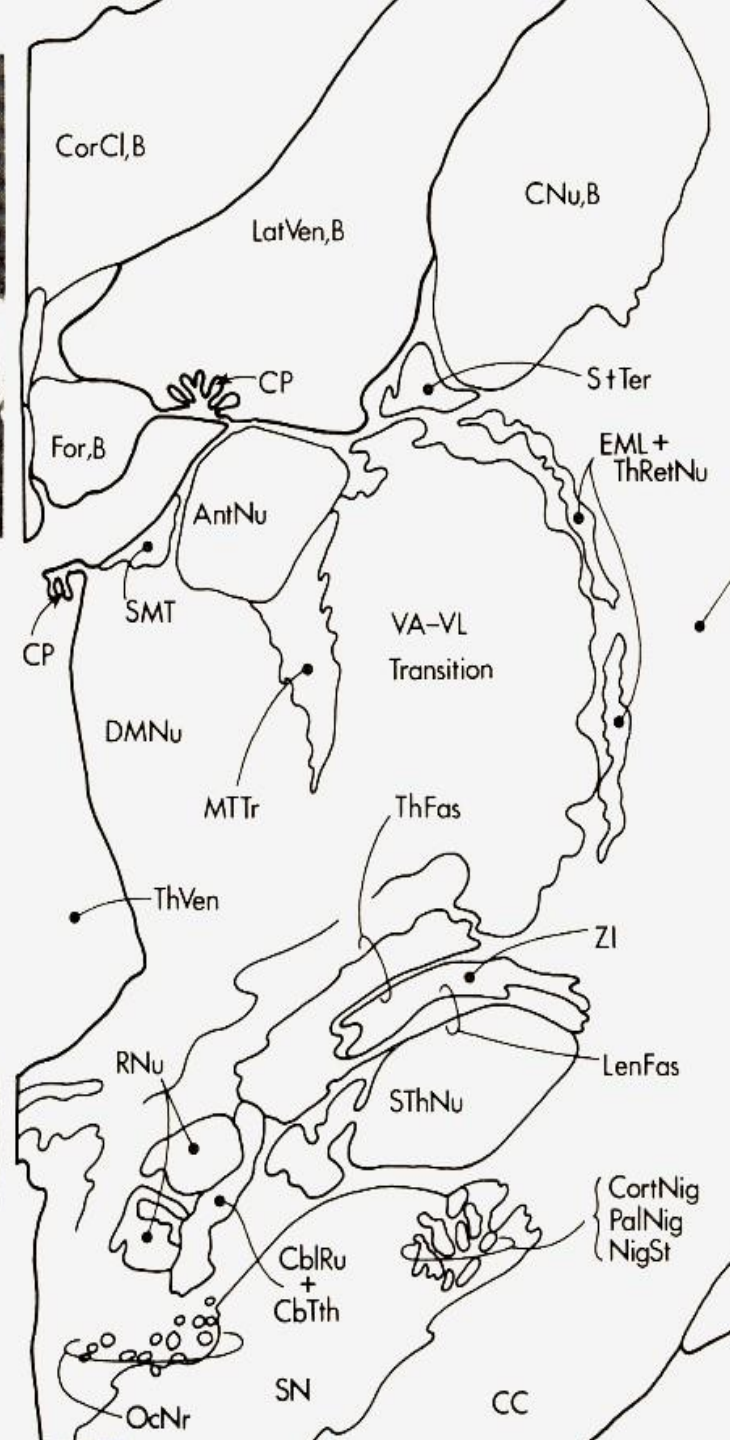
THALAMUS AND BASAL GANGLIA – *horizontal section*



CAPSULA INTERNA

THE THALAMUS - NUCLEI

- Anterior nuclei
- Medial nuclei (mediodorsalis nc.)
- Lateral nuclei – dorsal tier (lateral dorsal nc., lateral posterior nc., posterior ncll., (ncll. of pulvinar)
- **ventral tier** (**ventralis anterior – VA, ventralis lateralis – VL, ventralis posterolateralis- VPL, ventralis posteromedialis – VPM, ventralis intermedialis - VIM**
- **Medial geniculate ncl.**
- **Lateral geniculate ncl.**
- **Intralaminar nuclei**
- Midline nuclei
- Reticular nucleus

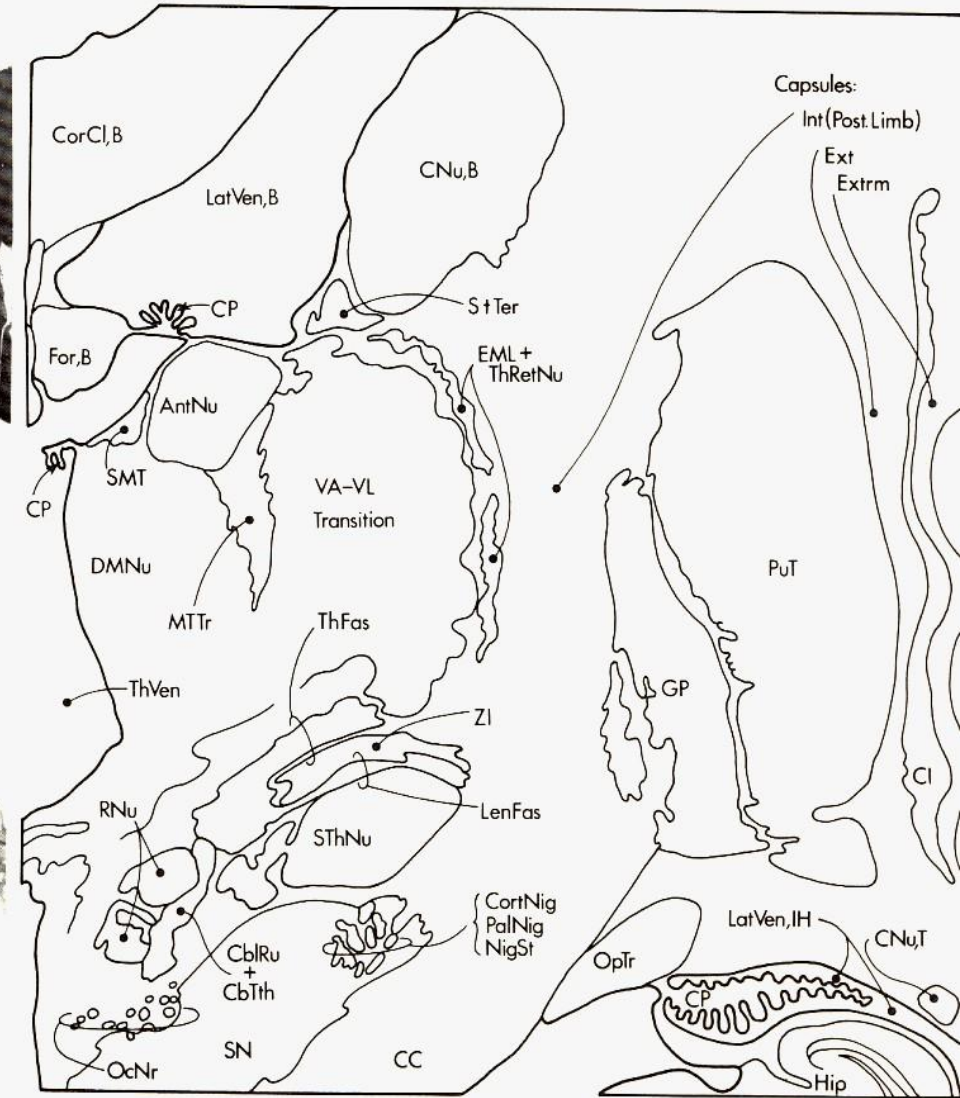


SUBTHALAMUS

Zona incerta

Subthalamic nc.



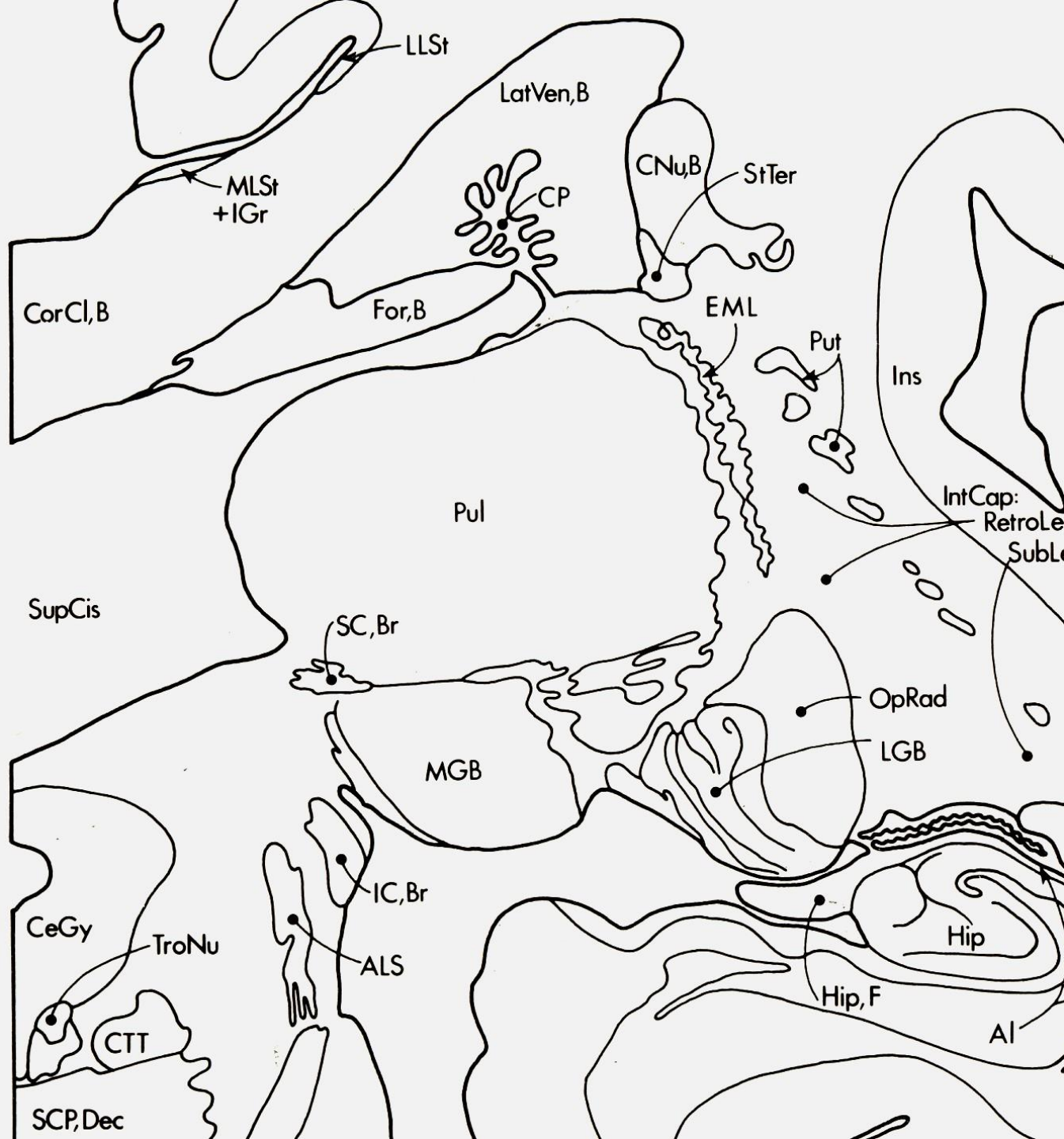


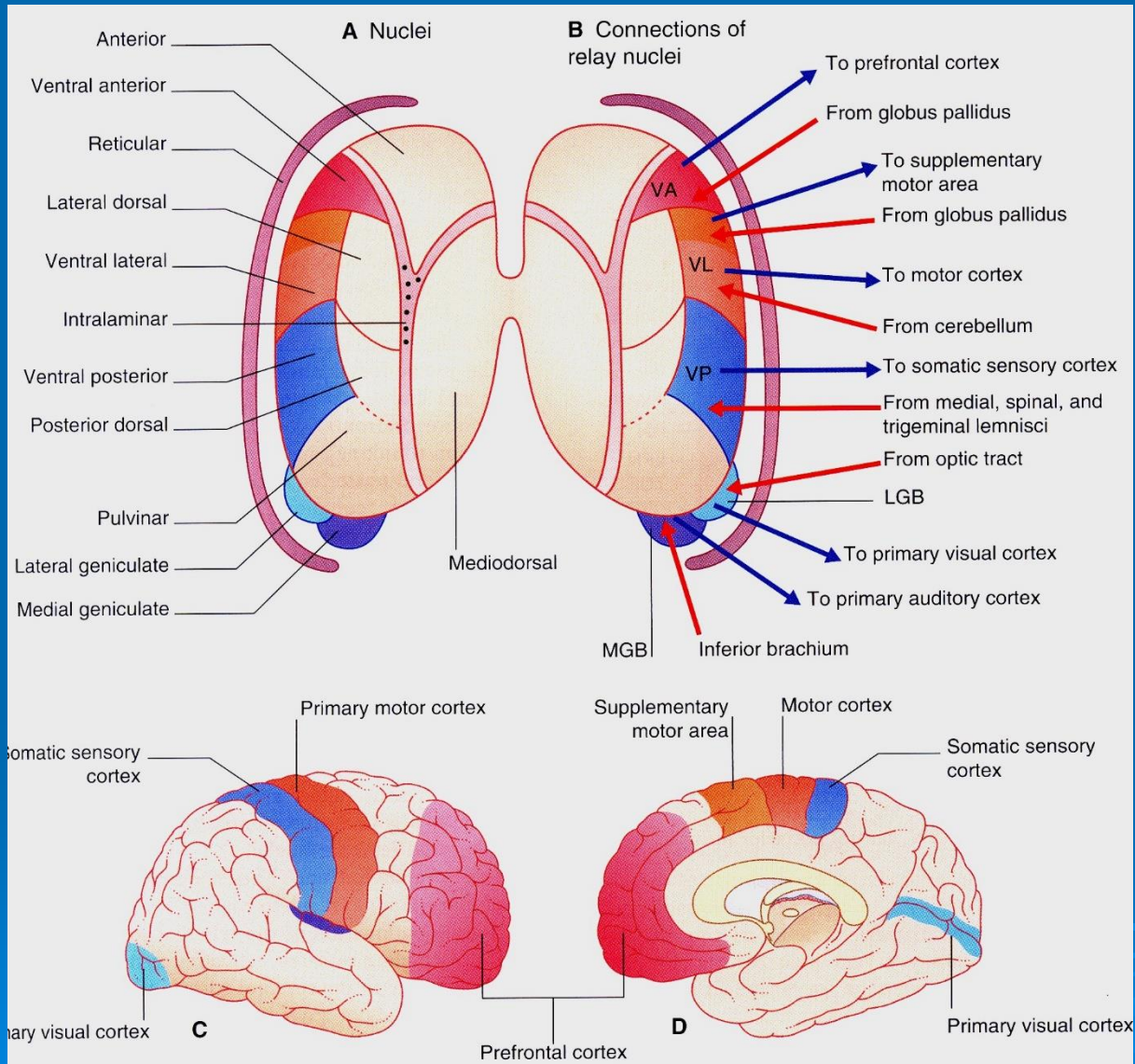
PULVINAR –
posterior nuclei

METATHALAMUS=
Medial and lateral
geniculate bodies

**CORPORA
GENICULATA**







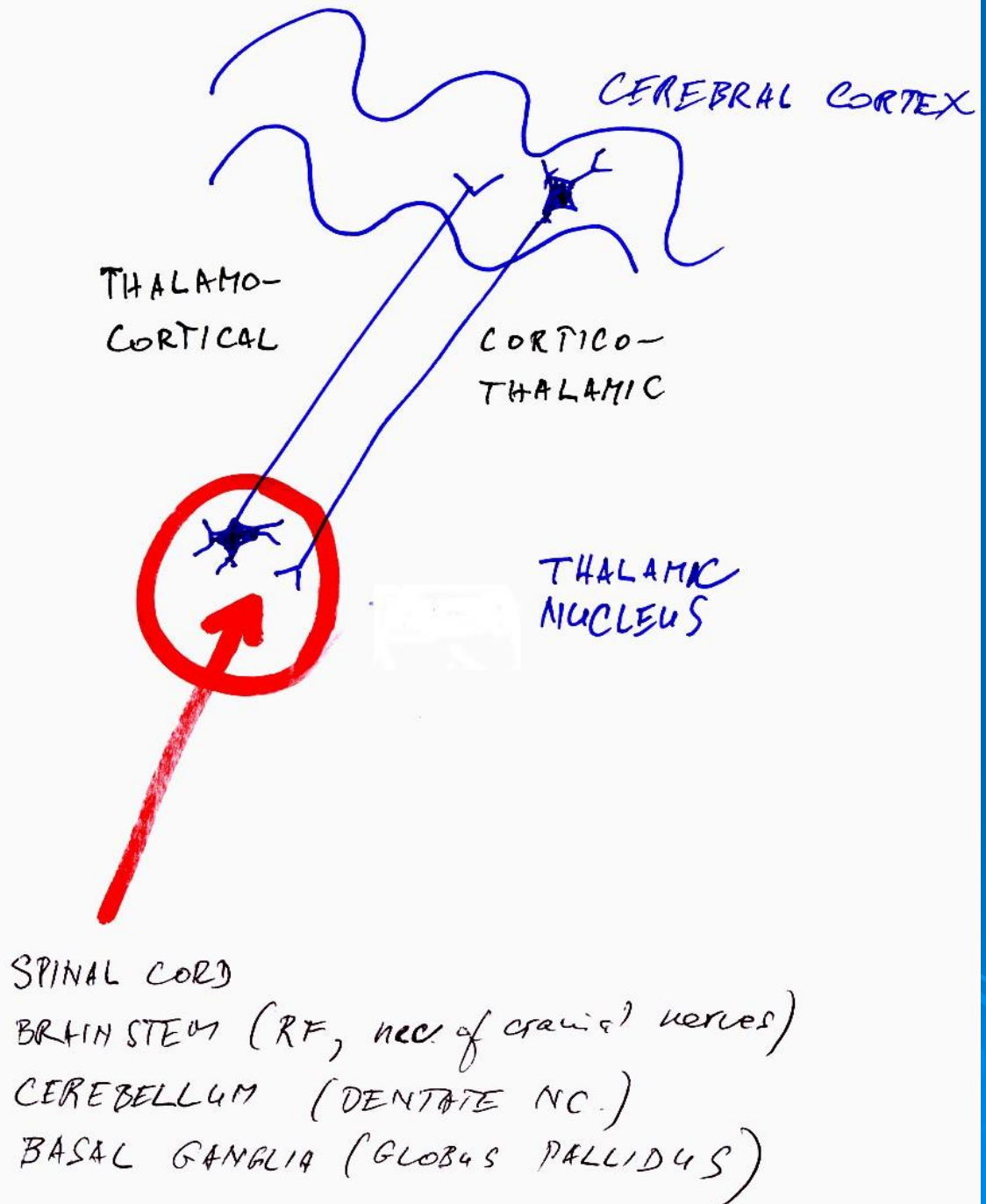
Parcellation of thalamic nuclei according Michigan's school

Table 16-1 Topographical Subdivisions of the Thalamus and Their Principal Nuclei

Subdivision	Principal nucleus or nuclei	Common abbreviation
Anterior division	Anterior	
Medial division	Dorsomedial	DM
Lateral division	Dorsal tier	
	Lateral dorsal	LD
	Lateral posterior	LP
	Pulvinar	
	Ventral tier	
	Ventral anterior	VA
	Ventral lateral	VL
	Ventral posterior	
	Ventral posterolateral	VPL
	Ventral posteromedial	VPM
	Medial geniculate	MGN
	Lateral geniculate	LGN
Intralaminar nuclei	Centromedian	CM
	Parafascicular	PF
	Others	
Reticular nucleus	Reticular nucleus	

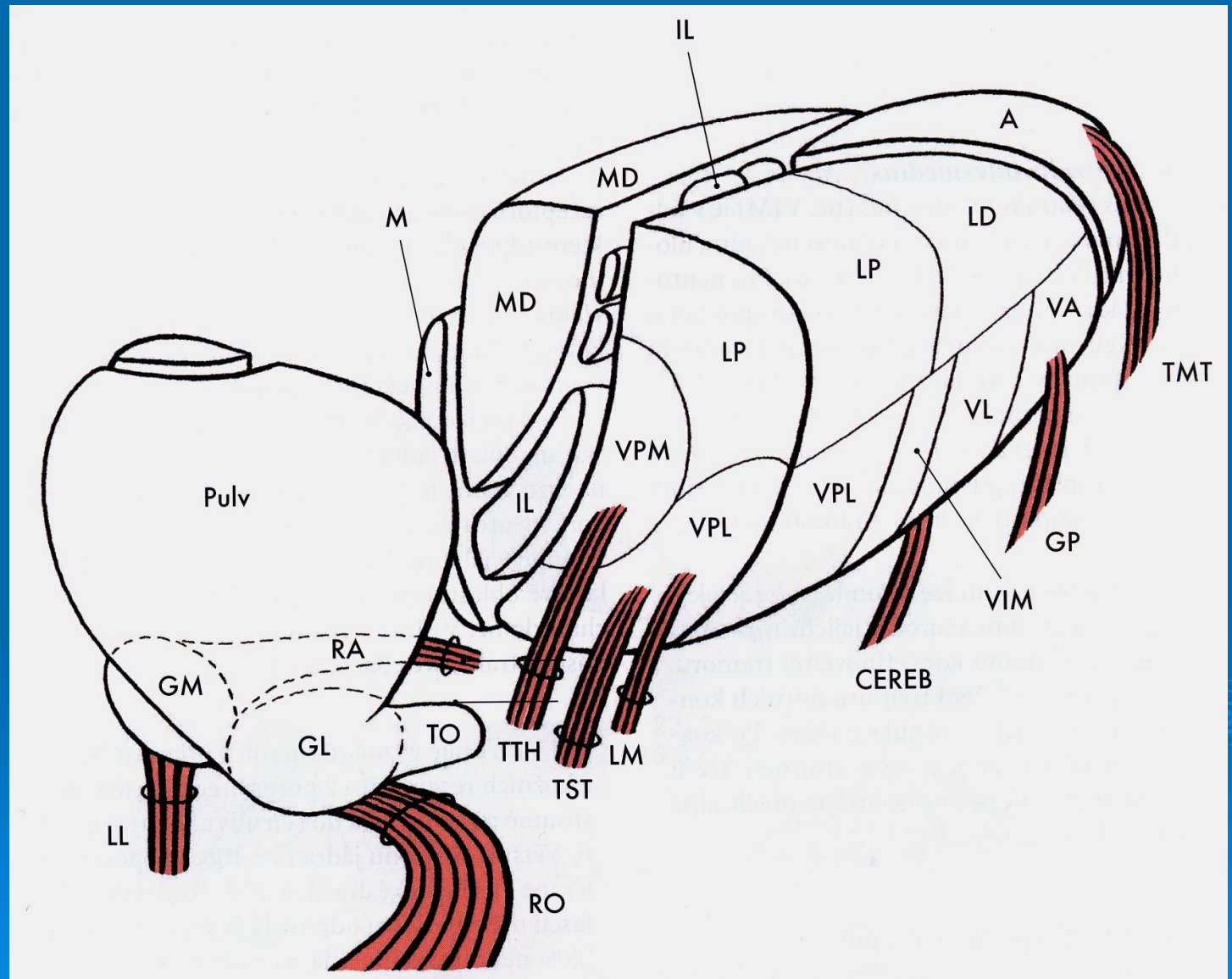
Neuronal connections of thalamic nuclei

Zapojení thalamických jader

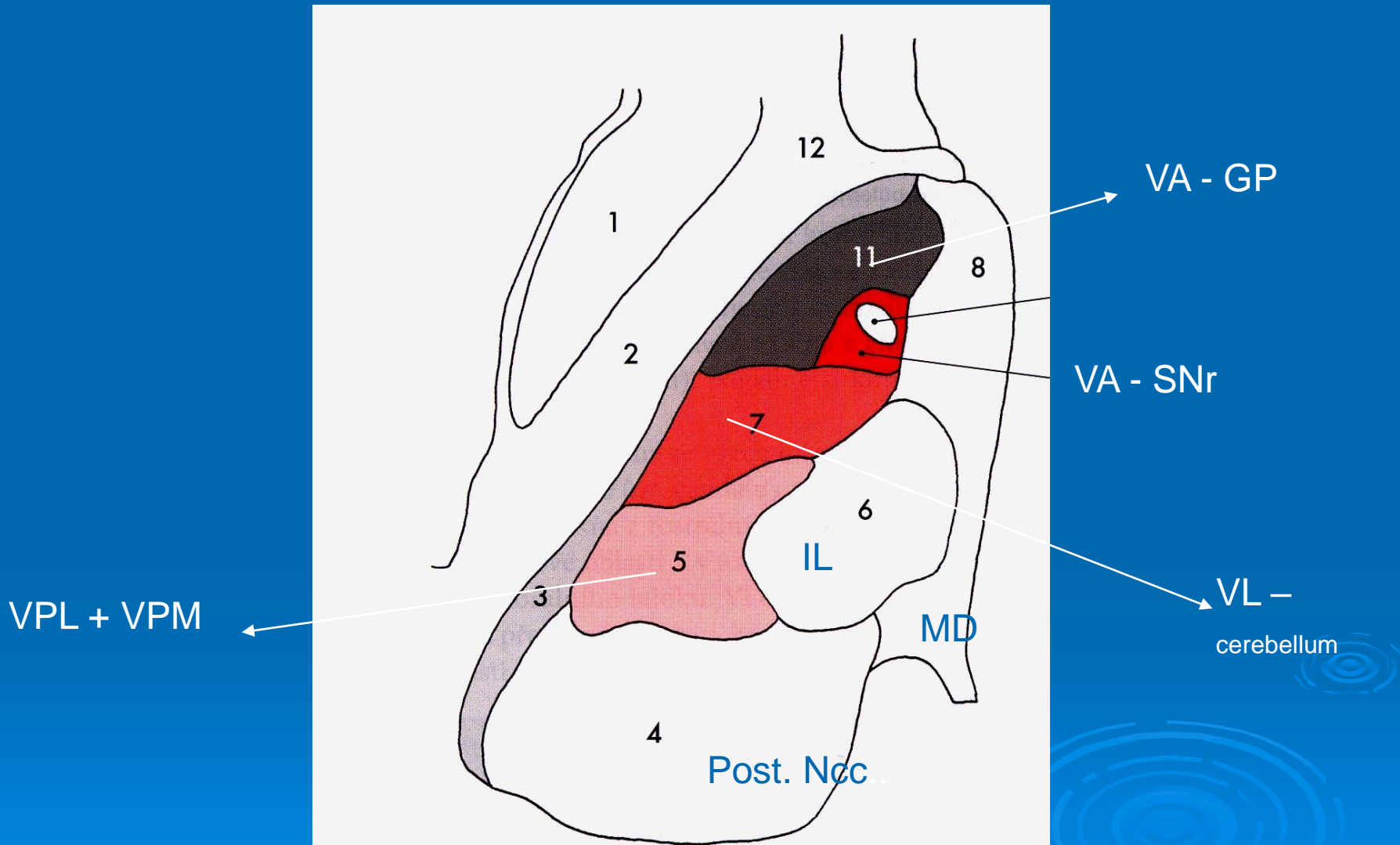


Podkorová aferentace talamických jader

Subcortical afferentation of thalamic nuclei



Termination of subcortical fibers in the thalamus – horizontal section



Thalamic nuclei

- **Relay nuclei (relé jádra, přepojovací jádra) —**
MGN, LGN, VPL, VPM, VL, VA
 - Receives input predominantly from a single source
 - Processed information is sent to a localized region of cortex
 - Are modality specific
 - Specific nuclei (after stimulation sharply localized cortical response)

Association nuclei

- MD, LD, LP, Posterior ncll.
 - Receives input from a number of structures or cortical areas
 - Sends fibers to the association cortical areas

Nonspecific nuclei

Intralaminar nuclei (centromedian, parafascicular)

- **Afferents** - from RF, spinothalamic fibers, cerebellum, BG
- **Efferents** – extensive areas of the frontal and parietal lobes, basal ganglia (striatum)
- **Function** – influence levels of consciousness and degrees of alertness

Projekce talamických jader do neokortexu (thalamokortikální projekce)

Thalamocortical projections

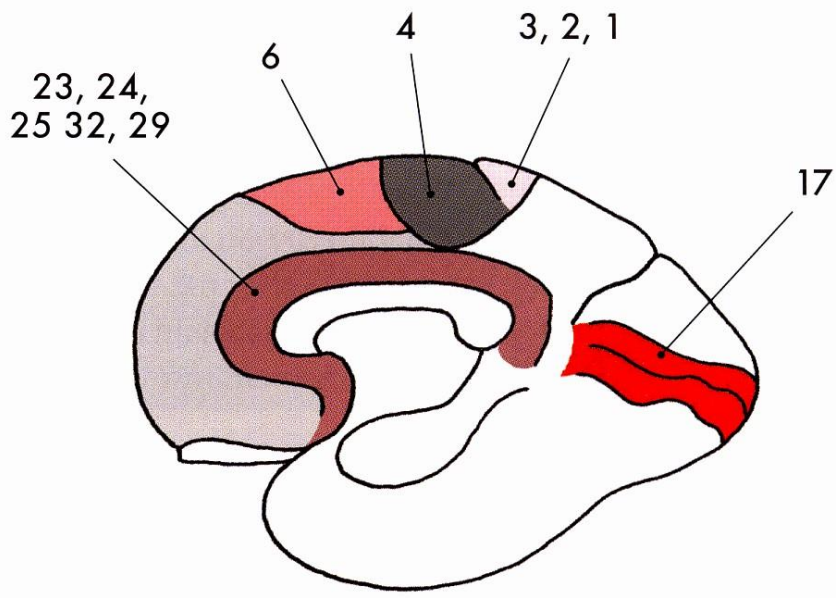
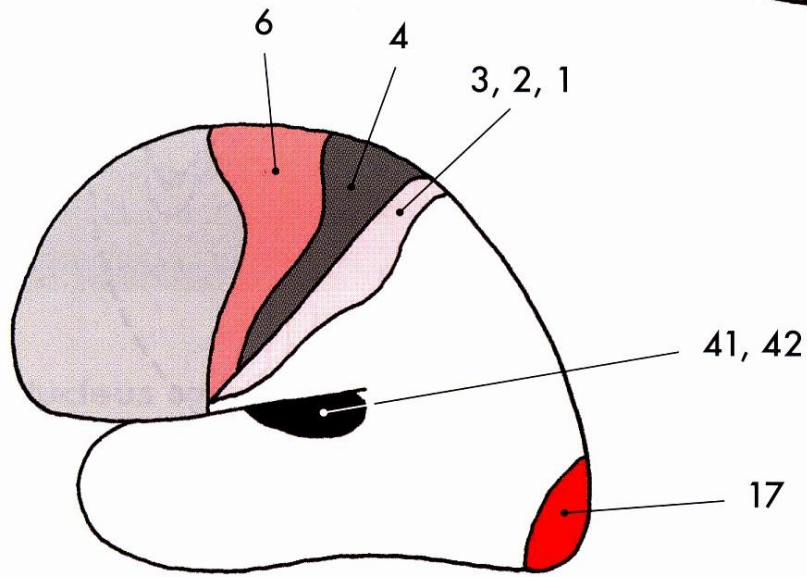
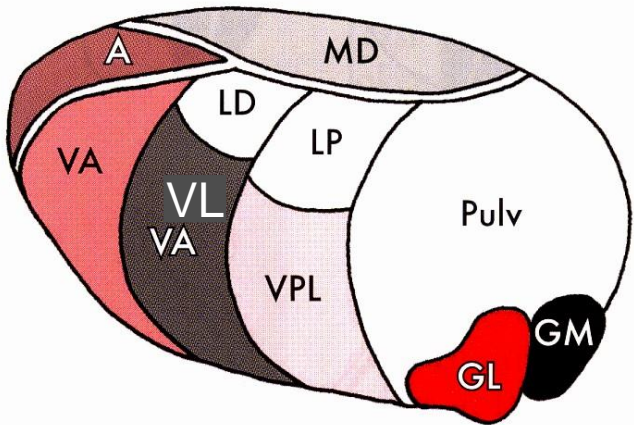


Table 16-2 Specific Inputs to and Cortical Outputs From Thalamic Relay and Association Nuclei

Type	Nucleus	Specific inputs	Cortical output
Relay	Anterior	Mammillothalamic tract, hippocampus	Cingulate gyrus
	Lateral dorsal (LD)	Hippocampus	Cingulate gyrus
	Ventral anterior, ventral lateral (VA/VL)*	Basal ganglia, cerebellum	Motor areas
	Ventral posterolateral (VPL)	Medial lemniscus (body), spinothalamic tract (body)	Somatosensory cortex
	Ventral posteromedial (VPM)	Medial lemniscus (face), spinothalamic tract (face)	Somatosensory cortex
			Central tegmental tract (taste)
Association	Medial geniculate (MGN)	Brachium of the inferior colliculus	Auditory cortex
	Lateral geniculate (LGN)	Optic tract	Visual cortex
	Dorsomedial† (DM)	Prefrontal cortex, olfactory and limbic structures	Prefrontal cortex
	Lateral posterior (LP)	Parietal lobe	Parietal lobe
	Pulvinar	Parietal, occipital, and temporal lobes	Parietal, occipital, and temporal lobes

*Basal ganglia outputs go mostly to VA and cerebellar outputs mostly to VL, but the two are considered together as a combined motor relay nucleus in this account.

†Also commonly referred to as the *mediodorsal nucleus (MD)*.

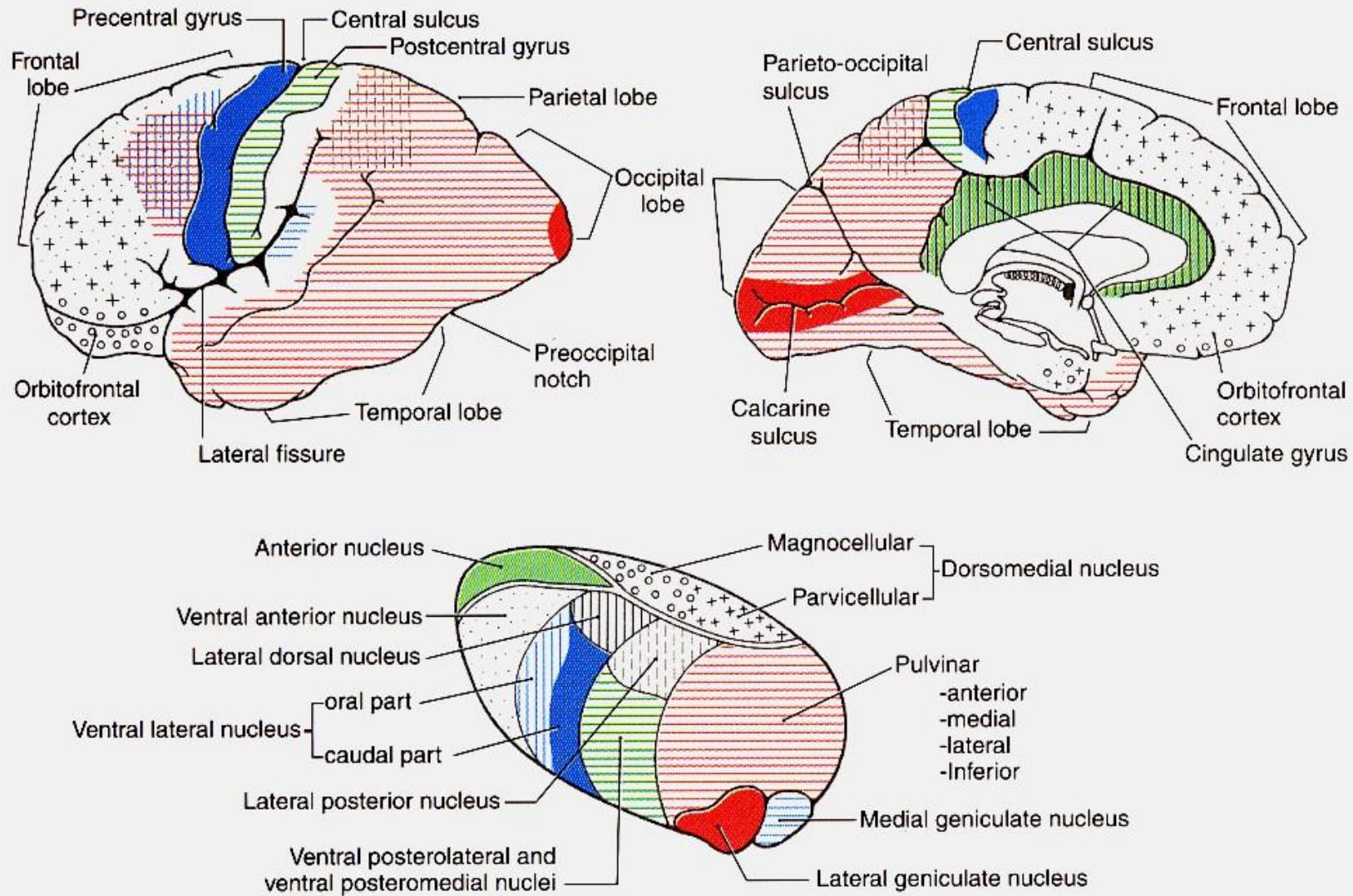


Figure 15-10. Relationship of the thalamic nuclei with the cerebral cortex as depicted by the patterns of thalamocortical connections. Each thalamic nucleus is pattern-coded or color-coded to match its target area in the cerebral cortex.

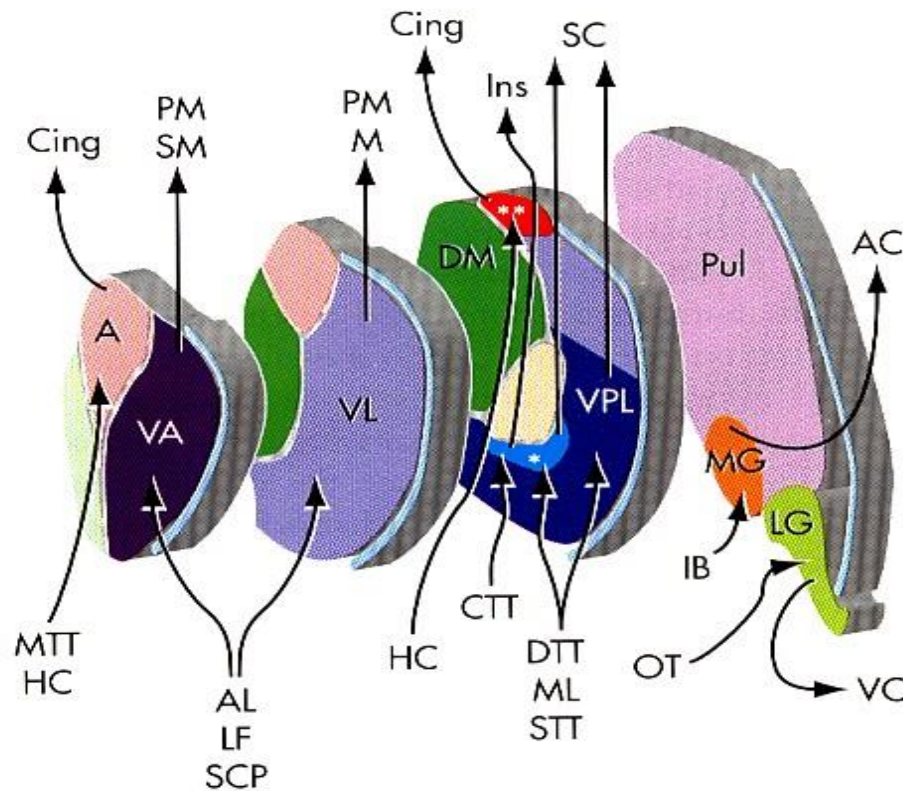


FIGURE 16-18

Major specific inputs to and outputs from relay nuclei. Thalamic nuclei: *, Ventral posteromedial nucleus; **, lateral dorsal nucleus; A, anterior nucleus; DM, dorsomedial nucleus; LG, lateral geniculate nucleus; MG, medial geniculate nucleus; Pul, pulvinar; VA, ventral anterior nucleus; VL, ventral lateral nucleus; VPL, ventral posterolateral nucleus. Input pathways and structures: AL, Ansa lenticularis (see Chapter 19); CTT, central tegmental tract; IB, brachium of the inferior colliculus; DTT, dorsal trigeminal tract; HC, hippocampus; LF, lenticular fasciculus (see Chapter 19); ML, medial lemniscus; MTT, mammillothalamic tract; OT, optic tract; SCP, superior cerebellar peduncle (see Chapter 20); STT, spinothalamic tract. Cortical destinations: AC, Auditory cortex; Cing, cingulate gyrus; Ins, insula; M, primary motor cortex (precentral gyrus); PM, premotor cortex (see Chapter 18); SC, somatosensory cortex; SM, supplementary motor area (see Chapter 18); VC, visual cortex.

Somatotopic organization of the VPL and VPM ncll. =

termination of the lemniscal system and trigeminothalamic pathway

Somatotopická organizace VPL a VPM

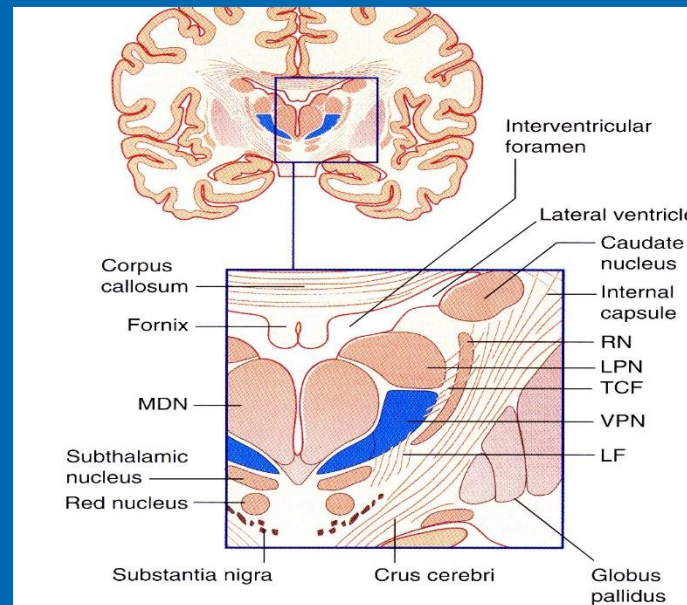
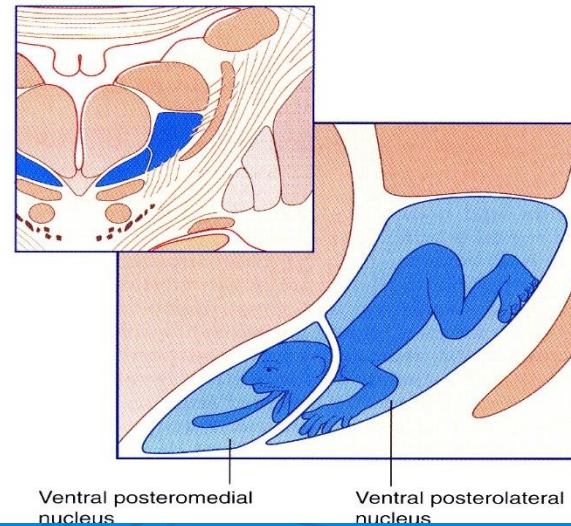


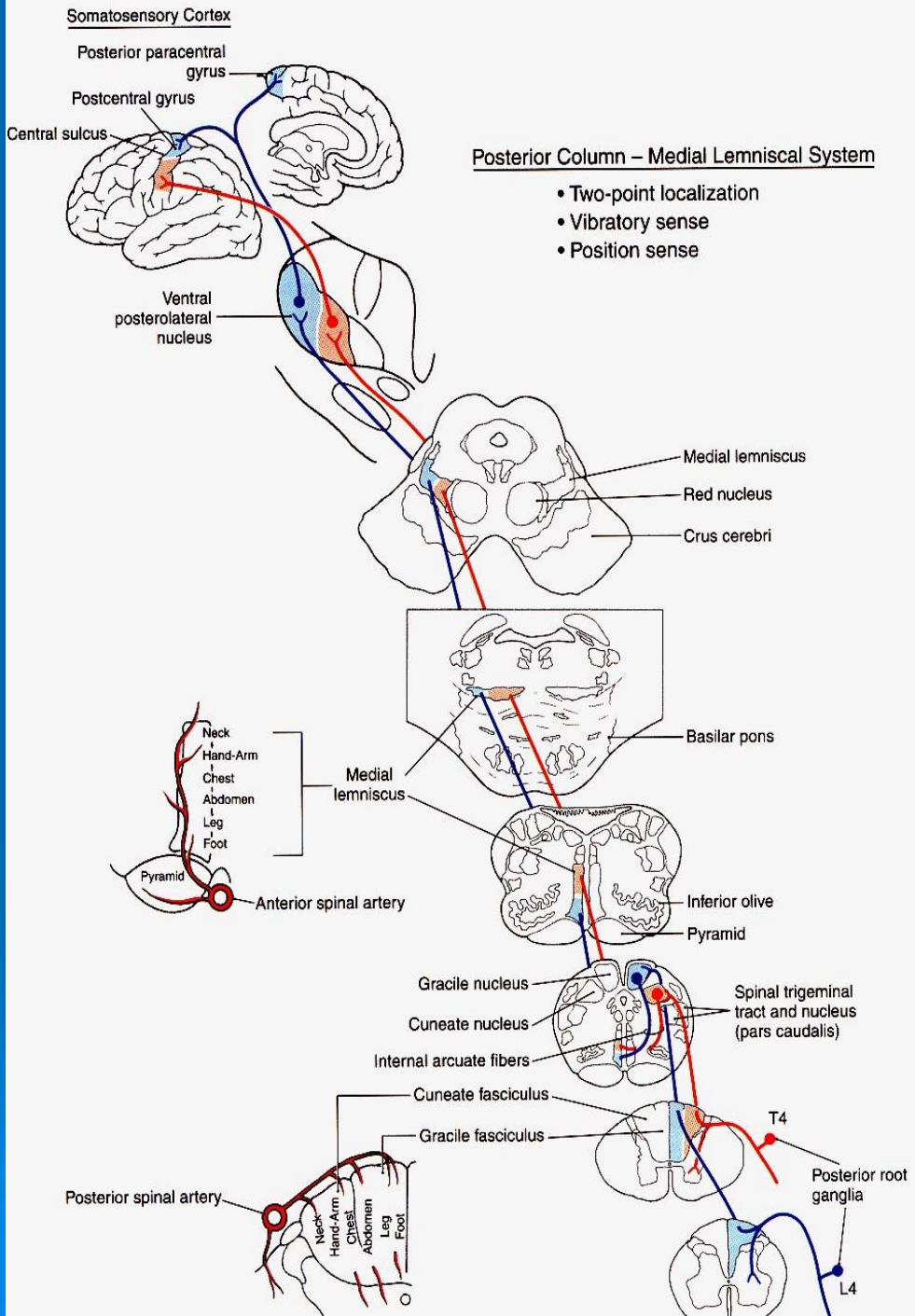
Figure 27.2 Coronal section through the thalamus and related structures. LF, lemniscal fibers; LPN, lateral posterior nucleus; MDN, mediodorsal nucleus; RN, reticular nucleus; TCF, thalamocortical fibers; VP, ventral posterior nucleus.



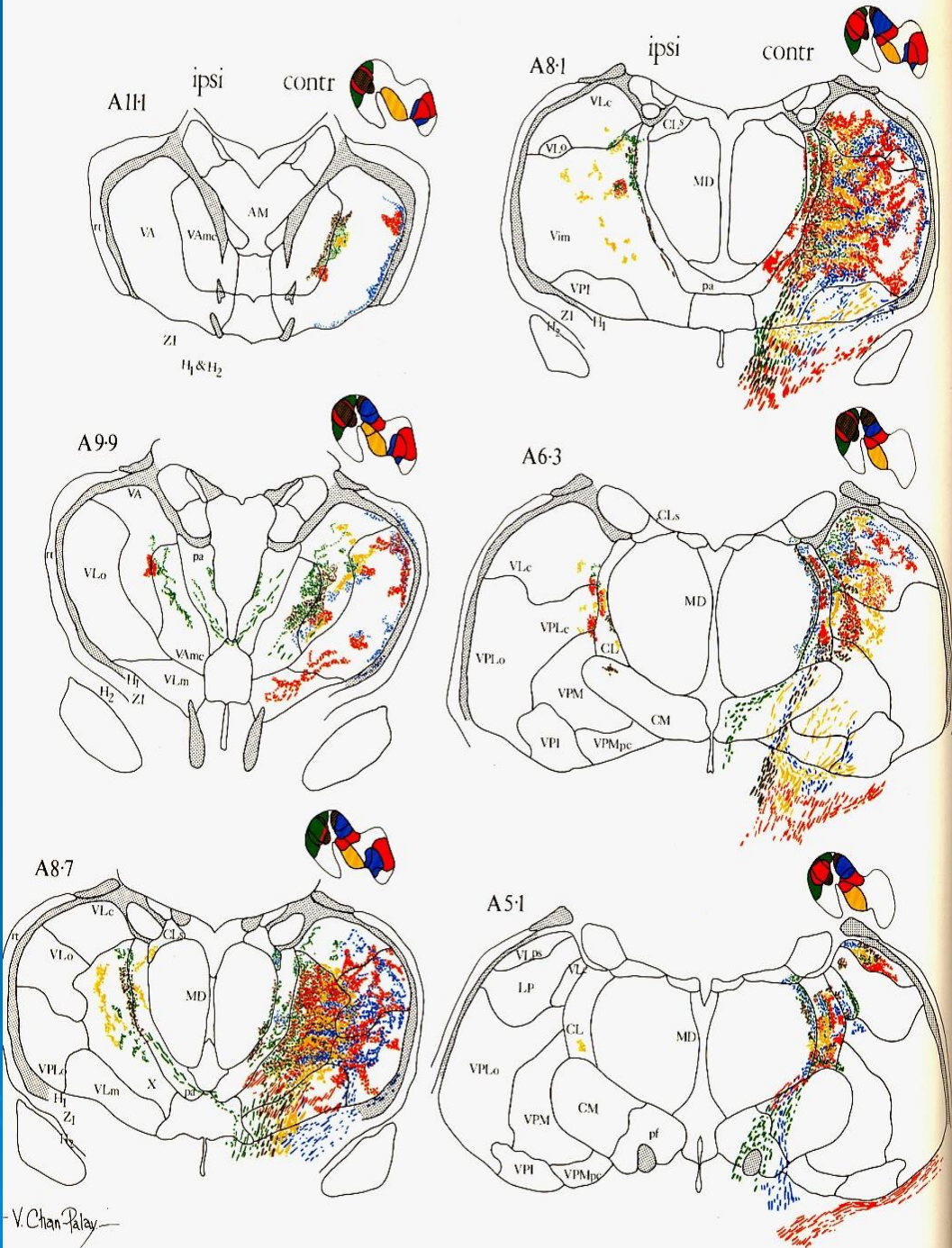
Ventral posteromedial nucleus

Ventral posterolateral nucleus

Lemniskový systém



Dentato-talamická projekce



V. Chan-Palay

Talamokortikální projekce

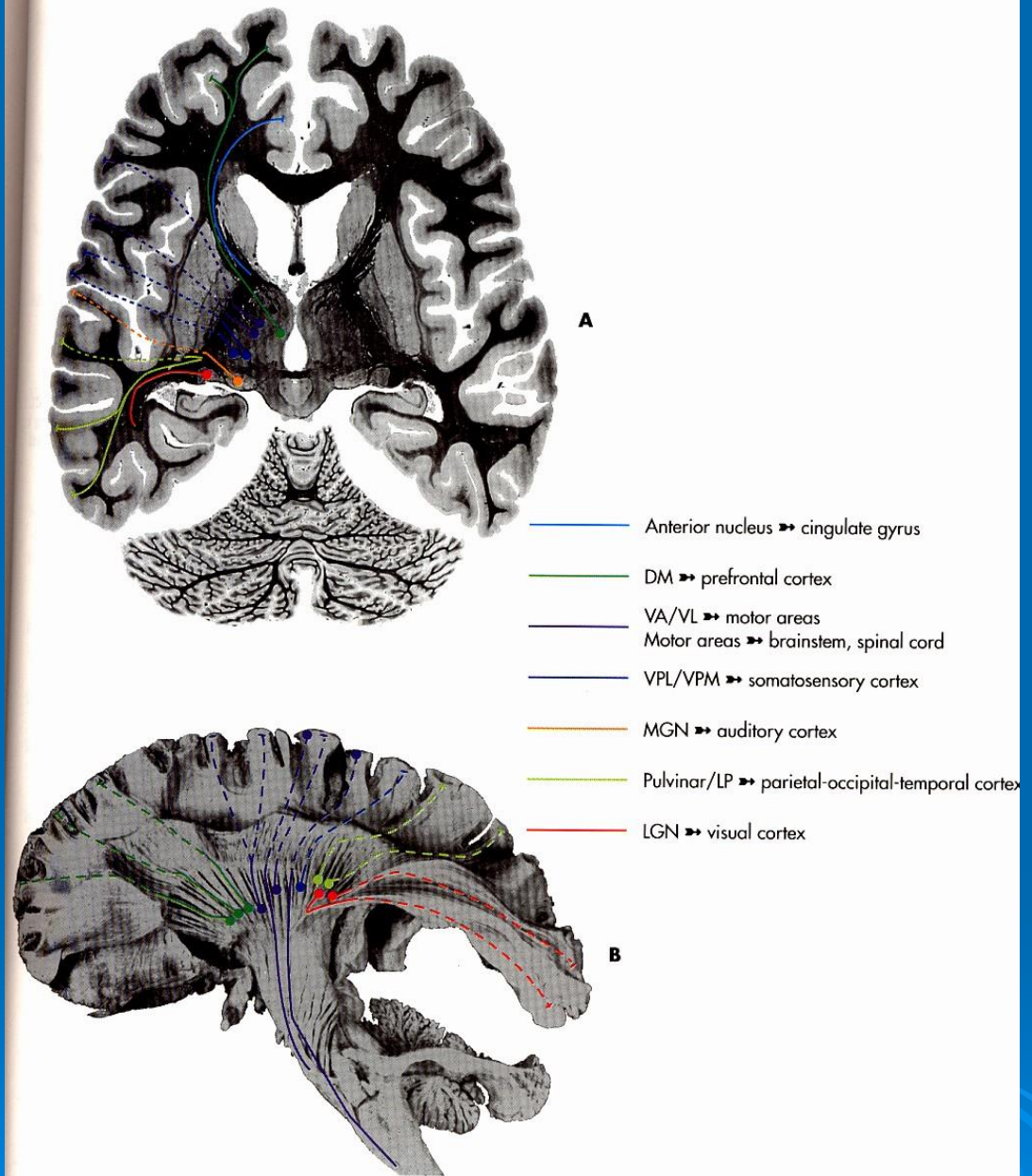


FIGURE 16-25

Principal components of the various parts of the internal capsule, as seen in a horizontal section (**A**) and in the dissection from Figure 16-24. The thalamic cell bodies indicated schematically in **B** would actually be on the other side of the internal capsule. Not all elements can be seen in both parts of the figure. For example, the anterior nucleus and the pulvinar are not present in the plane of section shown in **A**, so no cell bodies are indicated; neither cingulate nor auditory cortex is present in the dissection shown in **B**, so no projections to them are indicated. [**A** modified from Nolte J, Angevine JB Jr: *The human brain in photographs and diagrams*, ed 2, St. Louis, 2000, Mosby. **B** modified from Ludwig E, Klingler J: *Atlas cerebri humani*, Boston, 1956, Little, Brown.]

EPITHALAMUS

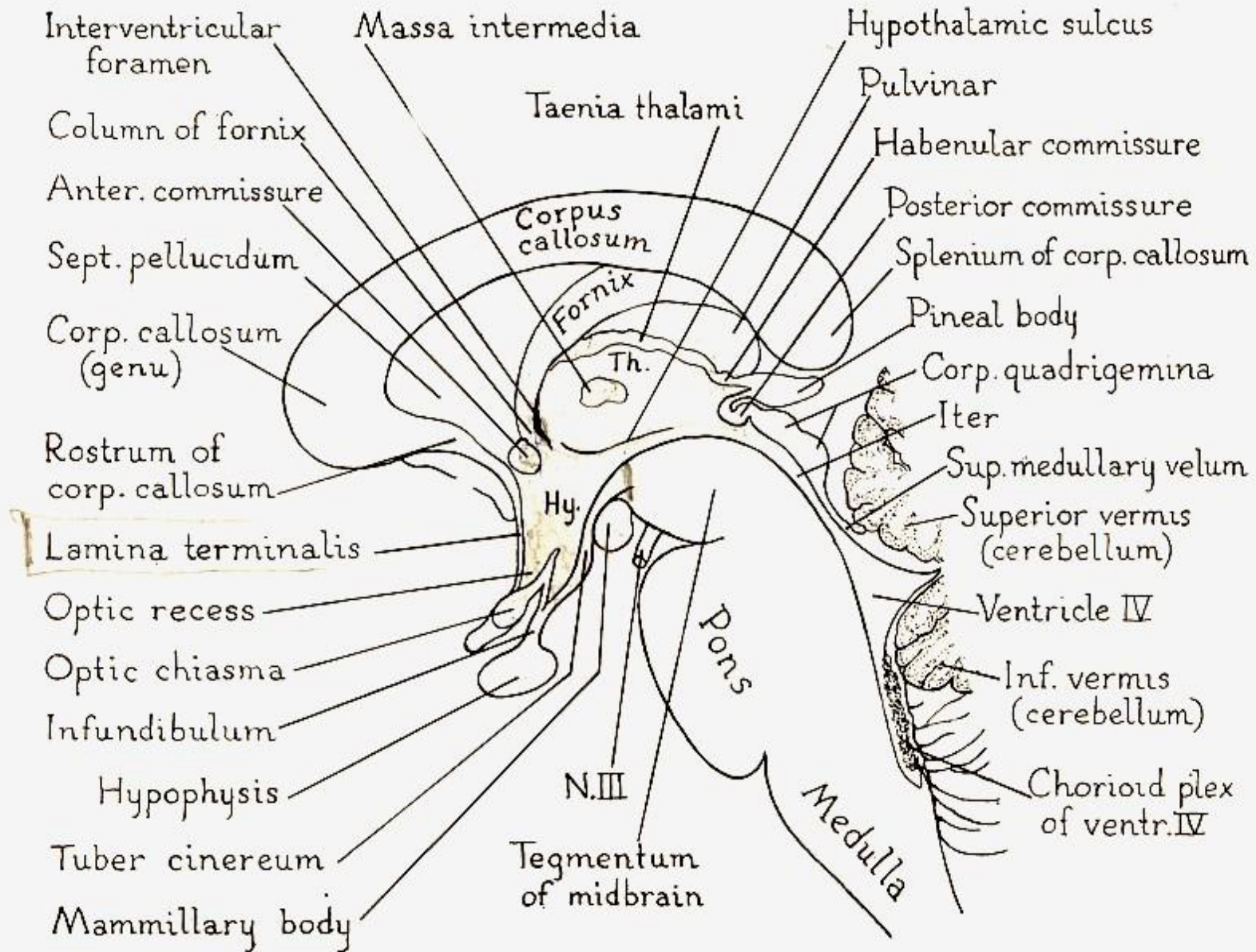


FIG. 262. Median sagittal section of brain stem. *Hy*, hypothalamus; *Th*, thalamus

EPITHALAMUS

- **Habenular nuclei**
- **Afferent fibers** – stria medullaris thalami (septum verum, olfactory cortex, hippocampus, hypothalamus, basal ganglia (globus pallidus))
- **Efferent fibers** – tractus habenulointerpeduncularis (RF, hypothalamus, ANS)
- **Glandula pinealis** - in amphibian and fishes contains light-sensitive cells. In mammals transformed to the endocrine gland.
 - Pinealocytes produce serotonin.
- **Afferent fibers** – superior cervical ganglion, hypothalamus, colliculus superior, LGB
- Pinealocytes produce serotonin – melatonin (night),
- Suppresses development of gonads (pinealectomy stimulates growth of the reproductive organs)

HYPOTHALAMUS



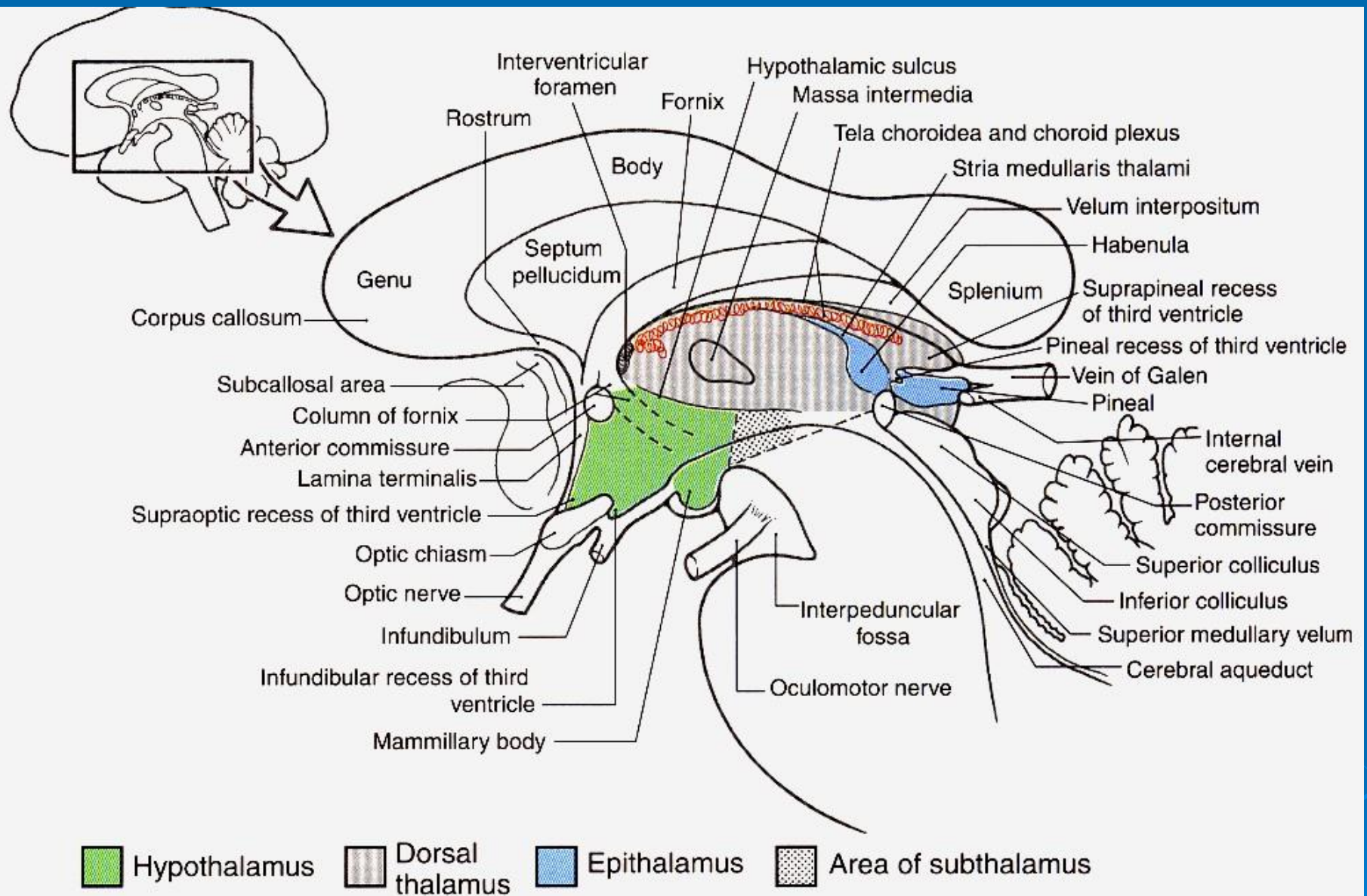


Figure 15-3. Mid-sagittal view of the diencephalon and closely related structures. This is a drawing of the specimen shown Figure 15-5.

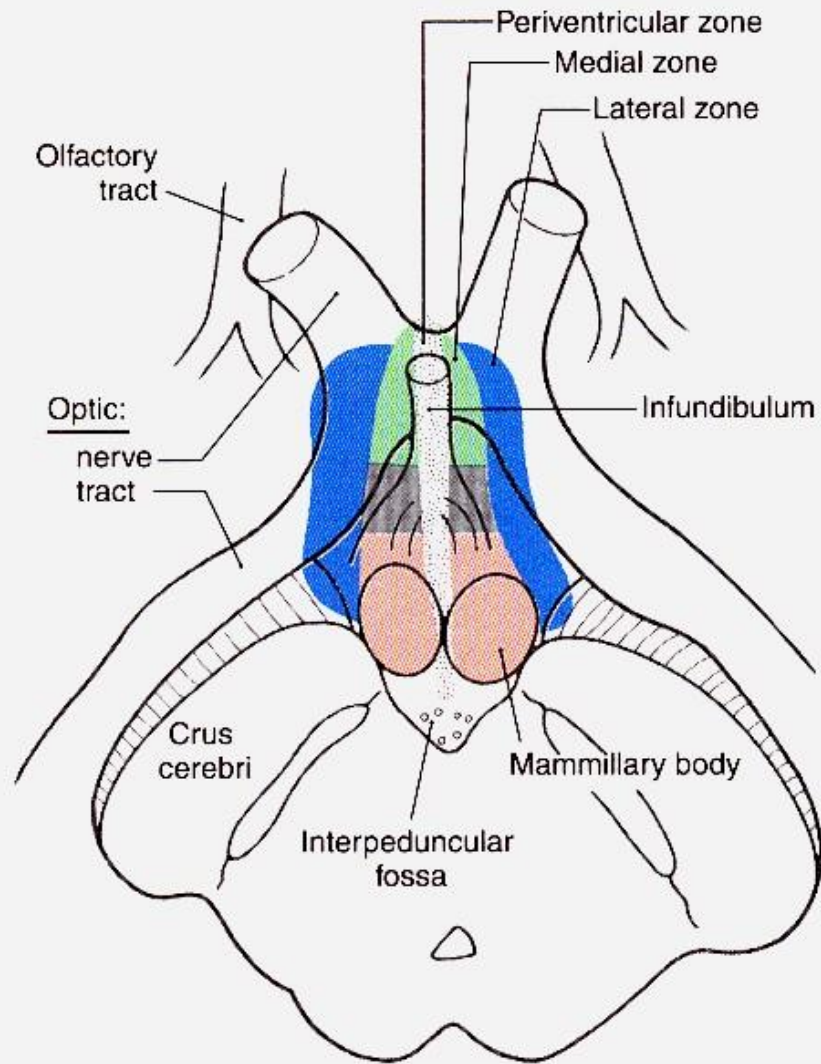


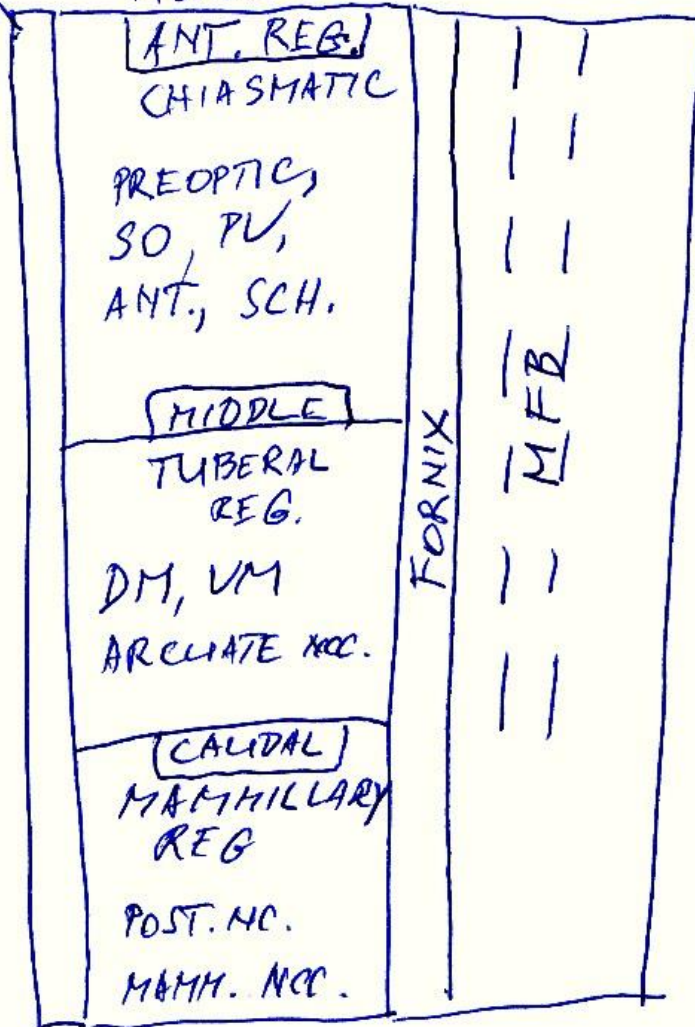
Figure 15-12. Anterior (ventral) view of the diencephalon illustrating the three zones of the hypothalamus as superimposed on external structures. The colors used for medial and lateral zones correlate with those in Figure 15-13.

PERIV.
ZONE

MEDIAL
ZONE

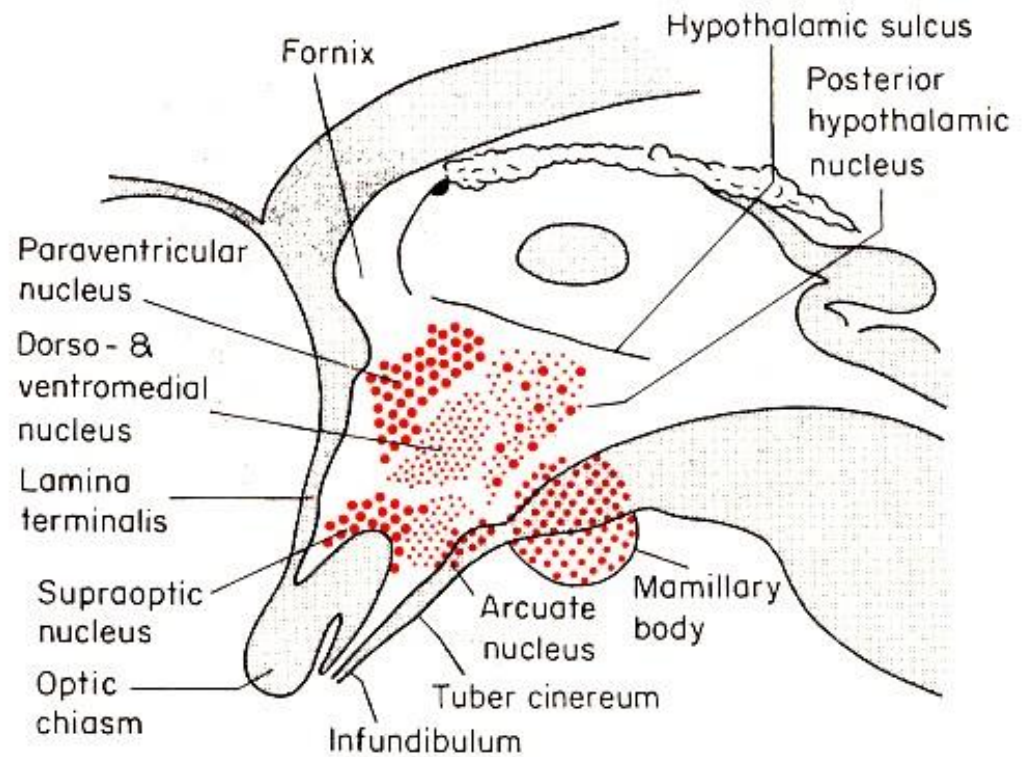
LATERAL ZONE

↓
NUCLEI



PROJEKCE HYPOTHALAMICKÝCH JADER NA MEDIÁLNÍ PLOCHU HYPOTHALAMU

Fig. 15.1. *The hypothalamus.* Median section through the third ventricle. Some of the major hypothalamic nuclei are shown with red dots. The size of the dots indicates the relative size of the neurons of the various nuclei. Redrawn after Le Gros Clark et al. (1936).



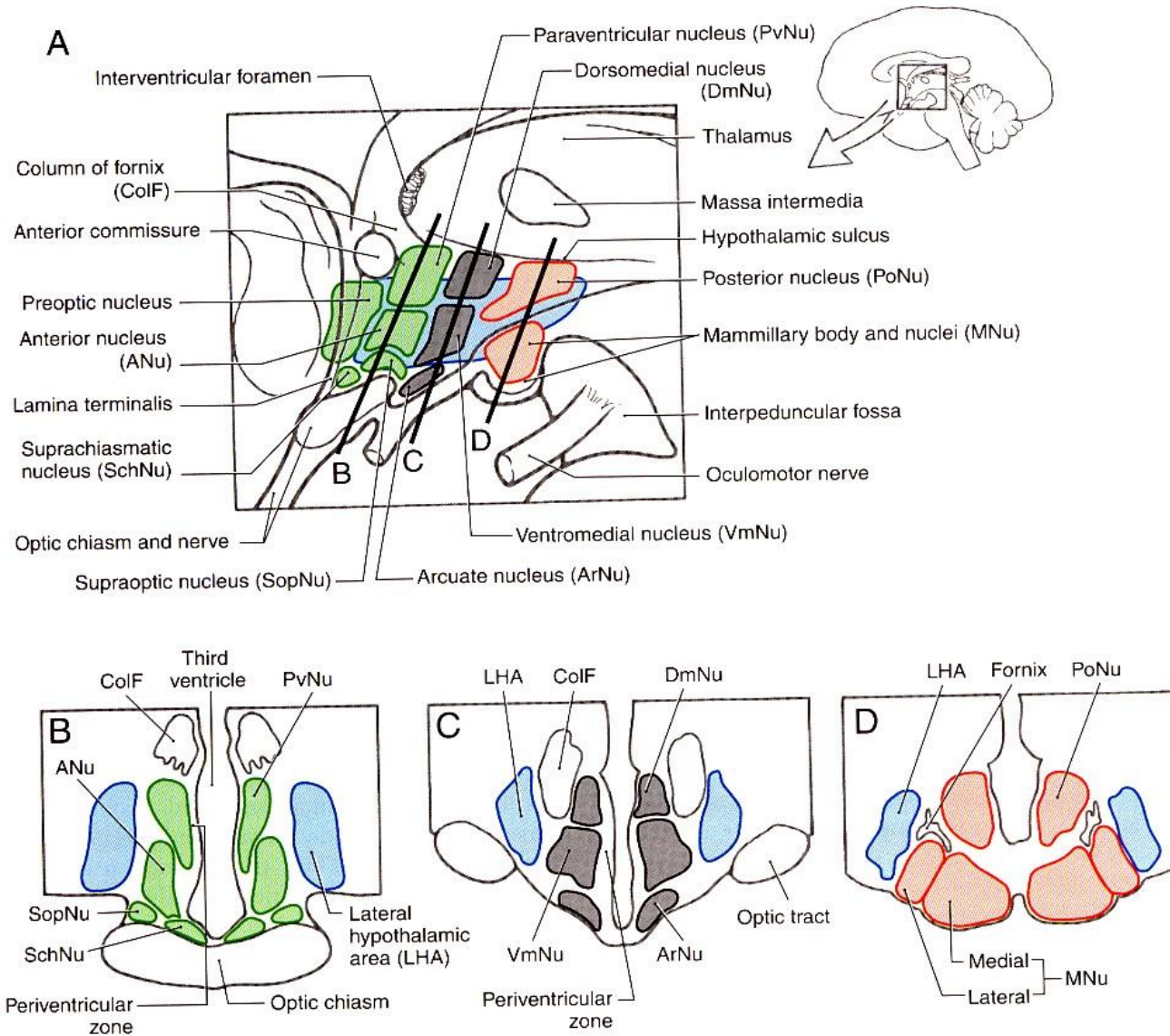


Figure 15-13. Mid-sagittal (*A*) and cross-sectional (*B-D*) views illustrating the nuclei of medial and lateral hypothalamic zones and the nuclei associated with chiasmatic (*B*), tuberal (*C*), and mammillary (*D*) regions. The colors used here correlate with those in Figure 15-12. (*A* adapted from Haymaker W, Anderson E, Nauta WJH: *The Hypothalamus*. Charles C Thomas, Springfield, Ill., 1969, with permission.)

Aferent hypothalamu

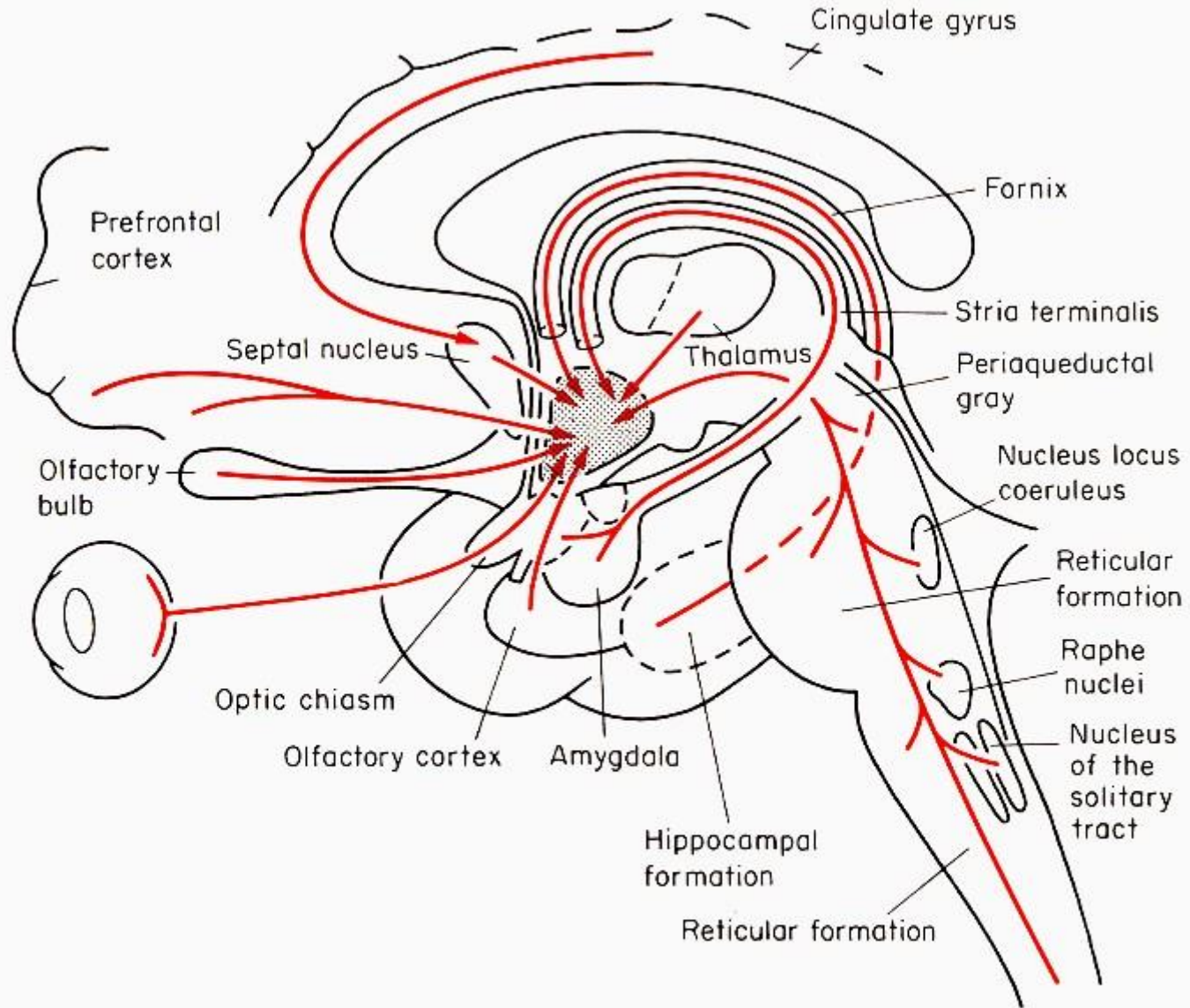


Fig. 15.2. *Main afferent connections of the hypothalamus. Arrows indicate the direction of impulse conduction.*

Efferent connections of the hypothalamus

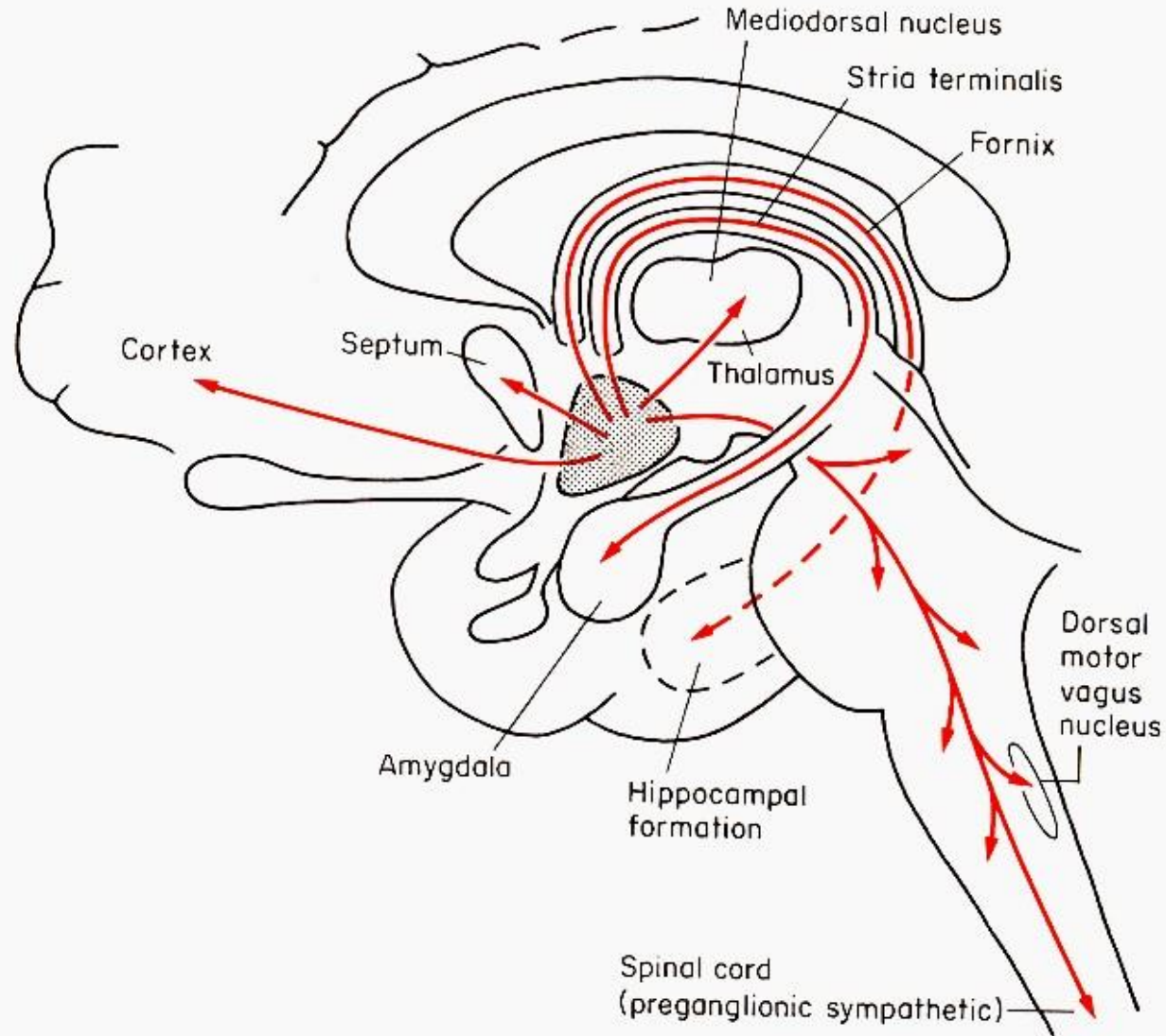


Fig. 15.3. *Main efferent connections of the hypothalamus.* The connections to the pituitary

gland are not included, nor are the efferent connections of the mammillary nucleus.

Hypothalamo-hypophyseal relations

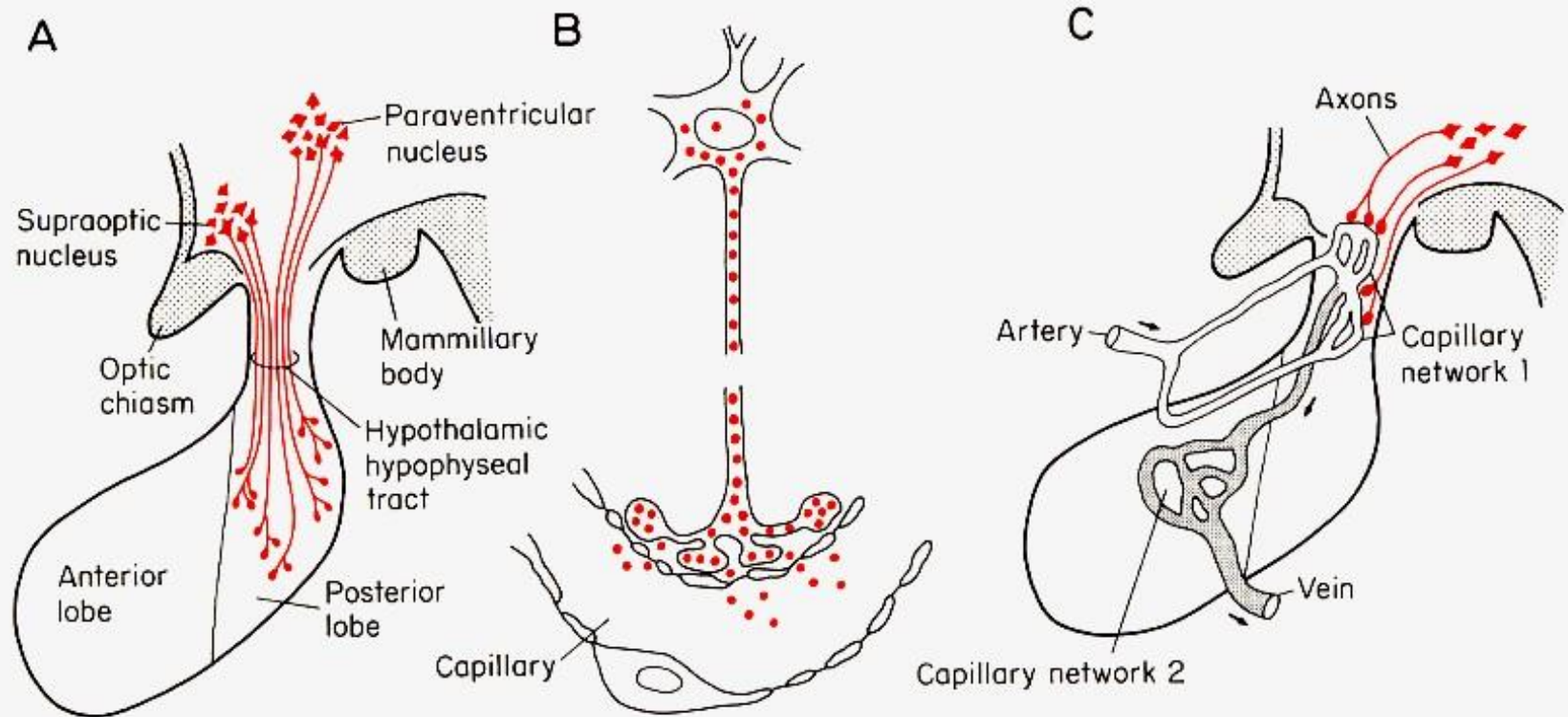


Fig. 15.5. *The relationship between the hypothalamus and the pituitary gland. A.* Connections from the hypothalamus to the posterior lobe. **B.** Axonal transport of peptide hormones (neuropeptides) from the hypothalamus to the pitu-

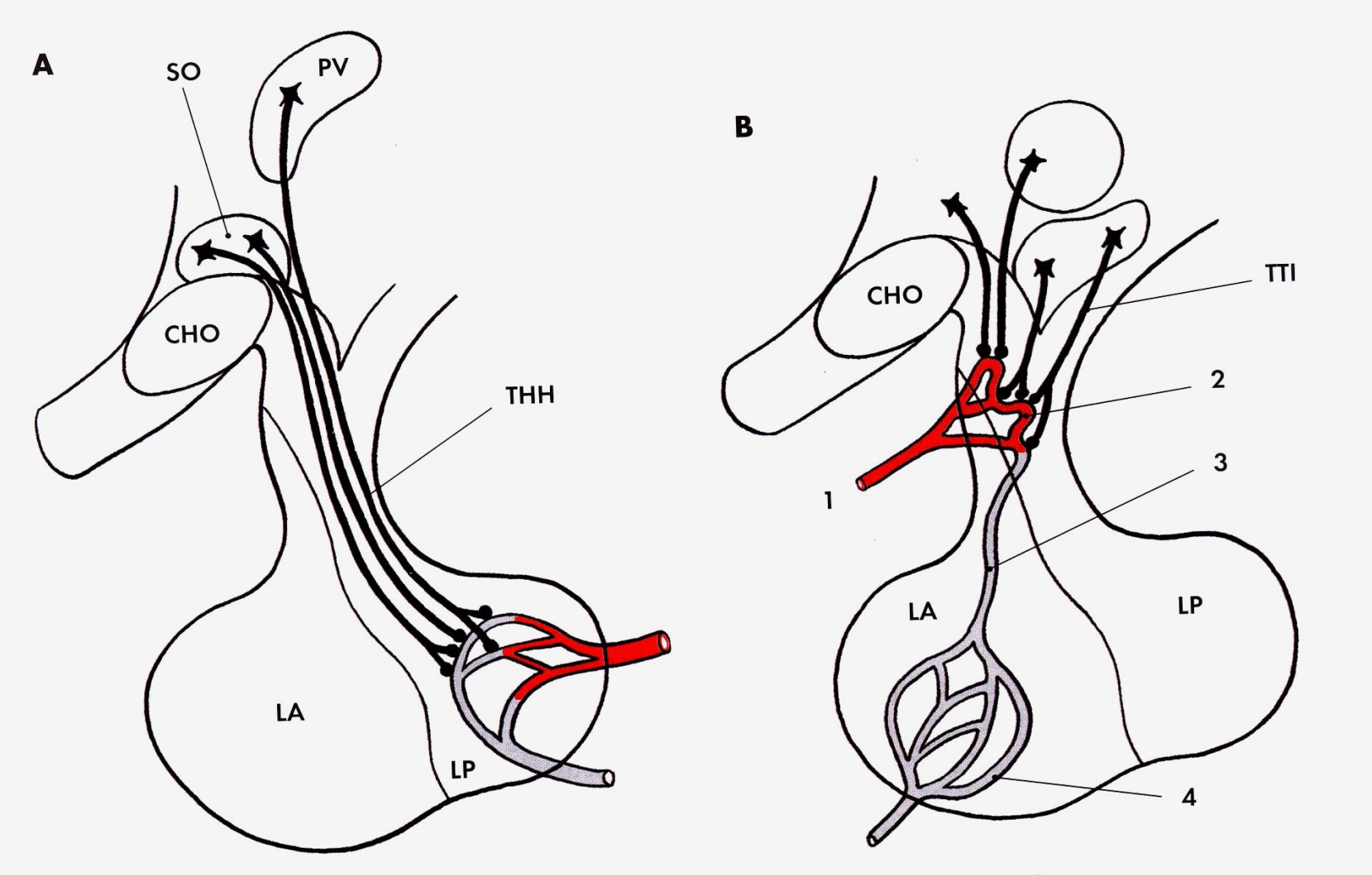
itary. **C.** The portal vessels of the pituitary stalk ensure that releasing hormones (factors) are transported from the median eminence in the upper part of the stalk to the epithelial cells of the anterior lobe.

Lobus anterior

Lobus posterior

Hypothalamo-hypofyzeální vztahy

ACTH, FSH, LH PRL, MSH



Releasing – inhibiting faktory

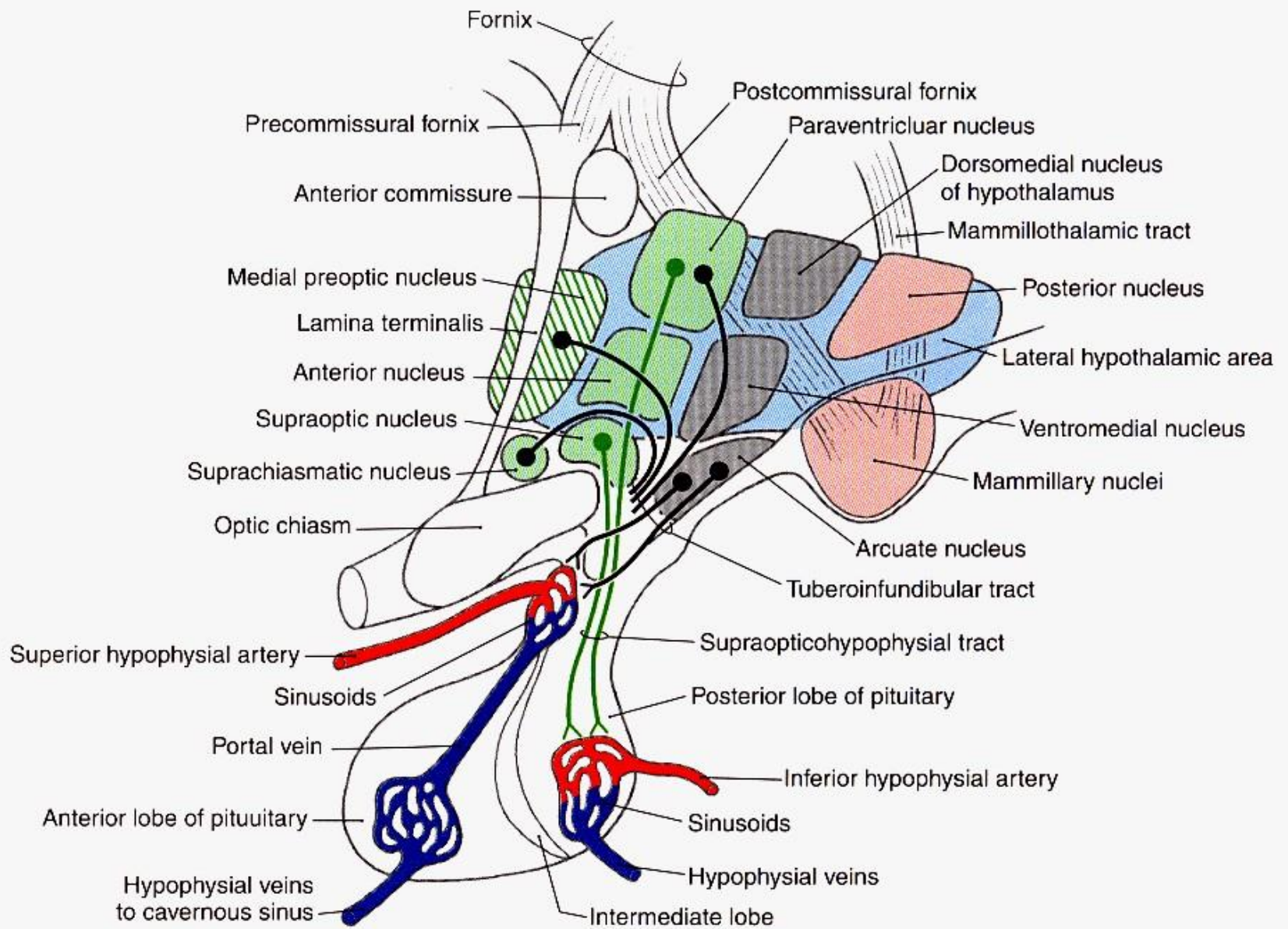


Figure 30-4. Midsagittal view of the hypothalamus emphasizing the nuclei, which contribute to the tuberoinfundibular supraopticohypophysial tracts, the hypophysial portal system, and the general relations of the fornix and mammillothalamic tract.

HYPOTHALAMUS

➤ Lateral zone

- No discrete nuclei
- Regulation of food and water intake

➤ Medial zone

- Well defined nuclei

Chiasmatic region

- (SO, PV – hormone release)
- cardiovascular function (Ant.)
- circadian rhythms (SCH) (fluctuation in functions, metabolism, behavior, productions of
- hormones, enzymes...)
- body temperature (Preoptic ncl.)

➤ *Tuberal region*

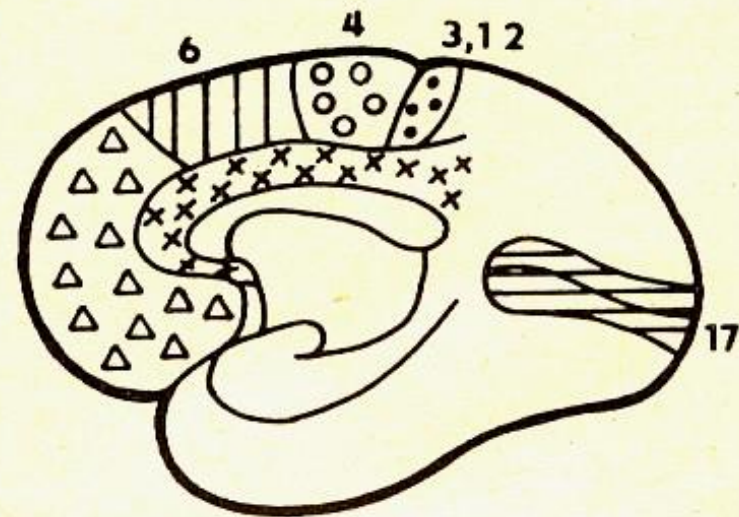
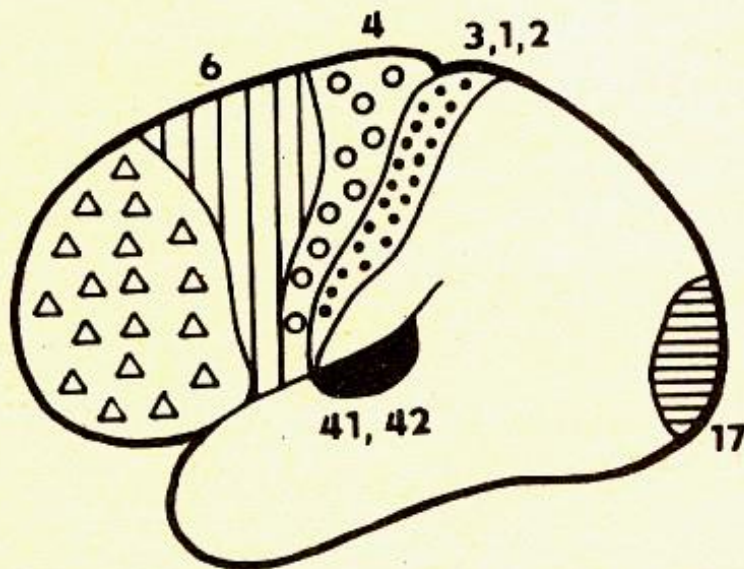
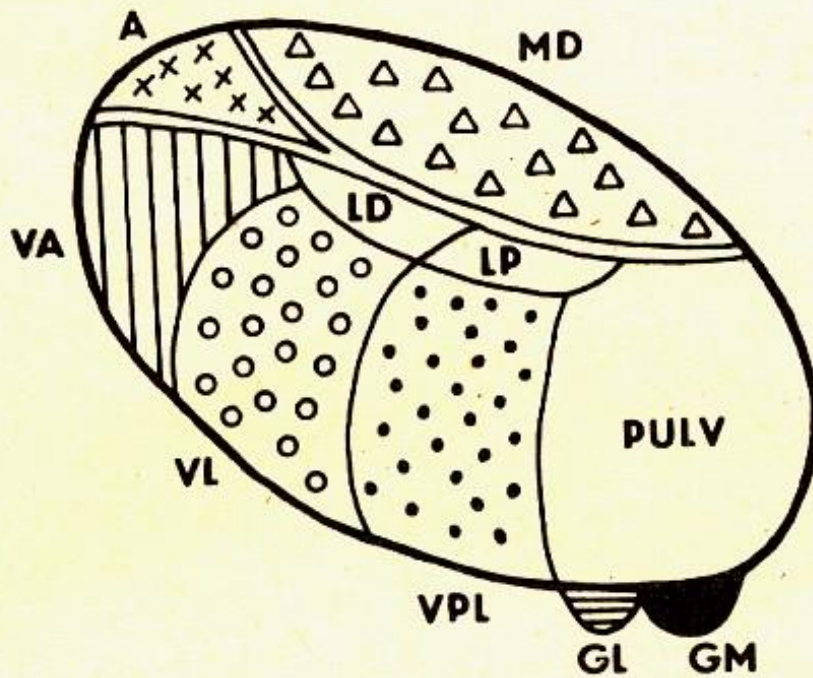
- VM – satiety center (lesion produces hyperphagia + obesity, regulation of food intake)
- Arcuate ncl. - delivers peptides to the portal vessels

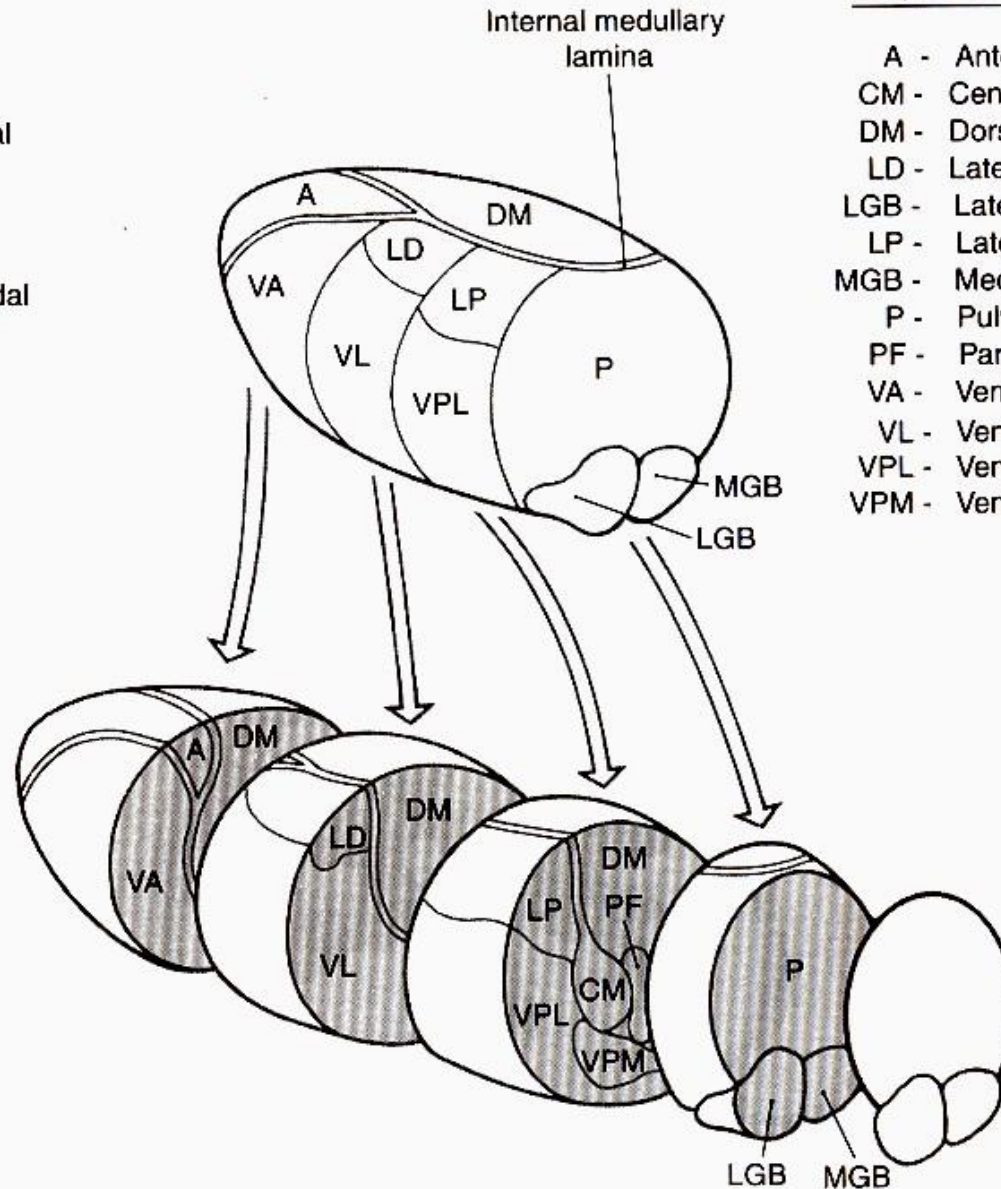
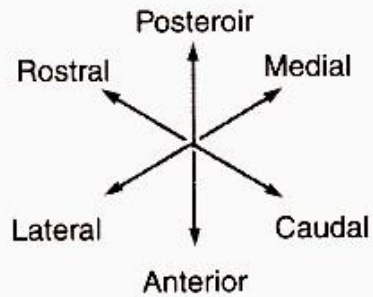
➤ *Mamillary region*

- Posterior ncl.- elevating of blood pressure, pupillary dilatation, body heat conservation
- Mammillary ncl. – **memory formation !!!**

Abbreviations

Al	Alveus of Hippocampus
CblTh	Cerebellothalamic Fibers
CC	Crus Cerebri
Cing	Cingulum
CinGy	Cingulate Gyrus
Cl	Clastrum
CNu, B	Caudate Nucleus, Body
CNu, T	Caudate Nucleus, Tail
CorCl, B	Corpus Callosum, Body
CP	Choroid Plexus
DMNu	Dorsomedial Nucleus of Thalamus
EML	External Medullary Lamina
Ext	External Capsule
Extrm	Extreme Capsule
For, B	Fornix, Body
GP	Globus Pallidus
Hip	Hippocampal Formation
IGr	Indusium griseum
IML	Internal Medullary Lamina
Ins	Insula
Int	Internal Capsule
LatVen, B	Lateral Ventricle, Body
LatVen, IH	Lateral Ventricle, Inferior Horn
LDNu	Lateral Dorsal Nucleus of Thalamus
LenFas	Lenticular Fasciculus
LLSt	Lateral Longitudinal Stria
MI	Massa Intermedia
MLSt	Medial Longitudinal Stria
OpTr	Optic Tract
Put	Putamen
SMT	Stria Medullaris Thalami
SN	Substantia Nigra
SThNu	Subthalamic Nucleus
StTer	Stria Terminalis
ThFas	Thalamic Fasciculus
ThRetNu	Thalamic Reticular Nucleus
VL	Ventral Lateral Nucleus of Thalamus
ZI	Zona Incerta

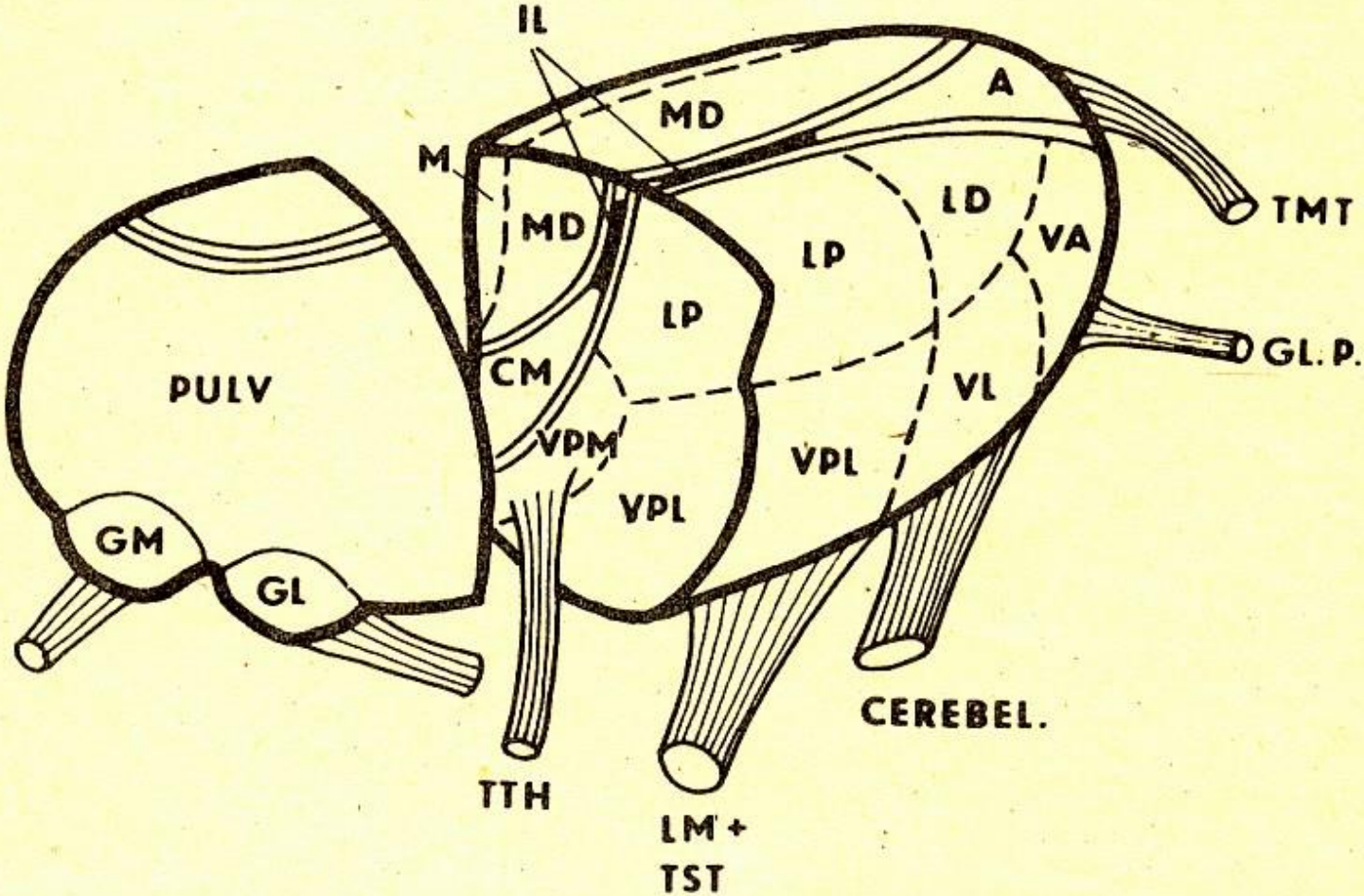




Thalamic nuclei

- A - Anterior
- CM - Centromedian
- DM - Dorsomedial
- LD - Lateral dorsal
- LGB - Lateral geniculate
- LP - Lateral posterior
- MGB - Medial geniculate
- P - Pulvinar
- PF - Parafascicular
- VA - Ventral anterior
- VL - Ventral lateral
- VPL - Ventral posterolateral
- VPM - Ventral posteromedial

Termination of subcortical projections in the thalamus



Zakončení podkorových vstupů v thalamu