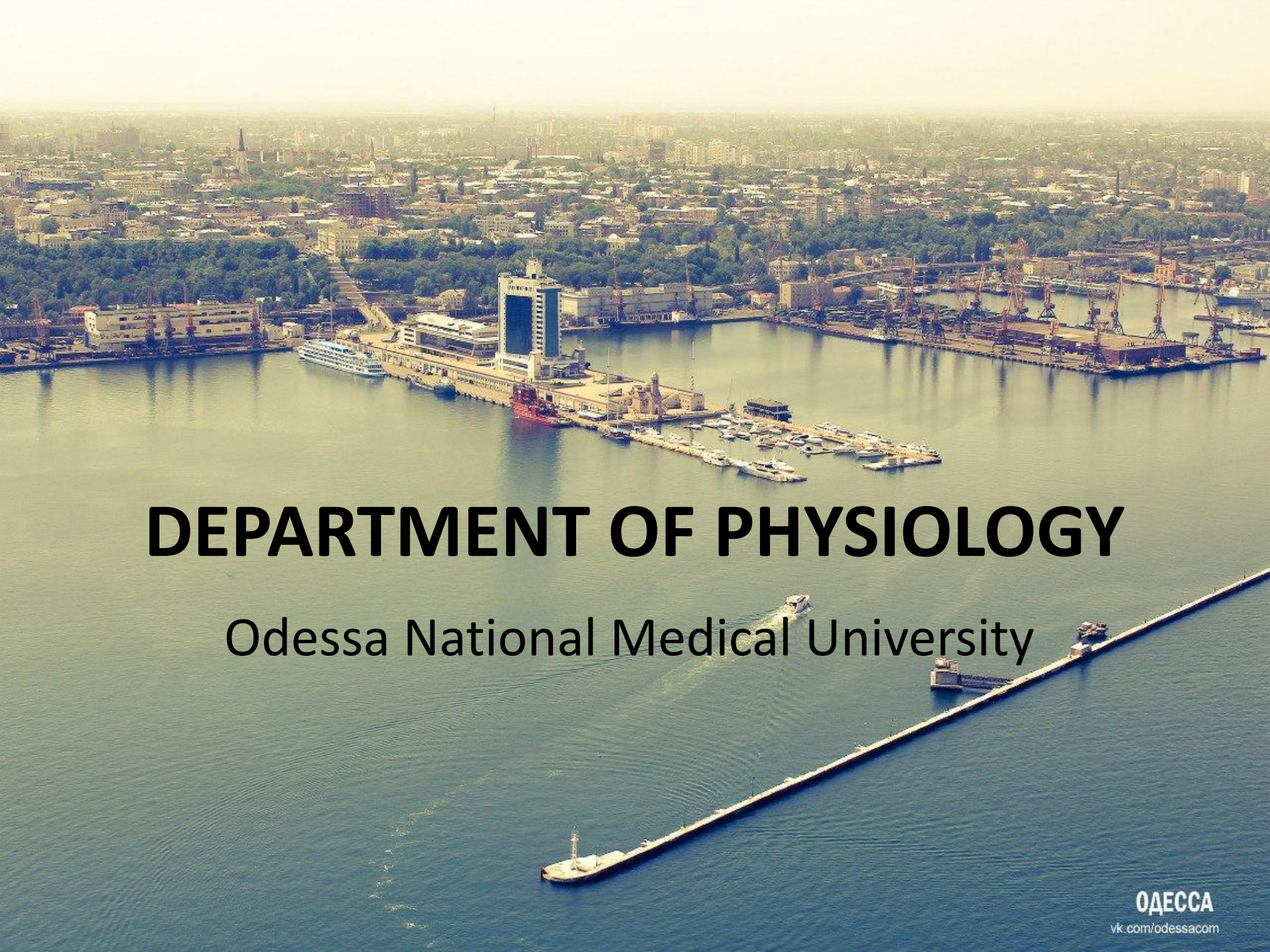


DEPARTMENT OF PHYSIOLOGY

Odessa National Medical University

Lecture №

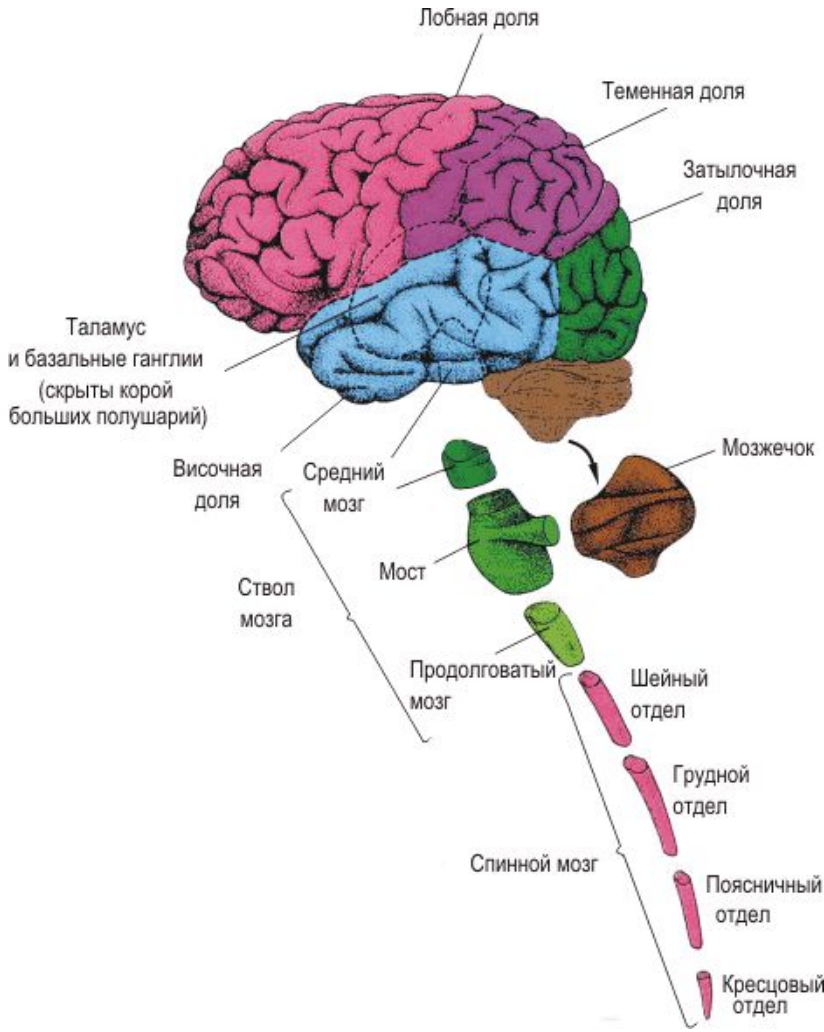
THE ROLE OF FOREBRAIN, LIMBIC SYSTEM AND CEREBRAL CORTEX IN THE FORMATION OF THE BODY'S SYSTEMIC ACTIVITY. PYRAMIDAL AND EXTRAPYRAMIDAL SYSTEMS.

as. DENYSENKO Oksana

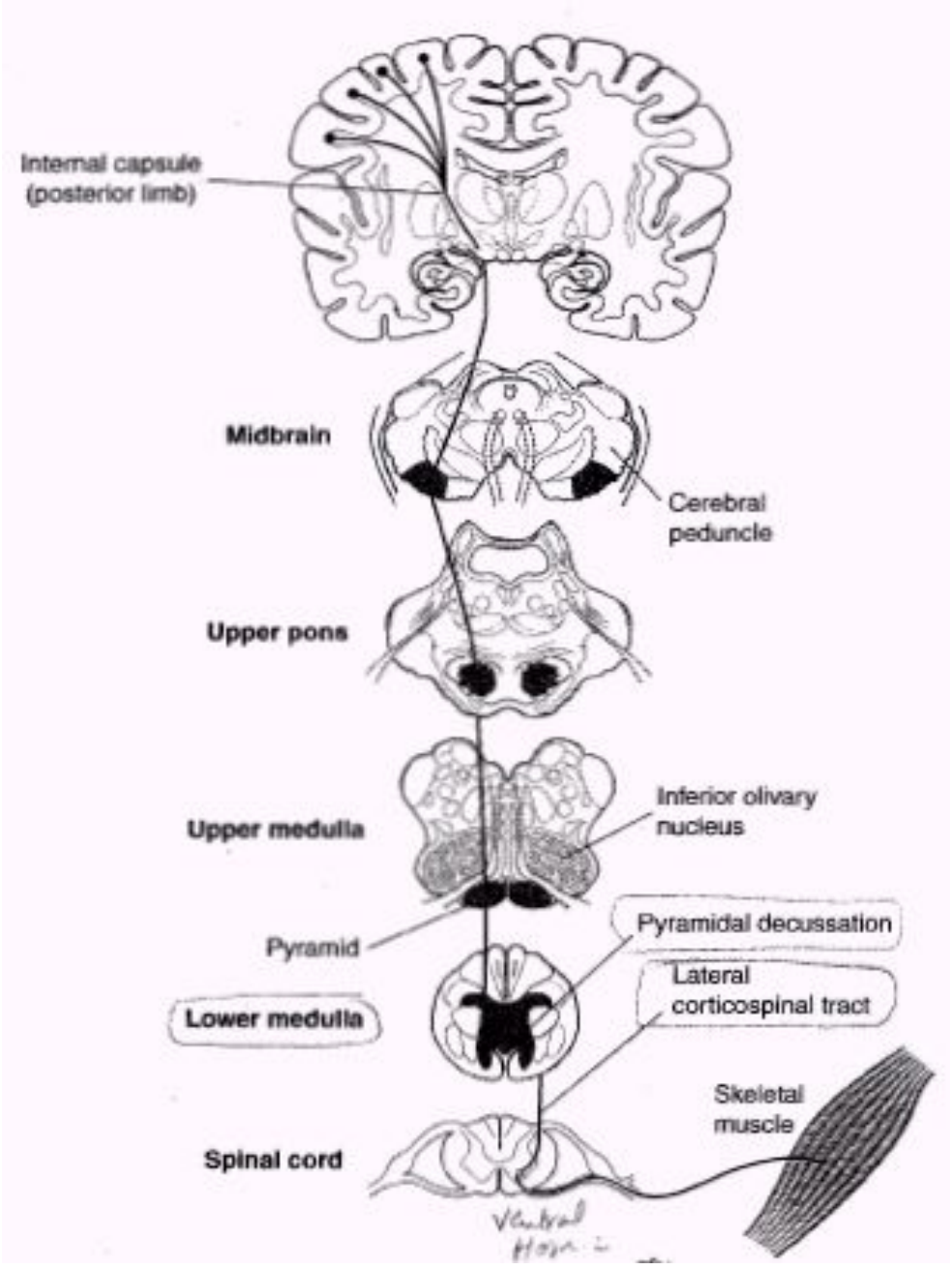
5 levels of regulation of human motor function:

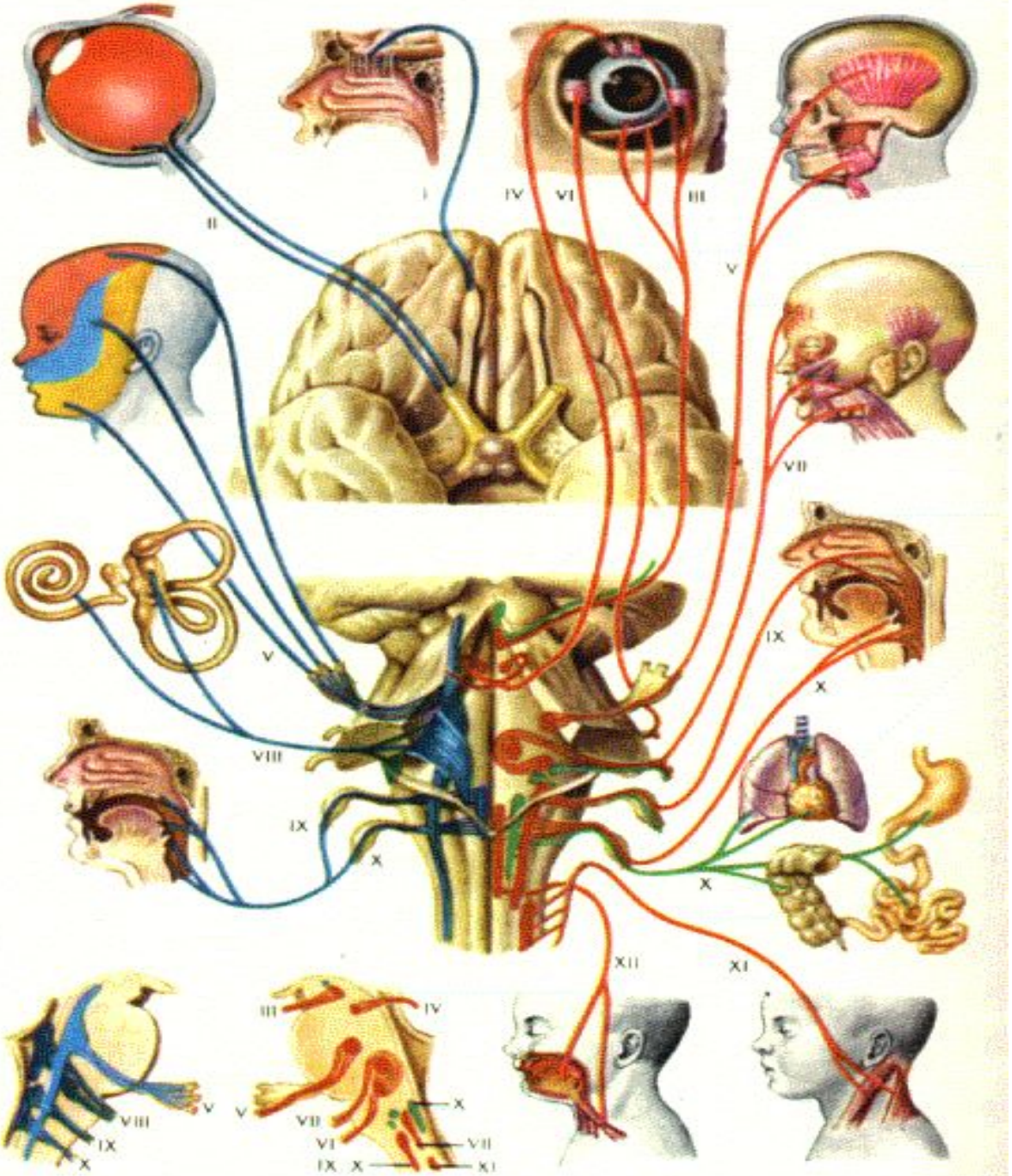
1. spinal cord;
2. the medulla oblongata and the pons;
3. midbrain and cerebellum;
4. Diencephalon (thalamus, hypothalamus);
5. Telencephalon (striopaladar system of subcortical nuclei + cortex)

The highest level is the cortex of the cerebral hemispheres!

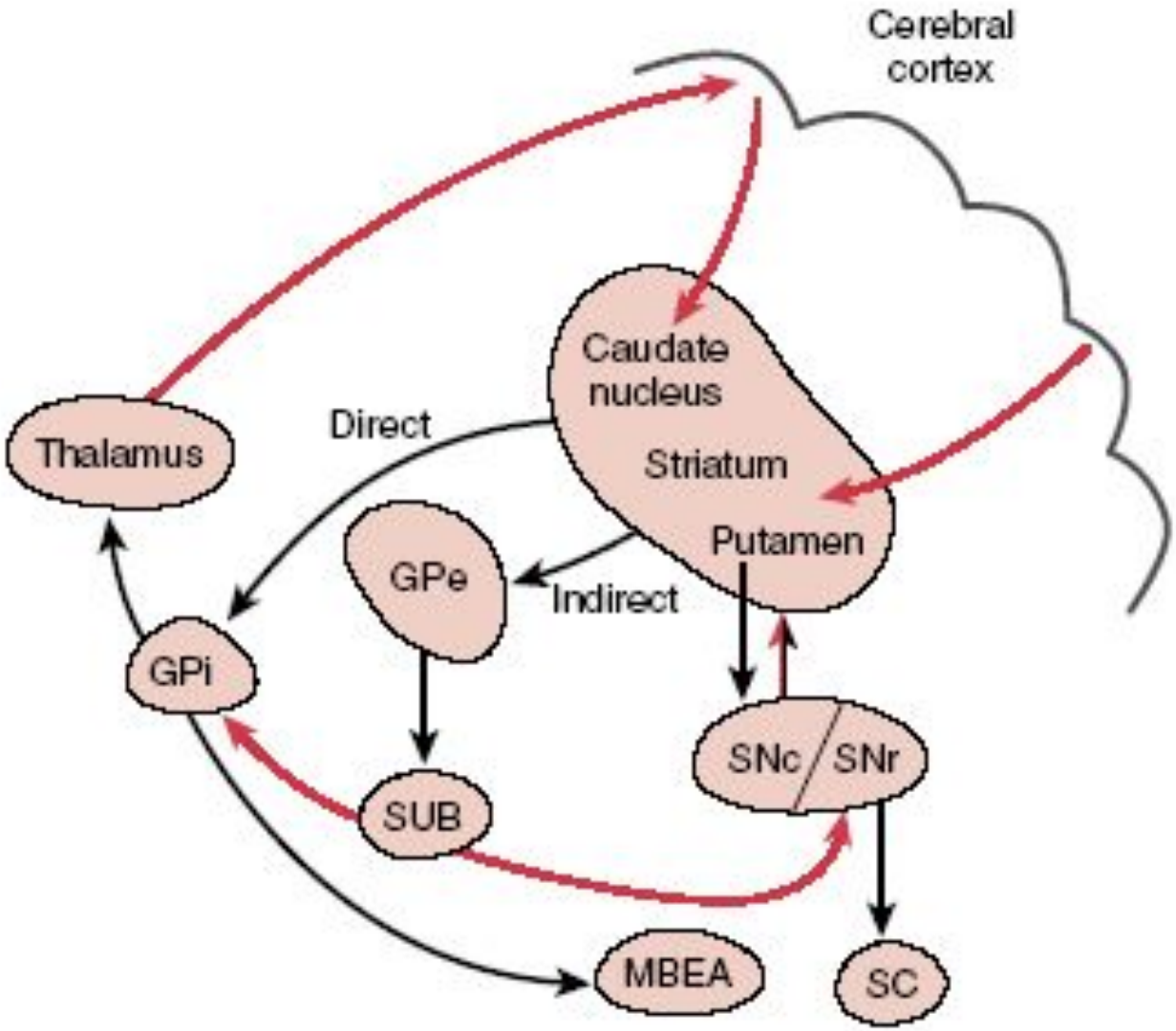


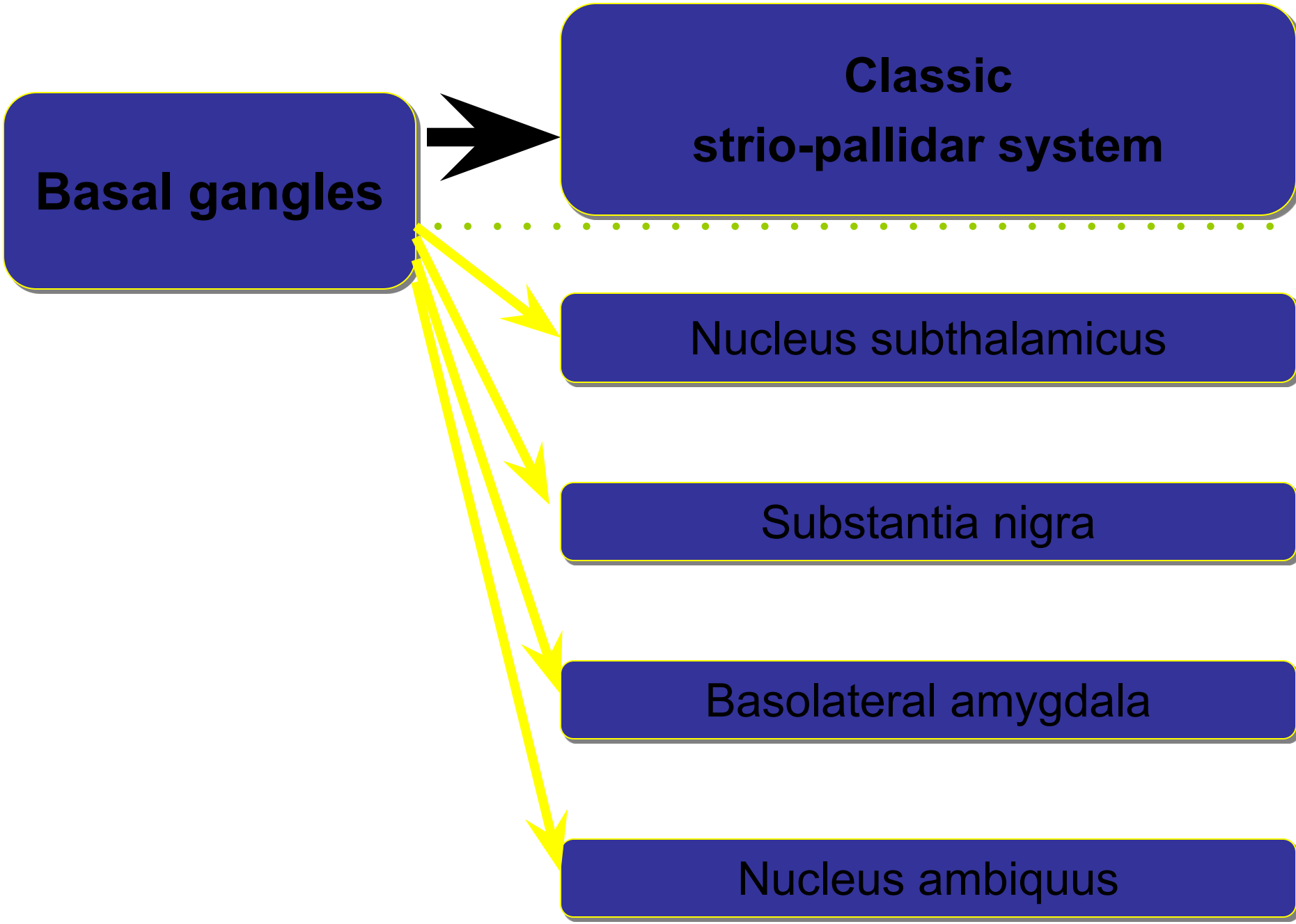
Tractus corticospinalis



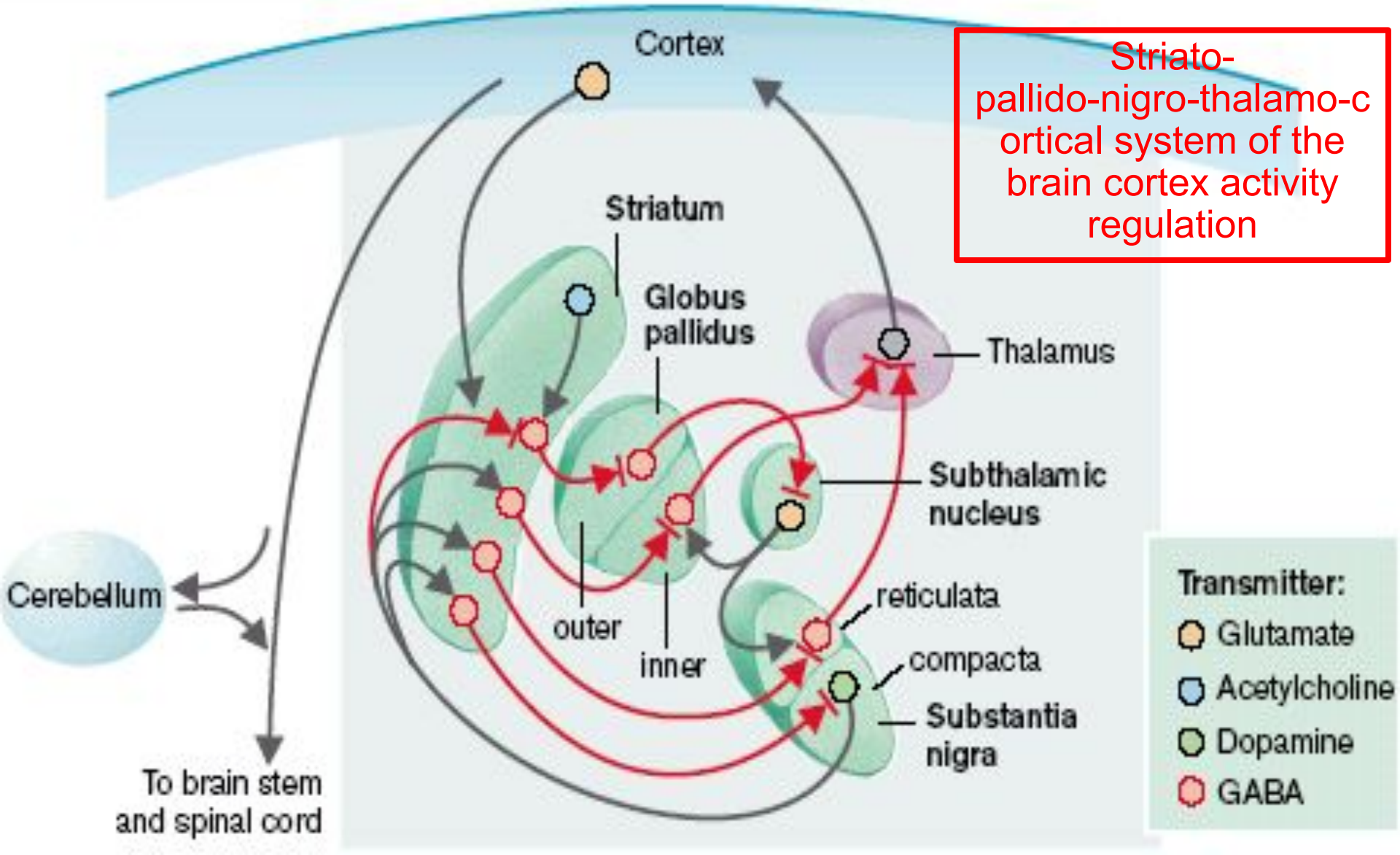

I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII

Basal gangles and circuitry




Basal gangles
Classic
strio-pallidar system
Nucleus subthalamicus
Substantia nigra
Basolateral amygdala
Nucleus ambiquus

Basal gangles afferent and efferent connections



Basal gangles FUNCTIONS

1. Movements regulation and their sensorimotor coordination

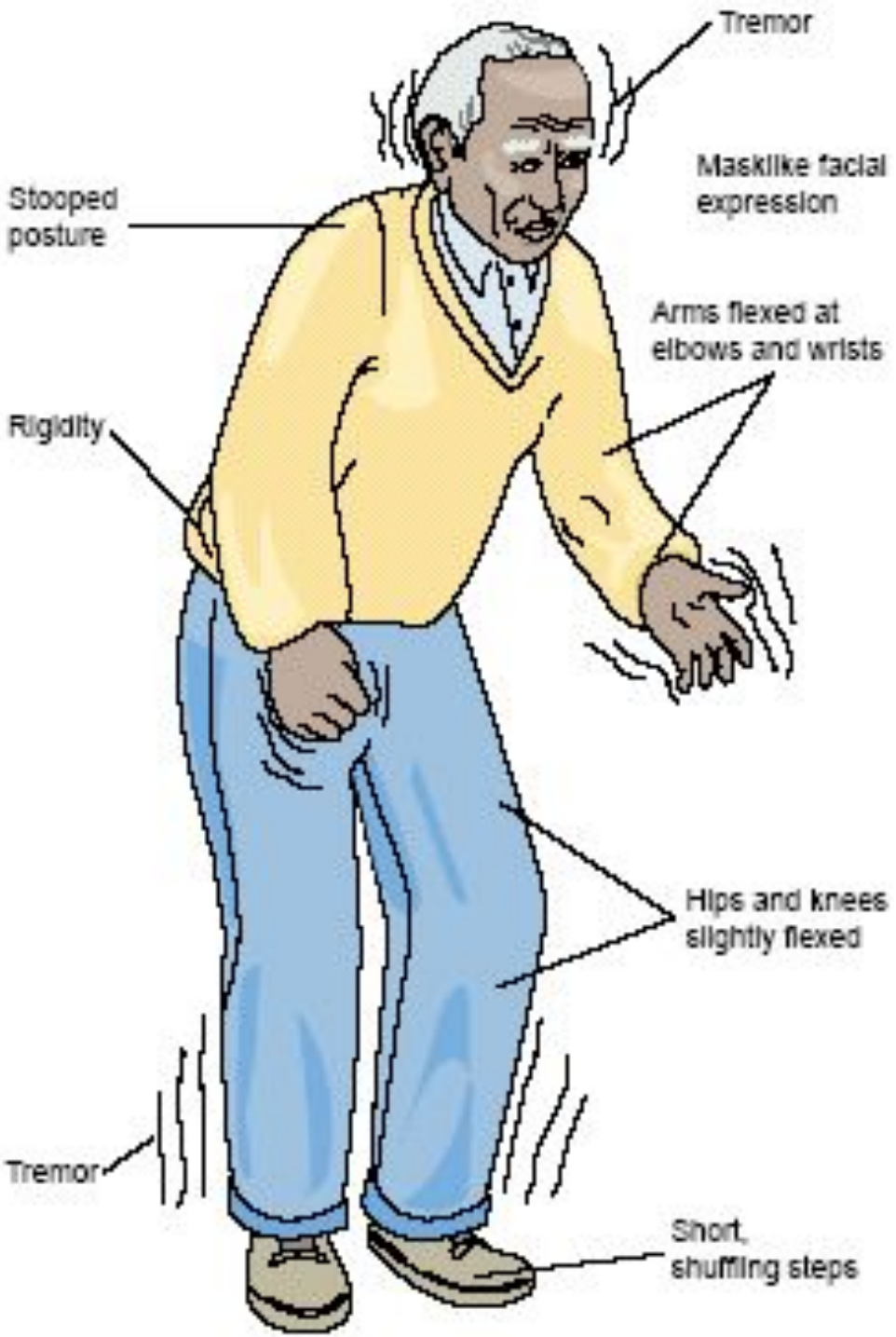
2. Muscle tone control and voluntary movements regulation

3. Centers of complex unconditioned reflexes and instincts

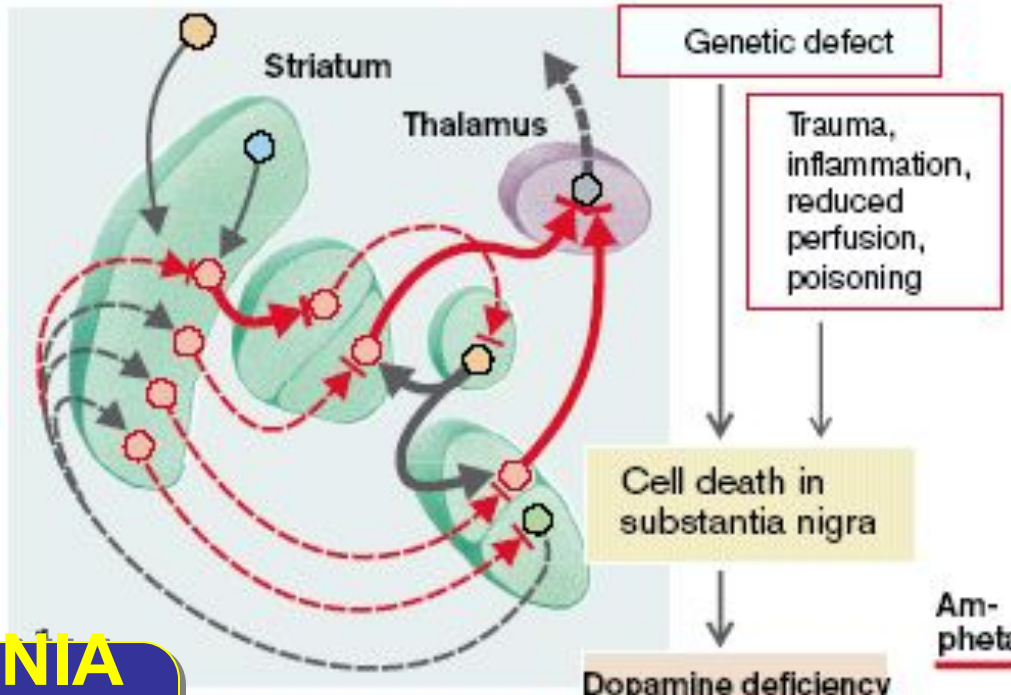
4. Centers of aggressive reactions inhibition

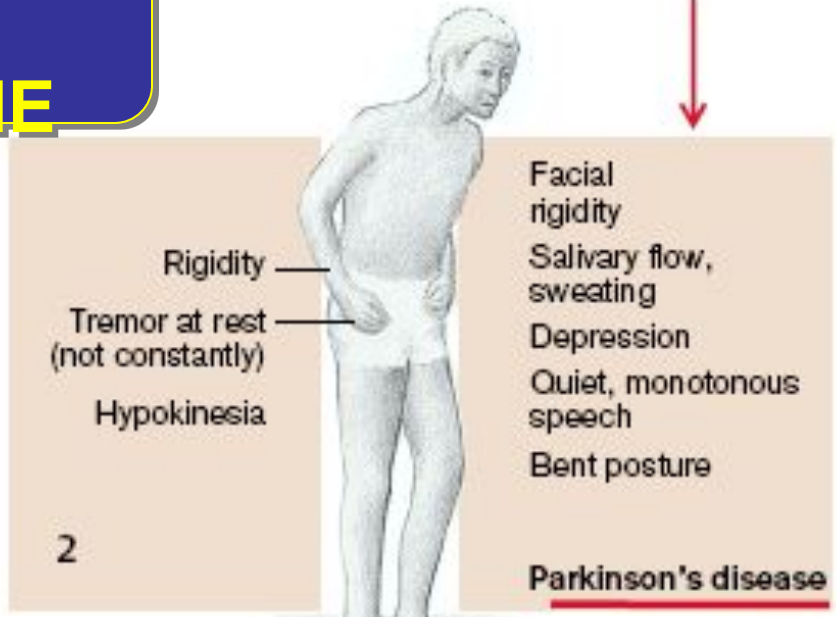
5. Sleep-wakefulness cycle maintenance

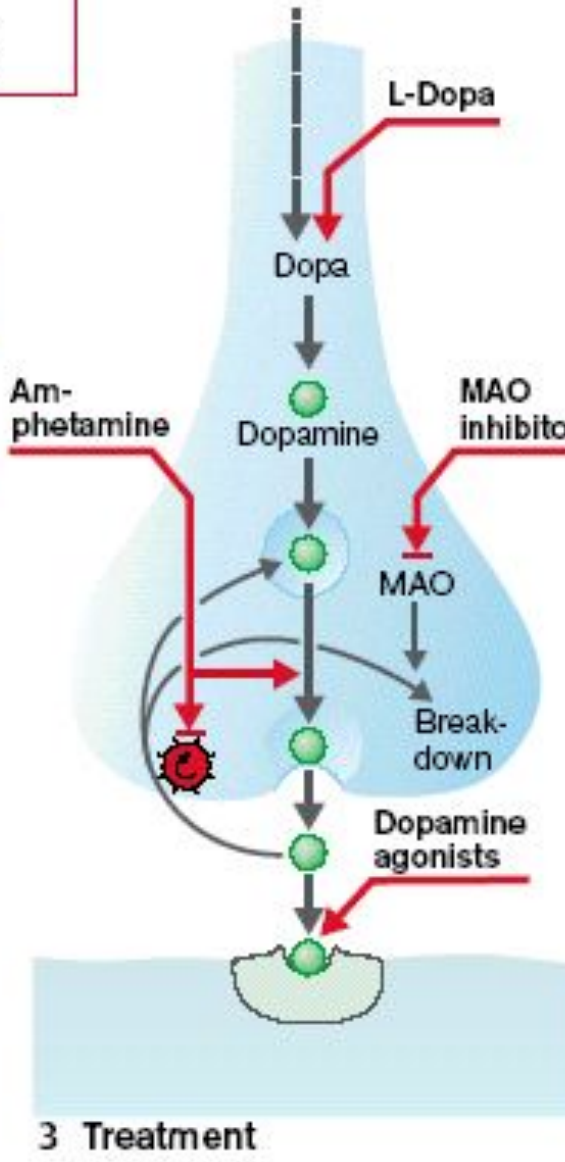
PARKINSONIAN SYNDROME



PARKINSONIAN SYNDROME







Strio-pallidar system failure

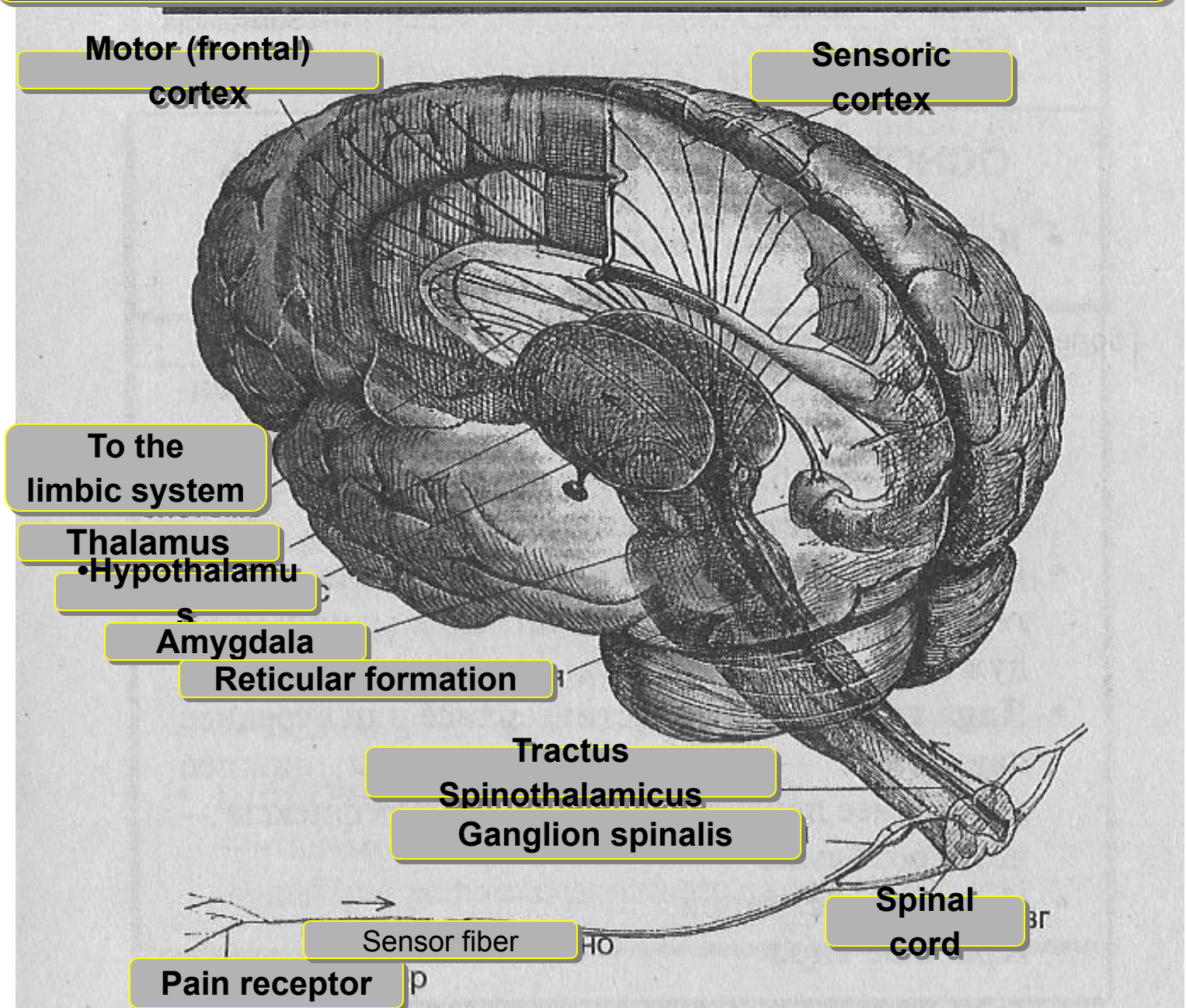
Athetosis

- slow vermis-like forearms and digits movements

Chorea

- seizure-like mimic and skeletal muscles contractions during the rest state

Thalamus and the reticular formation

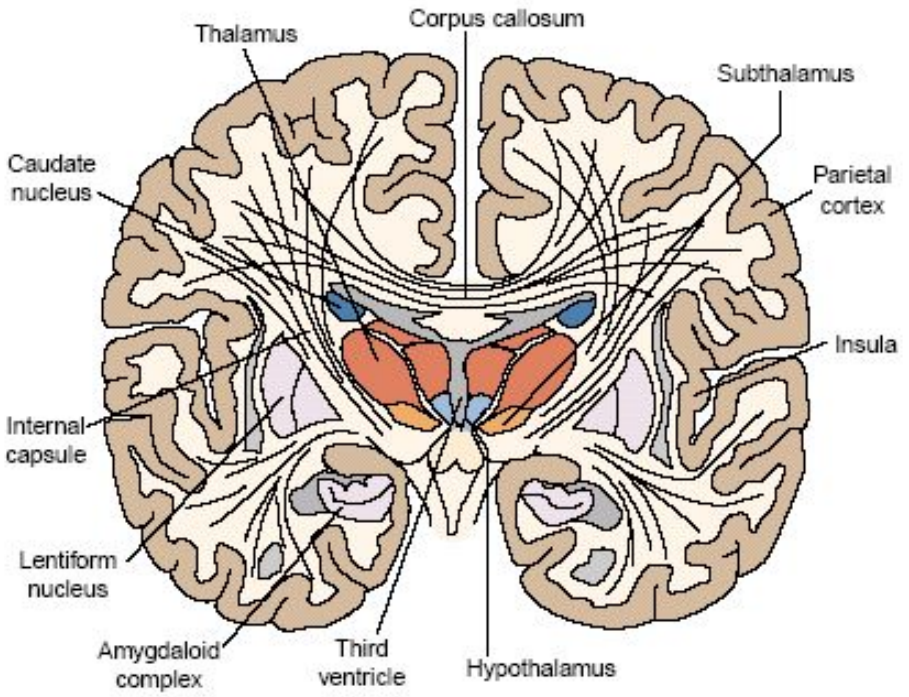


The main thalamic nuclei

Specific nuclei

- Relying
- Associative
- Motor

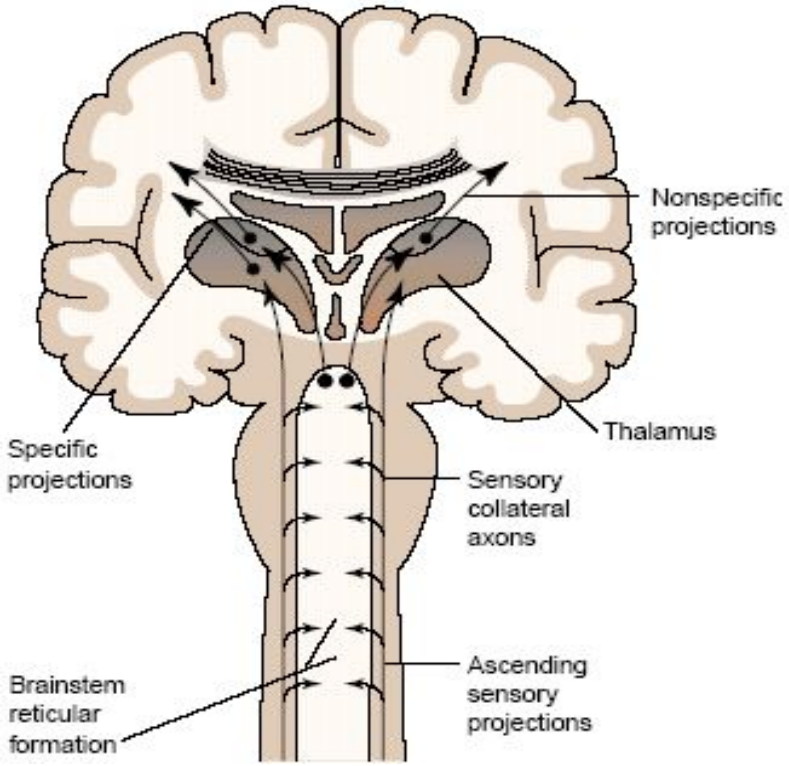
Nonspecific nuclei

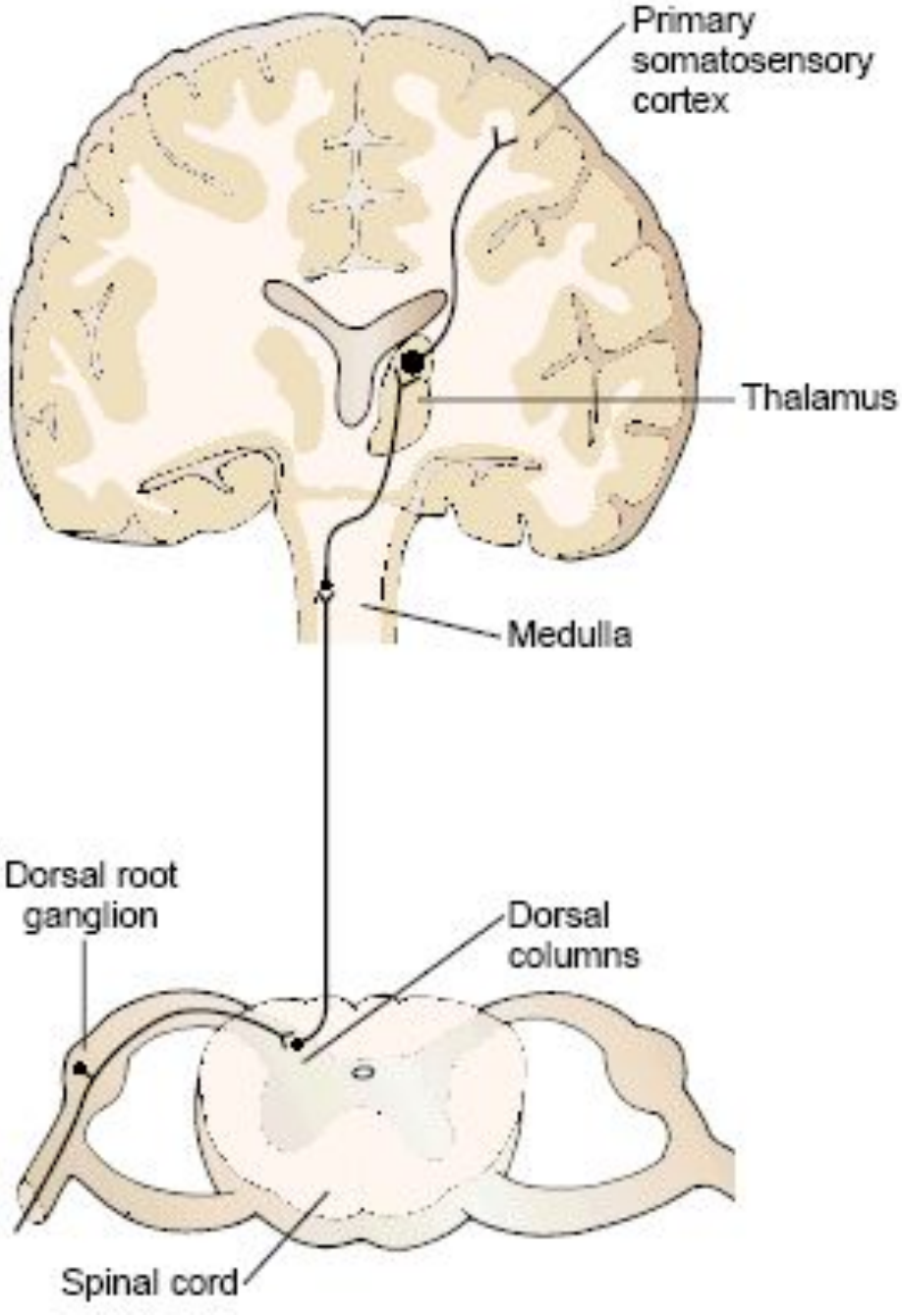


Specific thalamic nuclei

Relying	Associative	Motor
Ventrobasal complex	**Mediodorsal nucleus**	**N.N. frontolateral and ventrolateral**
Tactile, proprioceptive, temperature, pain, gustatory inputs to brain somatosensory cortex	Projections to frontal lobes	**Signals rely from cerebellum and basal gangles to motor cortex**
N.geniculatum int.	**Putamen**	
Audial information in- to brain audial centers	Projections to tempo- ral and occipital lobes	
N.geniculatum ext.	**Nucleus lateralis dorsalis**	
Visual information in- to brain visual centers	Projections to temporal lobe	
	Nucleus frontalis	
	Projection to limbic cortex	

Thalamus rely function



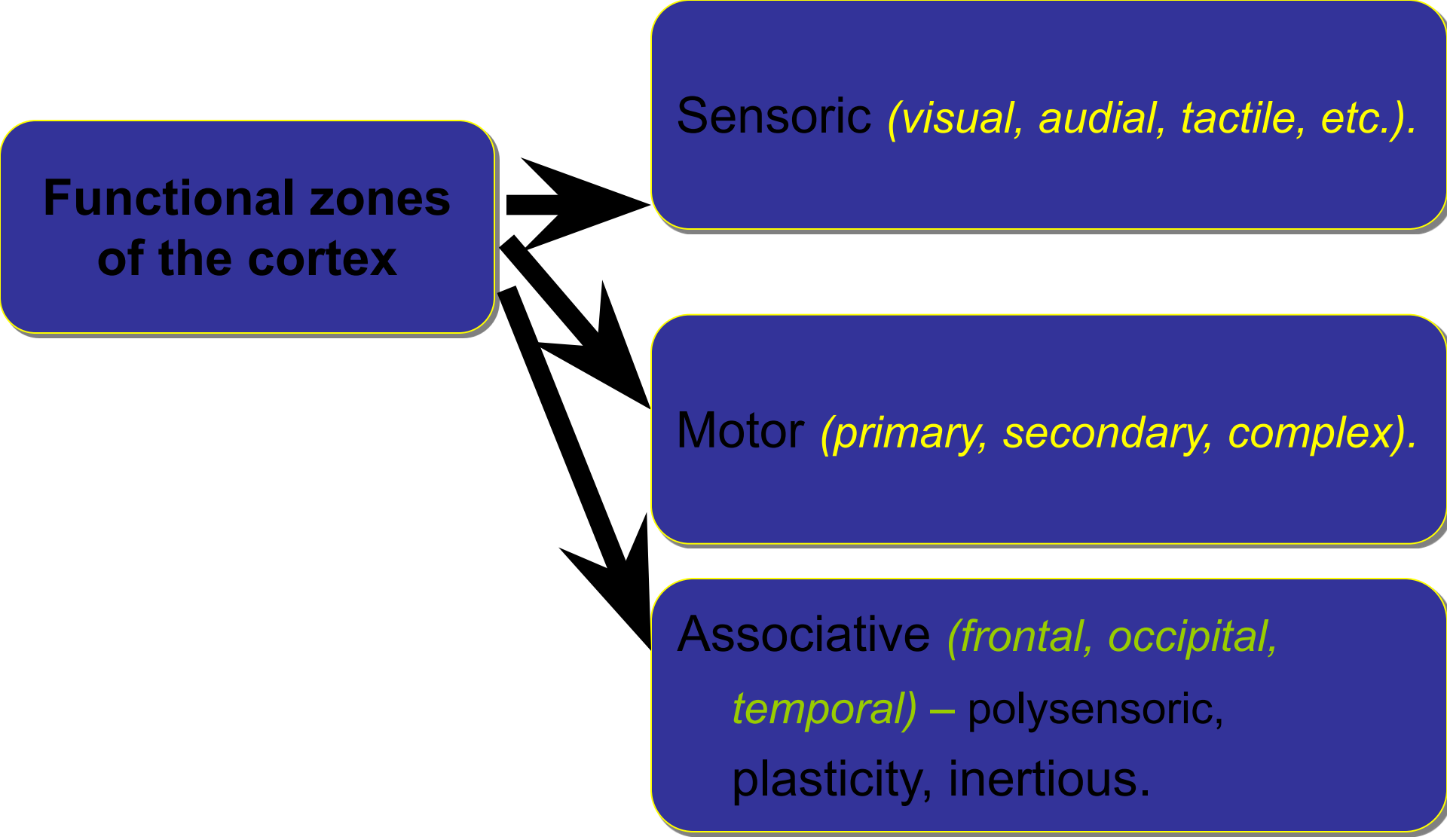


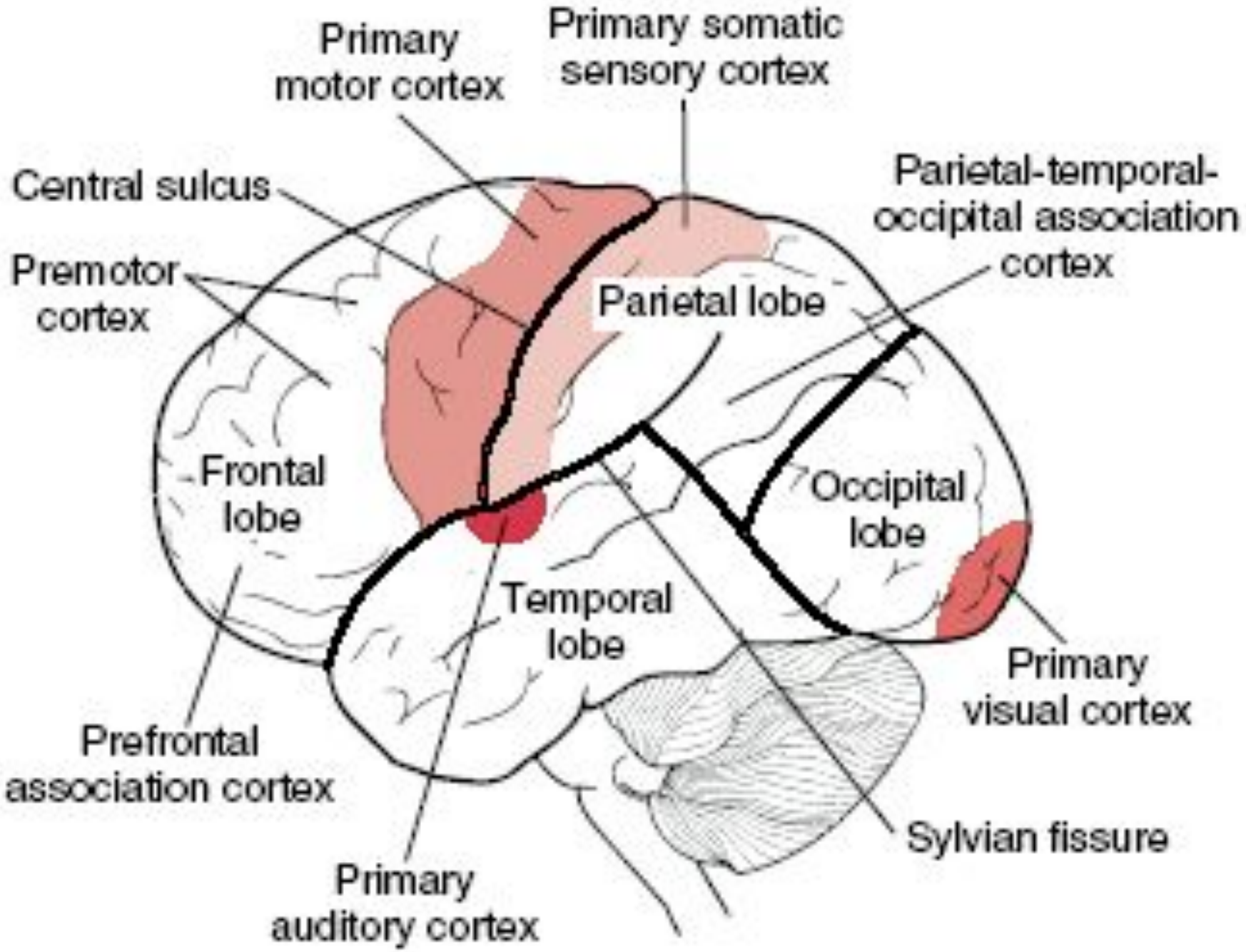
All sensory pathways have direct projections to thalamic nuclei, which convey the information to restricted areas of the sensory cortex.

Coordination and integration of peripheral sensory stimuli occur in the thalamus

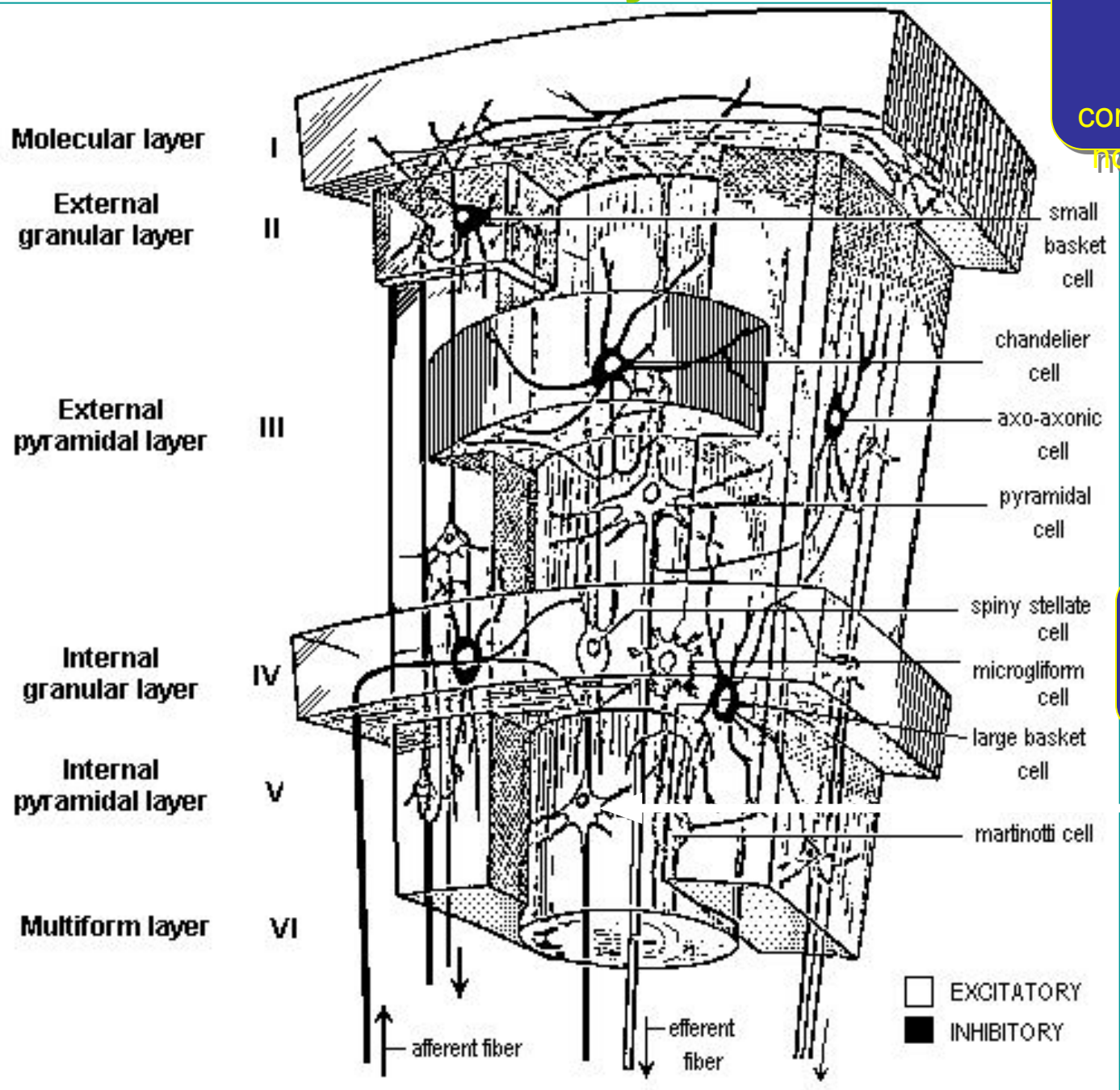
«… thalamus serves as the rely station, where all the external stimuli, coming together, change their expression and go to subcortical and cortical centers».

A. K. Walker


Functional zones of the cortex
Sensoric (visual, audial, tactile, etc.).
Motor (primary, secondary, complex).
Associative (frontal, occipital, temporal) – polysensoric, plasticity, inertious.


Primary motor cortex
Primary somatic sensory cortex
Central sulcus
Parietal-temporal-occipital association cortex
Premotor cortex
Parietal lobe
Frontal lobe
Occipital lobe
Temporal lobe
Primary visual cortex
Prefrontal association cortex
Sylvian fissure
Primary auditory cortex

Brain cortex layers



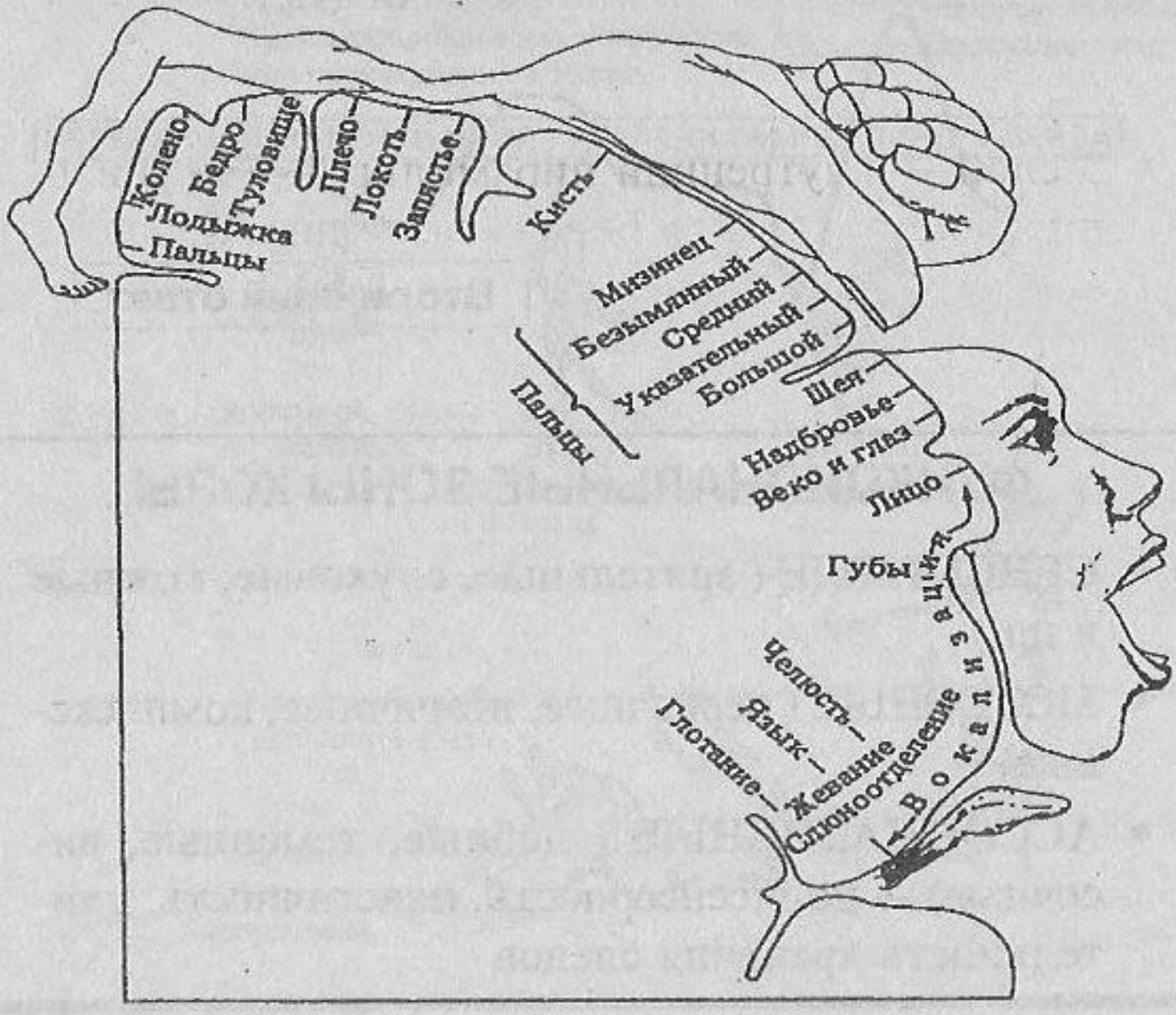
Pyramidal cells sprouted apical dendrites. + Afferent thalamo-cortical projections out of the nonspecific thalamic nuclei

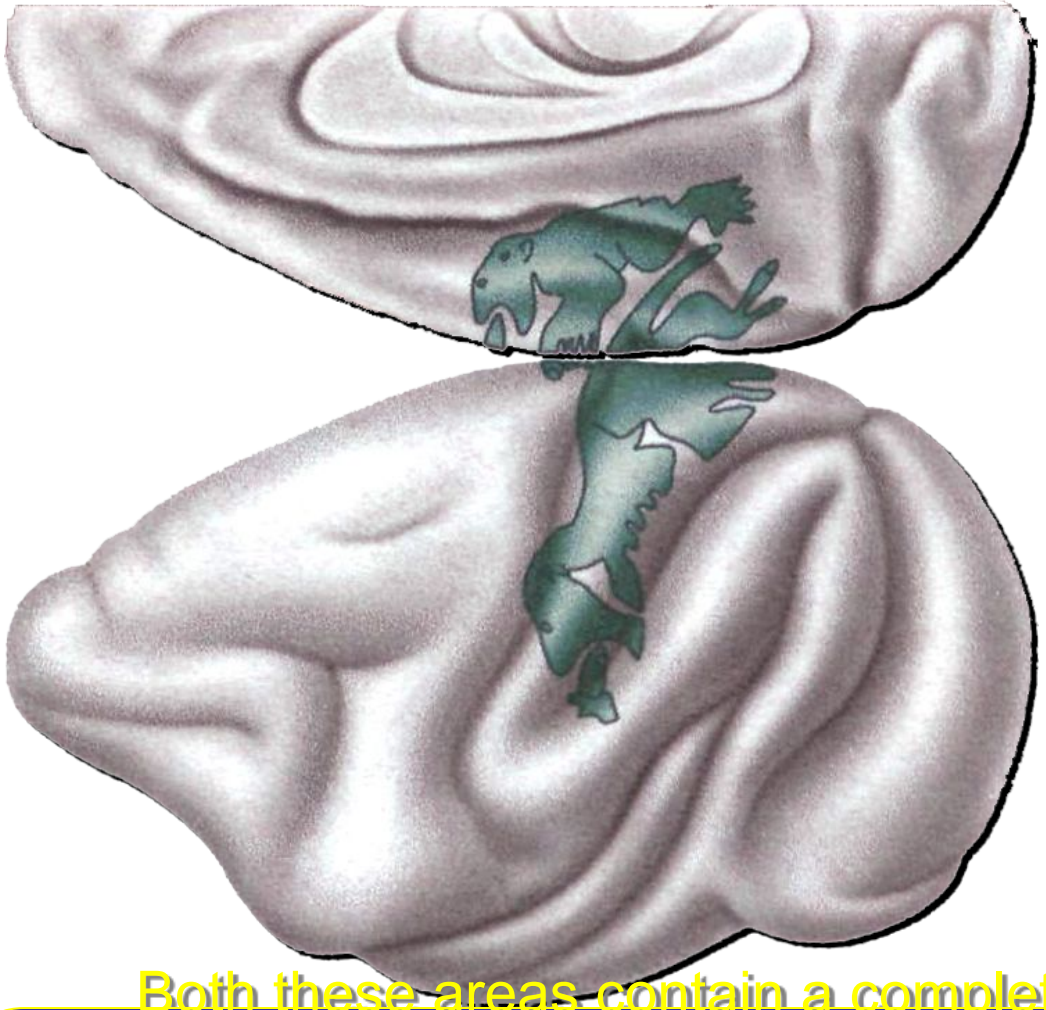
Numerous granular cells + Afferent thalamo-cortical projections out of the specific thalamic nuclei

Giant pyramidal cells

Веретёновидные клетки

BRAIN CORTEX HOMUNNCULUS



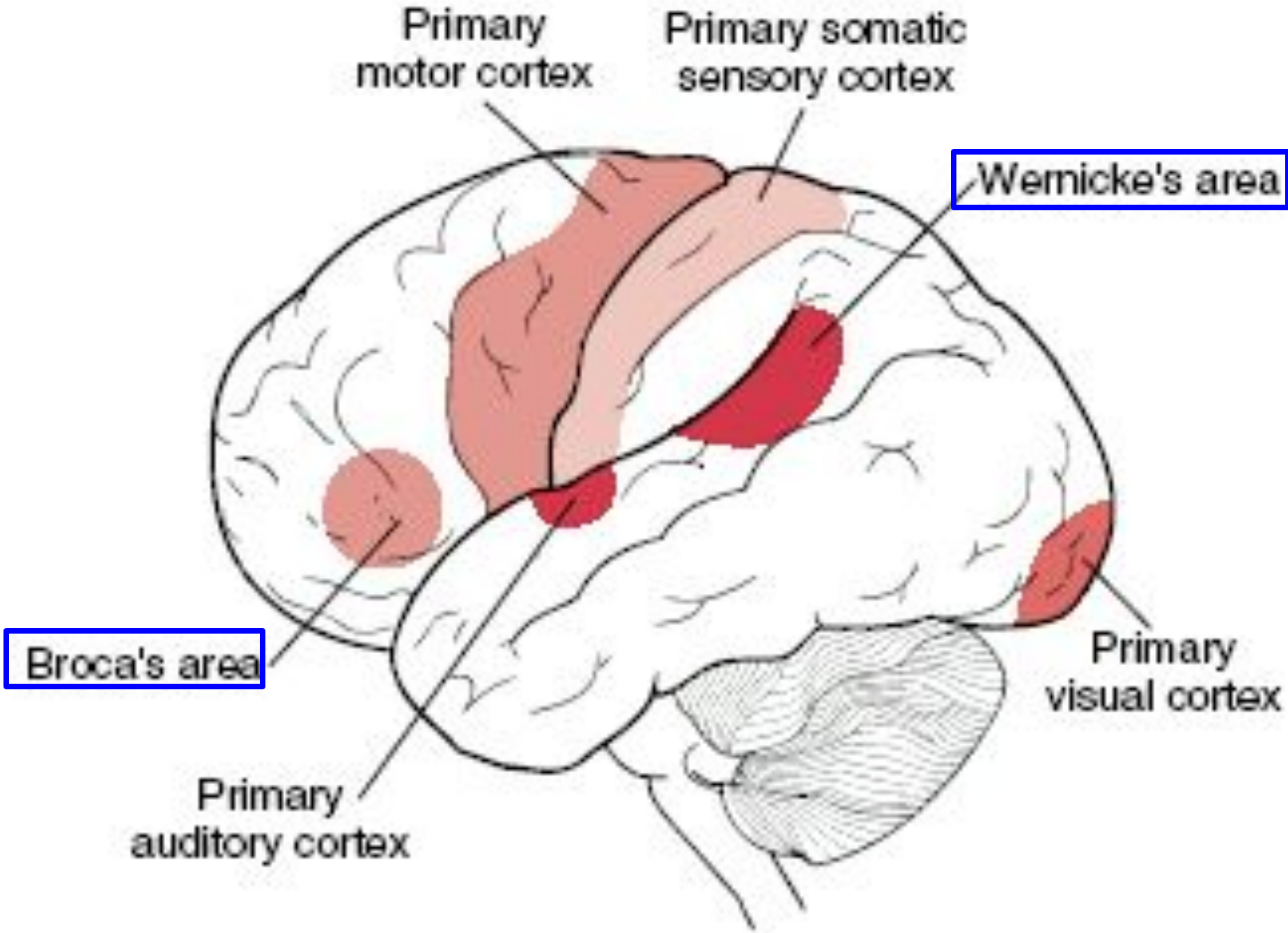


Lateral and mesial views of the cerebral cortex of the macaque monkey showing the primary (green area below) and the supplementary (green area above) motor areas according to Woolsey *(adapted from Woolsey, 1958).*

Both these areas contain a complete representation of body movements.

These representations were schematized in the form of two "homunculi,"

one located on the lateral cortical surface and the other on the mesial one. The two homunculi became a dogma for clinical and


Primary
motor cortex
Primary somatic
sensory cortex
Wernicke's area
Broca's area
Primary
visual cortex
Primary
auditory cortex

Frontal lobe FUNCTIONS

The major areas are:
(i) area 4 (motor area),
(ii) area 6 (premotor area),
(iii) frontal eye field (area 8),
(iv) supplementary motor area,
(v) prefrontal cortex
(areas 9, 10, 11, 12)
and Broca's area (area 44).

- **autonomic changes** (e.g. BP, heartrate, gastrointestinal secretion and motility) can be elicited.
- ♦ The area is somehow related
- to **pain perception**.
- It is connected with limbic system and thus associated with **emotions**.
- The **ability to judge** with a situation and make small plans are also associated with this area.

Parietal lobe FUNCTIONS

The major areas are:
(i) primary sensory area (also called somatic area I) or Brodmann's area 3, 1, 2, or the post central gyrus,
(ii) secondary somatic area or somatic area II and
(iii) somesthetic association area.

1. Sensory inputs integration, this integration
   produces a motive and the motive in turn
   can lead to an action.
2. Its presence is necessary for maintenance of body image.
3. The parietal lobe also contains angular gyrus. Destruction of angular gyrus causes agraphia (=inability to write), which is a form of aphasia .

Occipital lobe FUNCTIONS

Major areas of this lobe are:

(i) primary visual area (area 17),

(ii) visual association area (area 18), and

(iii) occipital eye field (area 19).

Temporal lobe FUNCTIONS

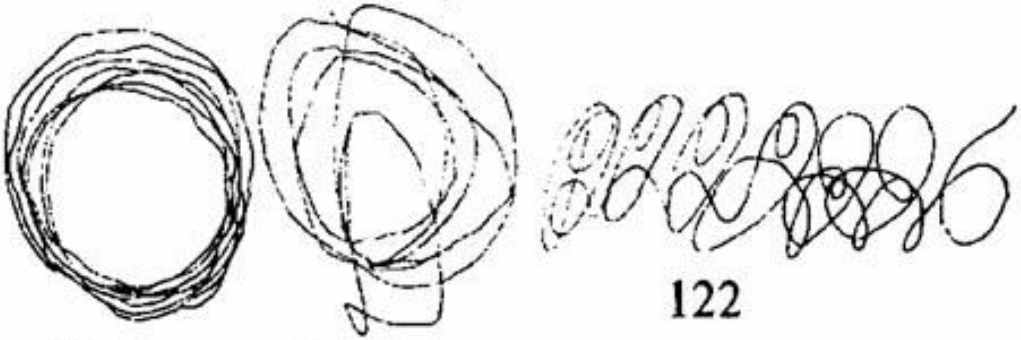
Major areas of this lobe are:

(i) Primary auditory area, in the gyrus of Heschl (area 41) which is situated in the floor of the lateral sulcus plus a small part of the superior temporal gyrus.

(ii) In area '41' sound is 'heard' while in the Wernicke's area the sound is 'interpreted'.

Symptoms assiciated with premotor cortex lesions:

- Changes in Personality and Consciousness.
- Judgments disturbances.
- Loss of spontaneity in interacting with others (changes in social behavior).
- Loss of flexibility in thinking. Difficulty with problem solving.
- Inability to focus on task (Attending).
- Mood changes (Emotionally Labile). Could based on relations of amygdaloid basolateral nucleus with cingulate and premotor cortex.
- Motivation disturbance.
- Inability to plan a sequence of complex movements needed to complete multi-stepped tasks, such as making coffee (Sequencing).
- Persistence of a single thought (Perseveration).



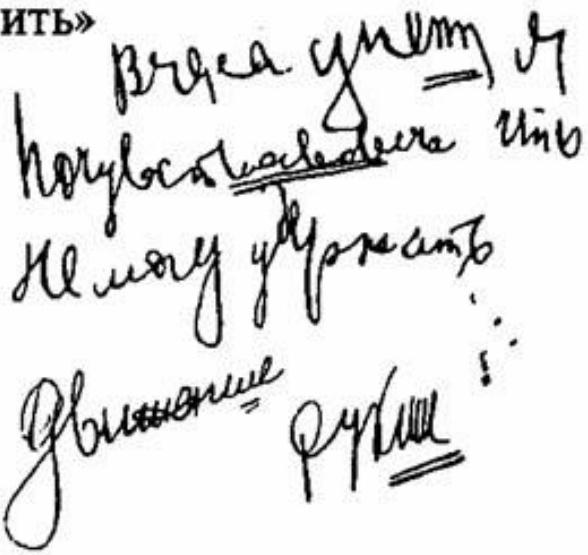
122

Круг
Circle

Квадрат
Square

101

«Как зарядил, так и иду.
Заметил, что не так, но не
мог изменить»



Письмо (letter)

Motor perseveration in patient with premotor region injury (by A.R.Luriya, 1973)

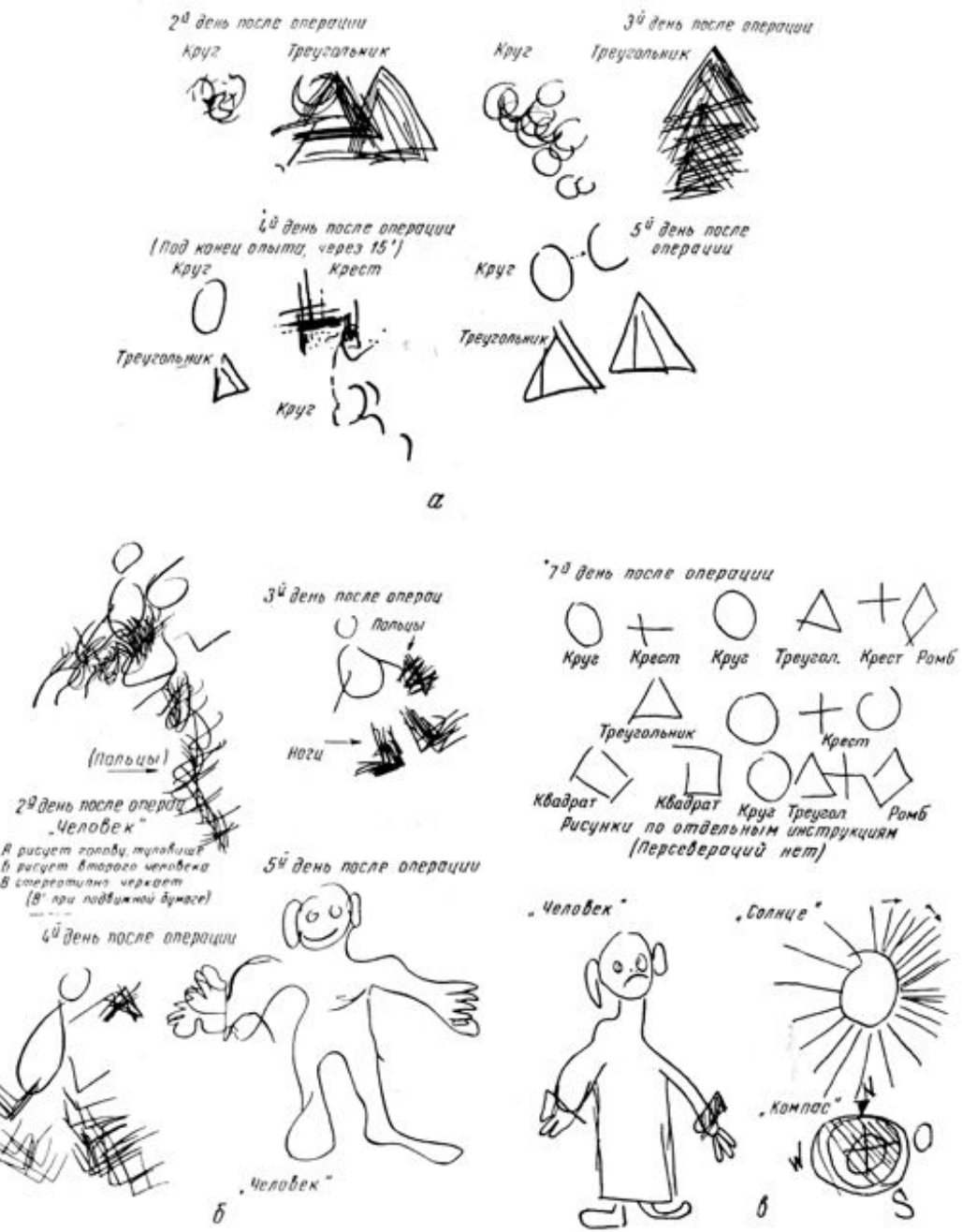
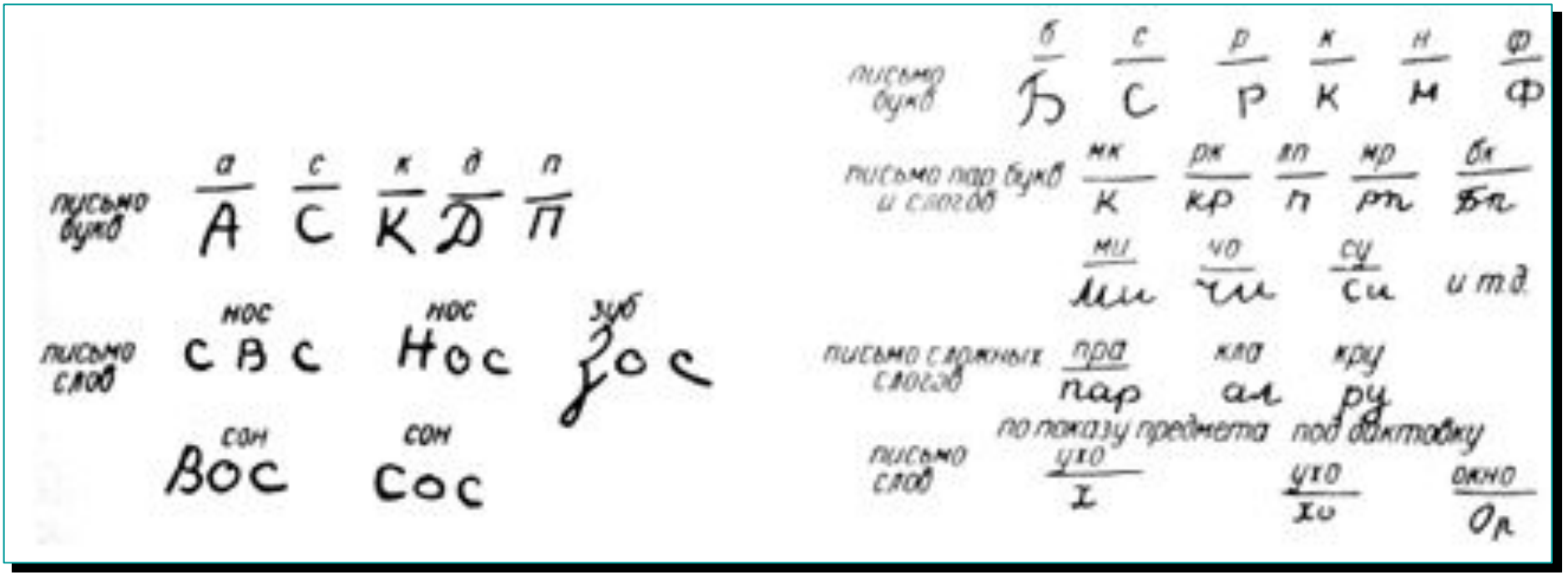


Рис. 33. Двигательные персеверации в послеоперационный период у больного с удалением опухоли (менингеомы) премоторной области: *а* — рисование фигур (2—5-й день после операции); *б* — рисование человечка (те же дни); *в* — рисование фигур и человечка на 7-й день после операции

Elementary (simple) motor perseveration in the postoperative period after removal of meningeoma from premotor region

Writings of the patient with kinetic motor aphasia




THANKS for attention!