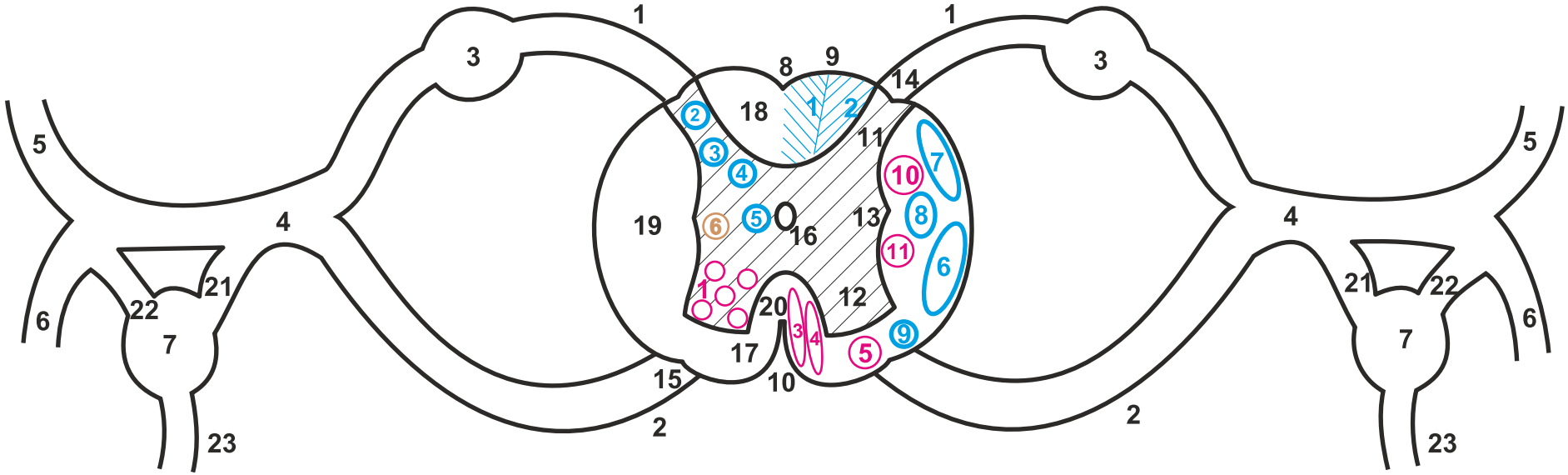
SCHEME OF THE STRUCTURE OF SPINAL CORD SEGMENTS

(Cross-section at the level of thoracic segments)

The area of the spinal cord, which formed one nevrotome, with two pairs of anterior and posterior roots, called a segment of the spinal cord. Human spinal cord has a 31 segments: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 coccygeal. Gray substance, substantia grisea, which consists of bodies of neurons located in the middle of the spinal cord of three grey column, columnae grisea: anterior column, columna anterior; posterior column, columna posterior; intermediate column, columna intermedia. In the cross section of the spinal cord grey columns have the form of three horns anterior horn, cornu anterius (12); posterior horn, cornu posterius (11); lateral horn, cornu laterale (13). White substance, substantia alba, which consists of processes of nerve cells located on the periphery of the spinal cord and surrounding grey substance in three funiculus: anterior funiculus, funiculus anterior (17); posterior funiculus, funiculus posterior (18); lateral funiculus, funiculus lateralis (19).



1 − posterior (sensory) root, radix posterior (sensoria); 2 − anterior (motor) root, radix anterior (motoria); 3 − spinal ganglion, ganglion spinale; 4 − spinal nerve, nervus spinale; 5 − posterior branch of spinal nerve, ramus posterior nervi spinalis; 6 − anterior branch of spinal nerve, ramus anterior nervi spinalis; 7 − sympathetic ganglion, ganglion sympathicum; 8 − posterior median sulcus, sulcus medianus posterior; 9 − posterior intermediate sulcus, sulcus intermedius posterior; 10 − anterior median fissure, fissura mediana anterior; 11 − posterior horn, cornu posterius; 12 − anterior horn, cornu anterius; 13 − lateral horn, cornu laterale; 14 − posterolateral sulcus, sulcus posterolateralis; 15 − anterolateral sulcus, sulcus anterolateralis; 16 − central canal, canalis centralis; 17 − anterior funiculus, funiculus anterior; 18 − posterior funiculus, funiculus posterior; 19 − lateral funiculus, funiculus lateralis; 20 − anterior white commissure, commissura alba anterior; 21 − white communicans ramus, ramus communicans albus; 22 − grey communicans ramus, ramus communicans griseus; 23 − interganglionar ramus of sympathetic trunk, ramus interganglionares trunci sympathici.

TOPOGRAPHY OF NUCLEUS IN THE GREY SUBSTANCE OF SPINAL CORD

Anterior horn, cornu anterius

Motor nuclei:

1. Anterolateral nucleus, nucleus anterolateralis
Anteromedial nucleus, nucleus anteromedialis
Central nucleus, nucleus centralis
Posterolateral nucleus, nucleus posterolateralis
Posteromedial nucleus, nucleus posteromedialis

Posterior horn, cornu posterius

Sensitive nuclei:

2. Gelatinous substance, substantia gelatinosa
3. Nucleus proprius
4. Thoracic nucleus, nucleus thoracicus

Lateral horn, cornu laterale

there is only on the level of segment C_8–L_3

5. Sensitive nucleus: intermediomedial nucleus, nucleus intermediomedialis
6. Sympathetic vegetative (autonomic) nucleus: intermediolateral nucleus, nucleus intermediolateralis – available in the thoracic and lumbar segments of the spinal cord. In the sacral segments of the spinal cord intermediolateral nucleus, nucleus intermediolateralis is a parasympathetic vegetative (autonomic) nucleus

TOPOGRAPHY OF PROJECTION TRACTS IN THE WHITE SUBSTANCE OF SPINAL CORD

Posterior funiculus, funiculus posterior:

1. Gracile fasciculus, fasciculus gracilis, fasciculus Hollya
2. Cuneate fasciculus, fasciculus cuneatus, fasciculus Burdakha

Anterior funiculus, funiculus anterior:

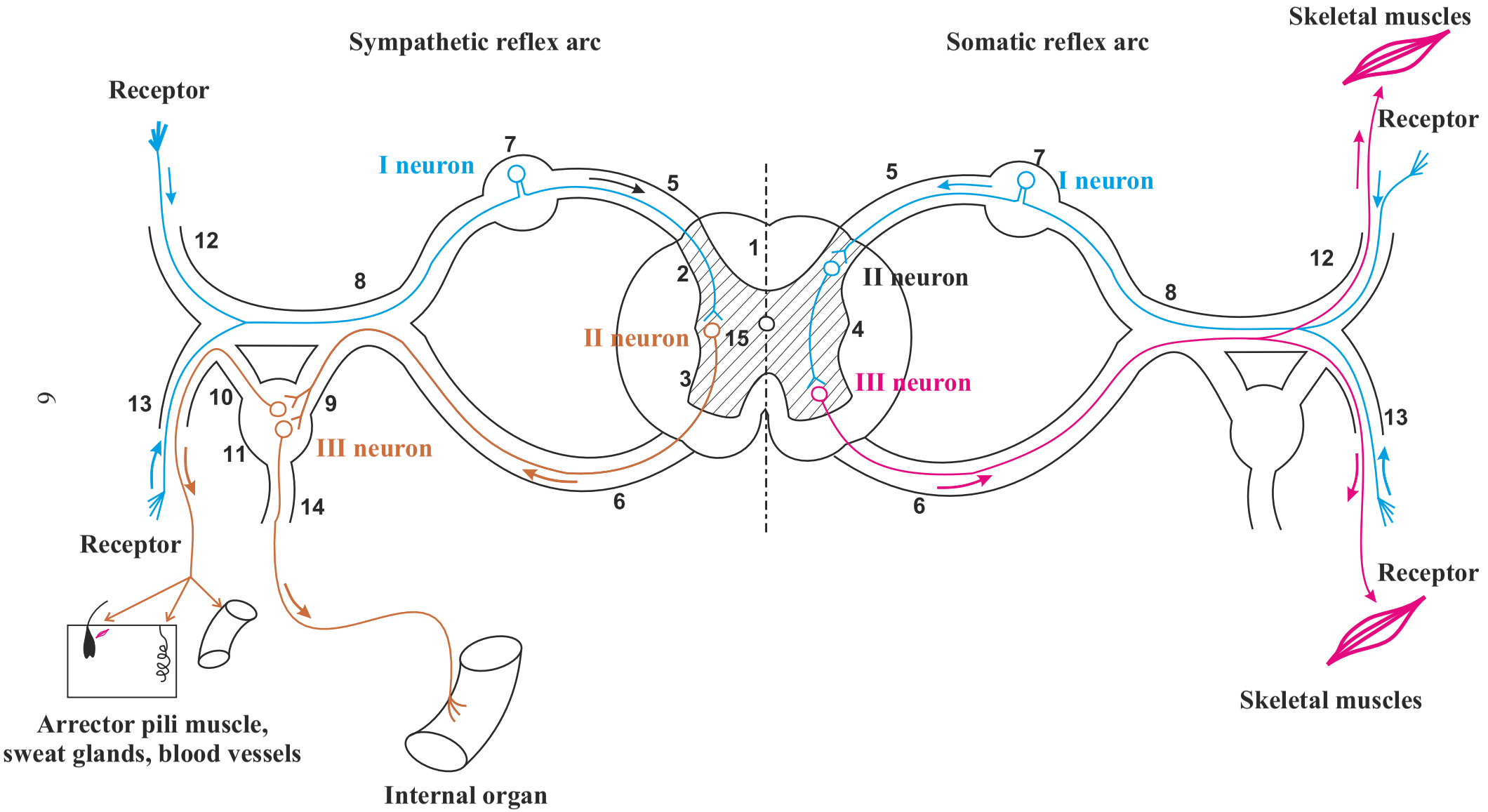
3. Tectospinal tract, tractus tectospinalis
4. Anterior corticospinal (pyramidal) tract, tractus corticospinalis (pyramidalis) anterior
5. Vestibulospinal tract, tractus vestibulospinalis
9. Anterior spinothalamic tract, tractus spinothalamicus anterior

The area of the white substance of spinal cord, in which pass anterior and lateral spinothalamic tract, now called anterolateral system.

Lateral funiculus, funiculus lateralis:

6. Anterior spinocerebellar tract, tractus spinocerebellaris anterior, tract Howersa
7. Posterior spinocerebellar tract, tractus spinocerebellaris posterior, tract Fleksiha
8. Lateral spinothalamic tract, tractus spinothalamicus lateralis
10. Lateral corticospinal (pyramidal) tract, tractus corticospinalis (pyramidalis) lateralis
11. Rubrospinal tract, tractus rubrospinalis

A SCHEME OF SIMPLE SOMATIC AND SYMPATHETIC REFLEX ARCHES



A simple somatic reflex arc consists of three neurons. The first pseudounipolar sensitive neurons are located in the spinal ganglions (7). They transmit sensitive information from the receptors to the second (embedded) neurons located in the posterior horns (2) of the spinal cord. Axons of embedded neurons in the anterior horns (3) switched on the third motor neurons. On the axons of the third neurons, which are components of the anterior roots, the anterior and posterior ramus of the spinal nerves, the team is on the contraction of the corresponding skeletal muscles.

Simple sympathetic reflex arc, as component of vegetative (autonomic) part of peripheral nervous system, functioning at the level of the thoracic and lumbar segments of spinal cord. Arc has the following features: the axons of pseudounipolar sensitive neurons, located in the spinal ganglion (7), in the intermediate columns (4) of the spinal cord are switched to the second neurons (15) – the intermediolateral nuclei (sympathetic). Their axons (preganglionic fibers) consisting of the anterior root (6) and the white communicans ramus (9), enter the sympathetic ganglion (11), where switches to the third neurons – sympathetic. Axons of the third neurons (postganglionic fibers), which are the components of the corresponding nerves, innervate smooth muscles and glands in the internal organs, as well as strained cardiac muscles. Part of the axons of the third neurons (postganglionic fibers), that pass through the grey communicans ramus (10), and then in the corresponding branches (12, 13) of the spinal nerves, innervates the arrector pili muscle, sweat glands and blood vessels in the body.

1.Spinal cord, medulla spinalis
2. Posterior horn, cornu posterius
3. Anterior horn, cornu anterius
4. Lateral horn, cornu laterale
5. Posterior (sensitive) root, radix posterior (sensoria)
6. Anterior (motor) root, radix anterior (motoria)
7. Spinal ganglion, ganglion spinale
8. Spinal nerve, nervus spinalis
9. White communicans ramus, ramus communicans albus
10. Grey communicans ramus, ramus communicans grisseus
11. Sympathetic ganglion, ganglion sympathicum
12. Posterior ramus of spinal nerve, ramus posterior nervi spinalis
13. Anterior ramus of spinal nerve, ramus anterior nervi spinalis
14. Interganglionar ramus of sympathetic trunk, ramus interganglionares trunci sympathici
15. Intermediolateral nucleus, nucleus intermediolateralis – sympathetic vegetative (autonomic) nucleus in the thoracic and lumbar segments of the spinal cord, in the sacral segments of the spinal cord – parasympathetic nucleus

PROJECTION TRACTS OF THE CENTRAL NERVOUS SYSTEM

All structures of the central nervous system should be viewed as a whole, is a system where the principle of subordination – dependence of function of some elements to others, higher coordinating authority of the nervous system is the cortex of the brain, which is very complex functional relationships: in the brain; in the cortex of the brain with located below the nerve nuclei, including cranial nerve nuclei and grey matter of the spinal cord; in the spinal cord; central nervous system with organs and tissues.

In the central nervous system, there are three kinds of tracts: association fibres, commissural fibres of telencephalon and projection tracts.

ASSOCIATION FIBRES

Ultimately brain associative fibres connecting different parts of the cortex within one hemisphere. In the spinal cord within each half of its inter-segment associative connections are made through the anterior, posterior and lateral own bundles.

COMMISSURAL FIBRES OF TELENCEPHALON

This is the corpus callosum fibres, anterior commissure and hippocampal commissure that connect the cortex of both hemispheres.

PROJECTION TRACTS

This is the fibres that connect the spinal cord to the brain and brainstem to the brain. These tracts are divided into:

- Afferent (ascending) or sensitive ways;
- Efferent (descending) or motor ways.

AFFERENT (ASCENDING, SENSORY) TRACTS DIVIDED INTO TWO GROUPS:

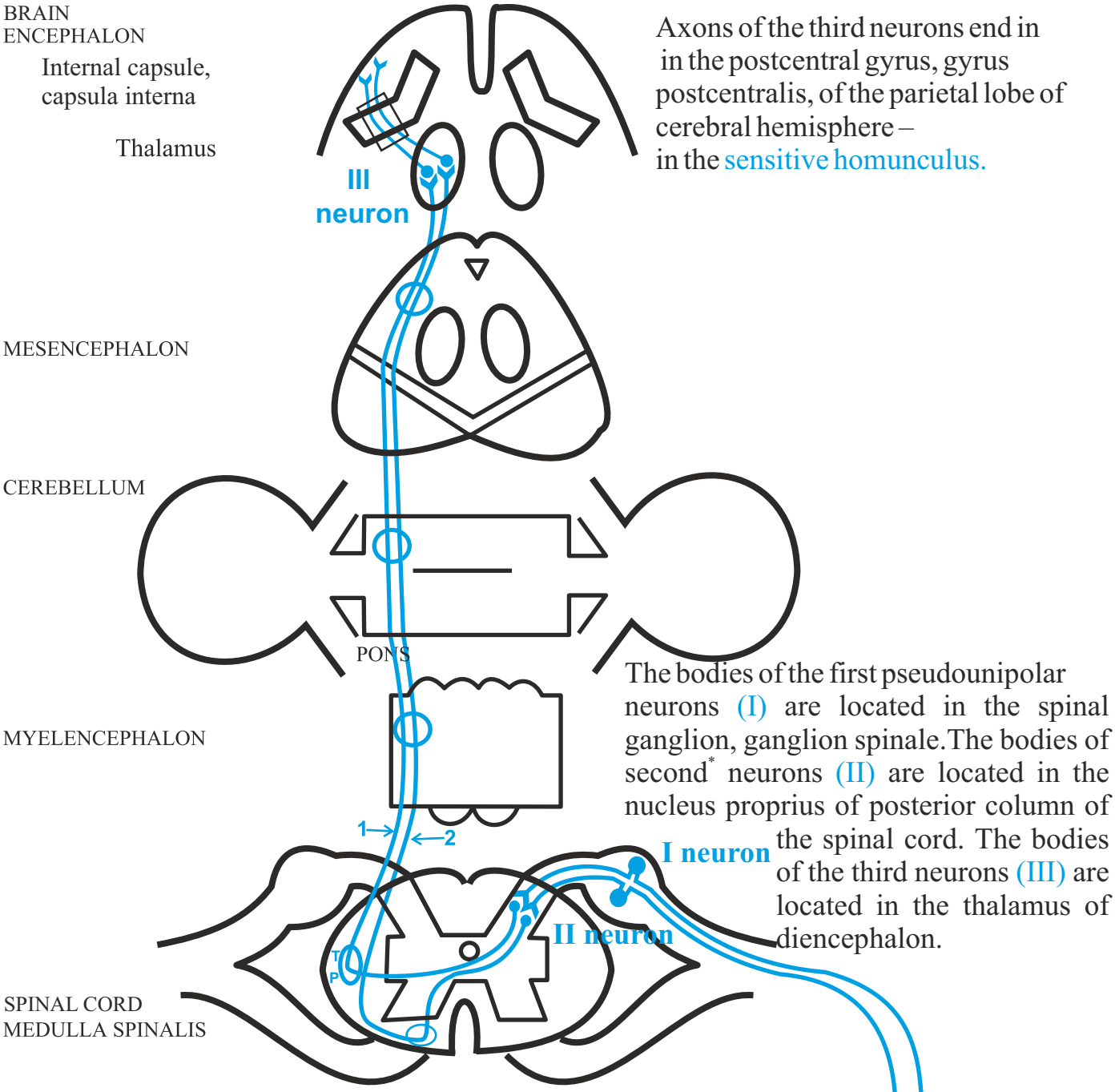
- Ways a conscious somatosensory sensitivity (cortical direction);
- Ways a conscious somatosensory sensitivity (cerebellar and not cortical direction).

For afferent (ascending) tracts transferred sensitive information from the receptors, these tracts provide:

- a conscious and somatic visceral sensitivity;
- carrying unconscious sensitivity to sensory and motor centers in the brainstem, cerebellum, diencephalon, basal nuclei;
- feedback for implementationof make somatic visceral reflexes.

The bodies of the first pseudounipolar sensitive neurons located in the spinal sensitive ganglion or in sensitive ganglion of cranial nerves. Dendrites of these neurons begin corresponding receptors, and their axons consisting roots go back to the spinal cord and form synapses with other neurons. Body of second neurons are in the sensitive respective nuclei of grey matter of the spinal cord or brainstem. The axons of the second neurons cross in anterior comissure of spinal cord or the medulla oblongata. Next axons pass through the brainstem, where all sensitive tracts united in medial lemniscus, and form synapses with third neurons in the thalamus. The axons of the third neurons of conscious sensitive tracts goes from the thalamus through the posterior limb of the internal capsule to the somatosensory cortex area of the brain - to the sensitive homunculus.

On the schemes sensitive tracts marked in blue.



Axons of the third neurons end in in the postcentral gyrus, gyrus postcentralis, of the parietal lobe of cerebral hemisphere – in the sensitive homunculus.

The bodies of the first pseudounipolar neurons (I) are located in the spinal ganglion, ganglion spinale. The bodies of second* neurons (II) are located in the nucleus proprius of posterior column of the spinal cord. The bodies of the third neurons (III) are located in the thalamus of diencephalon.

Proprioreceptors are located in the skin and mucous membranes

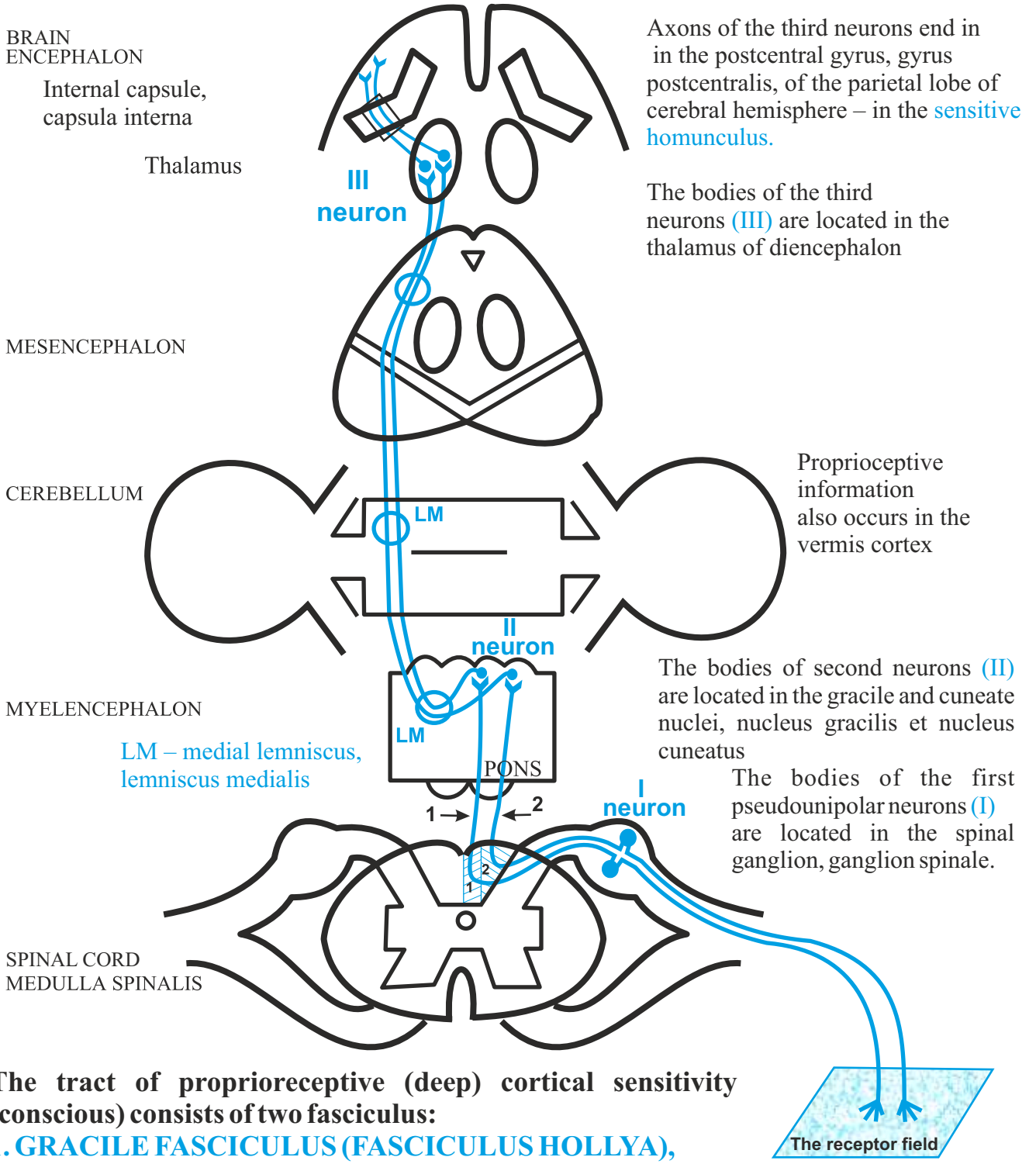
1. LATERAL SPINOTHALAMIC TRACT, TRACTUS SPINOTHALAMICUS LATERALIS

On it there is a conscious information about pain (P) and temperature (T) sensitivity.

2. ANTERIOR SPINOTHALAMIC TRACT, TRACTUS SPINOTHALAMICUS ANTERIOR

It provides conscious information about the sensation of touch and pressure.

*Note: in foreign textbooks it is noted that the bodies of the II neurons in the tract of pain and temperature sensitivity are located in the gelatinous substance, substantia gelatinosa, (Бобрик І.І., Черкасов В.Г., 2001)



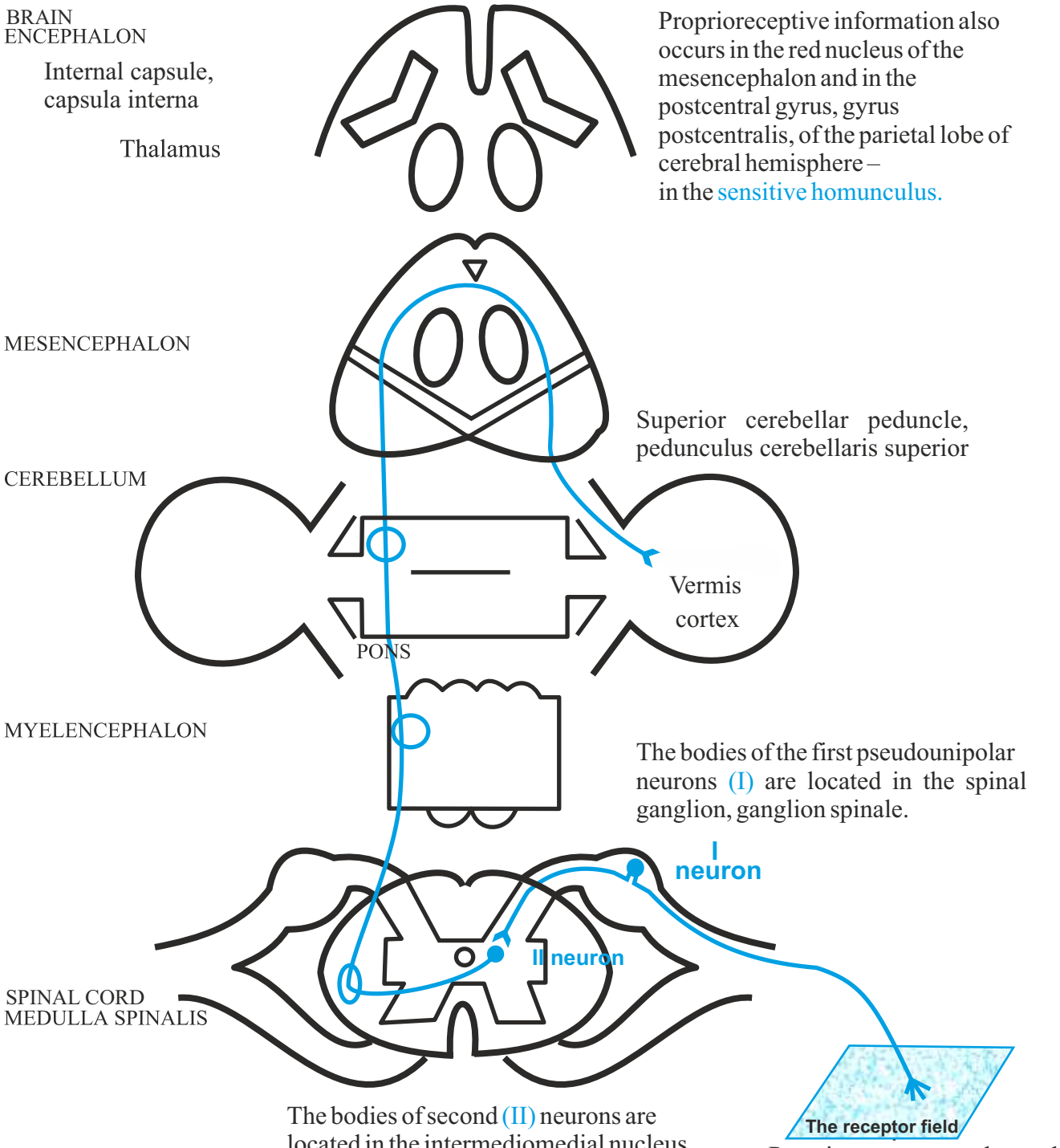
The tract of proprioreceptive (deep) cortical sensitivity (conscious) consists of two fasciculus:

1. GRACILE FASCICULUS (FASCICULUS HOLLYA), FASCICULUS GRACILIS

The gracile fasciculus passes information about the proprioreceptive sensitivity from the receptors of the lower extremities and the lower part of the trunk through 19 inferior spinal segments.

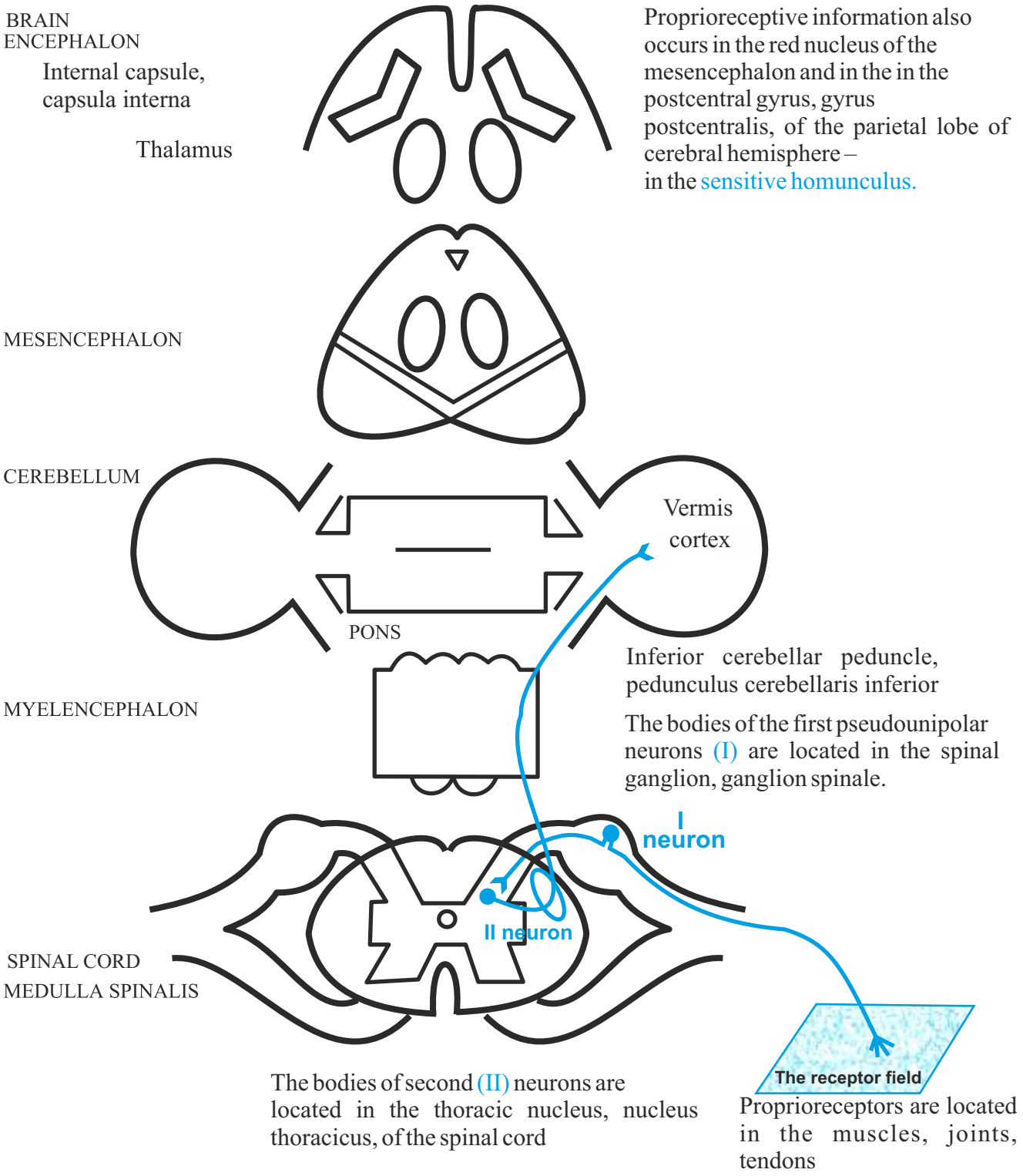
2. CUNEATE FASCICULUS (FASCICULUS BURDAKHA), FASCICULUS CUNEATUS

The cuneate fasciculus passes information about the proprioceptive sensitivity from the receptors of the upper extremities and the upper part of the trunk through 12 superior spinal segments.



ANTERIOR SPINOCEREBELLAR TRACT, TRACTUS SPINOCEREBELLARIS ANTERIOR – UNCONSCIOUS

It undergoes an unconscious sensitive (proprioreceptal) information on the state of the musculoskeletal system, which is necessary for reflex coordination of movements and providing a balance of the body.



POSTERIOR SPINOCEREBELLAR TRACT, TRACTUS SPINOCEREBELLARIS POSTERIOR – UNCONSCIOUS

It undergoes an unconscious sensitive (proprioreceptal) information on the state of the musculoskeletal system, which is necessary for reflex coordination of movements and providing a balance of the body.

Attention!

The cerebellar cortex receives a «copy» of all motor impulses from the cerebral cortex, as well as in the afferent spinocerebellar tracts information about all activity on the periphery. Consequently, the cerebellum controls and coordinates volitional movements through the extrapyramidal system.

EFFERENT (DESCENDING, MOTOR) TRACTS DIVIDED INTO TWO GROUPS:

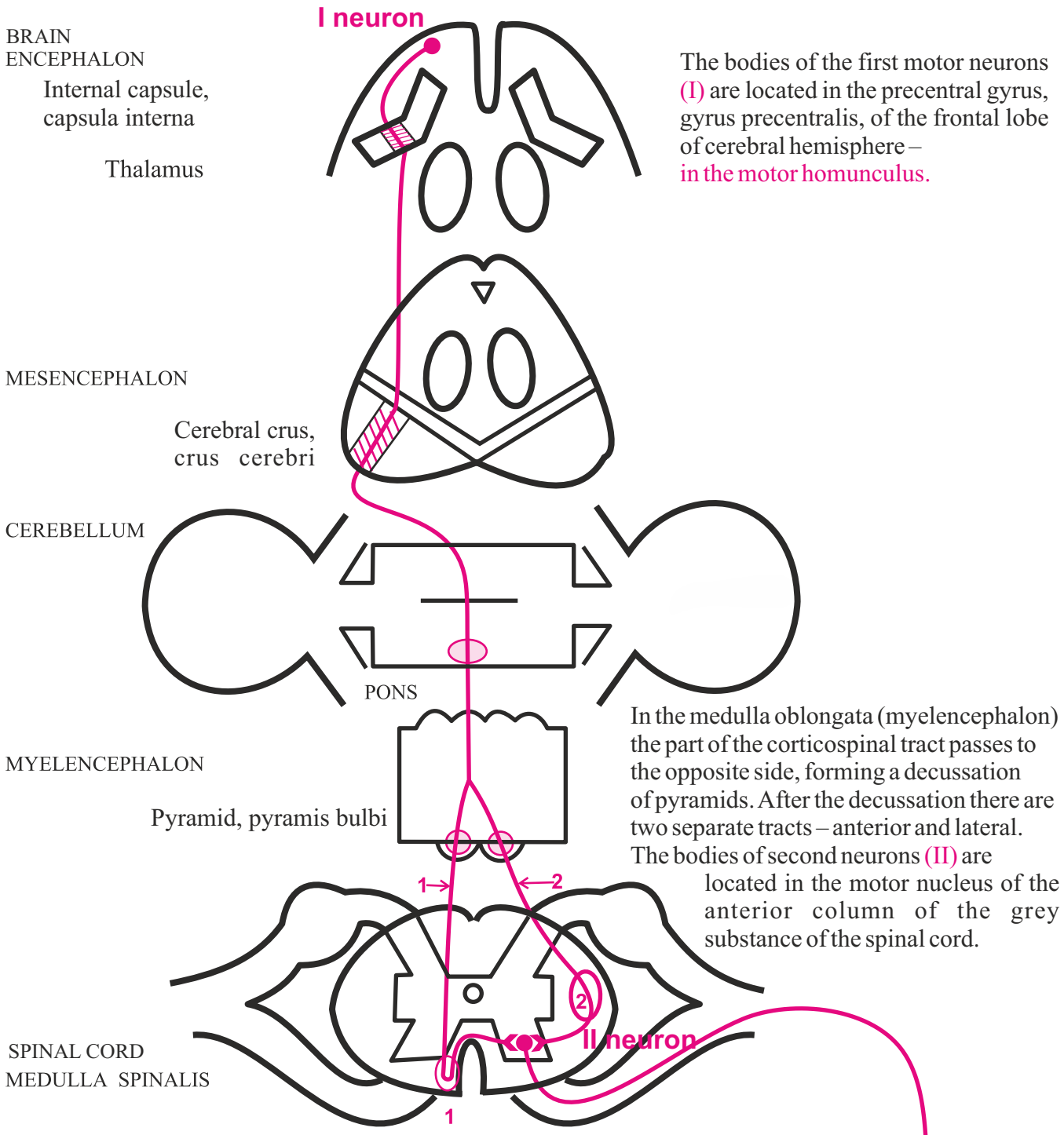
- **Conscious (pyramidal) movement tracts** that transmit nerve impulses to skeletal muscles in their willful targeted reduction;
- **Unconscious (extrapyramidal) movement tracts** which transmit nerve impulses from the motor nuclei of mesencephalon and pons, as well as the cerebellum, to skeletal muscles in their automatic (unconscious) reduction, provide support muscle tone and coordination.

Body of the first motor neurons of conscious (pyramidal) motor tract are mainly in precentral gyrus - in motor homunculus, in posterior third of the superior and middle frontal gyri, in the middle third of the all frontal gyri, in the superior part of postcentral gyrus of the cerebral hemisphere.

Axons of the first neurons of conscious motor tracts pass through the appropriate parts of the internal capsule, and then, with the axons of the first neuron of unconscious (extrapyramidal) motor tracts, passing through the base of peduncle of the midbrain, the pons and the medulla oblongata (in the appropriate parts of the brainstem much of axons of first motor neurons cross over).

In anterior column of grey matter of the spinal cord axons of motor neurons first form synapses with the bodies of the second motor neurons (motor nuclei). Axons second motor neurons that are a part of the anterior (motor) roots of the spinal cord and then to the respective branches of spinal nerves innervating skeletal muscles appropriate.

On the schemes motor tracts marked in red.



The bodies of the first motor neurons (I) are located in the precentral gyrus, gyrus precentralis, of the frontal lobe of cerebral hemisphere – in the motor homunculus.

In the medulla oblongata (myelencephalon) the part of the corticospinal tract passes to the opposite side, forming a decussation of pyramids. After the decussation there are two separate tracts – anterior and lateral. The bodies of second neurons (II) are located in the motor nucleus of the anterior column of the grey substance of the spinal cord.

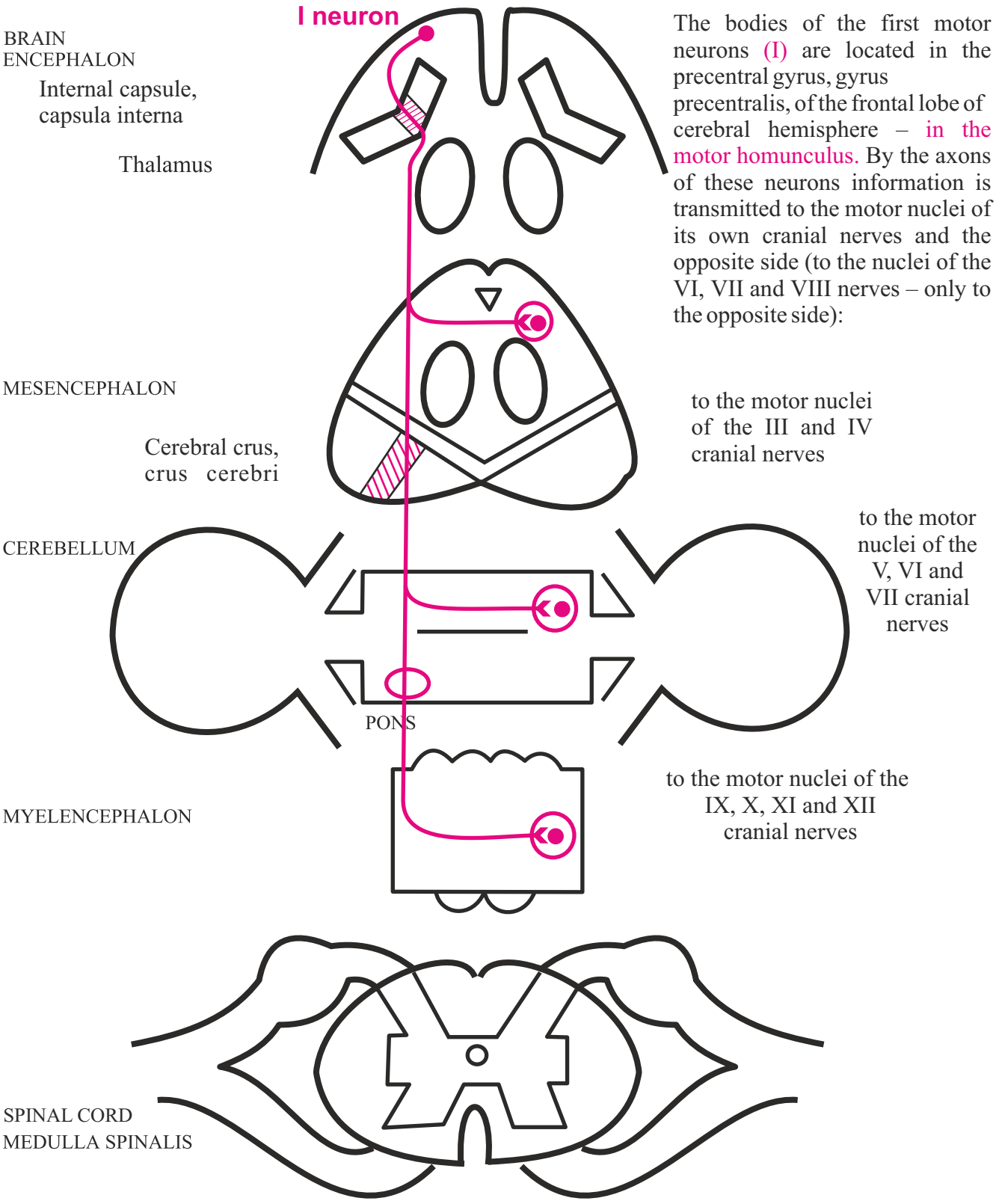
The team is transmitted to the conscious contraction of the corresponding skeletal muscles.

1. ANTERIOR CORTICOSPINAL (PYRAMIDAL) TRACT, TRACTUS CORTICOSPINALIS (PYRAMIDALIS) ANTERIOR

The anterior tract is significantly "younger" from the lateral, lowered to the level of the cervical and thoracic segments.

2. LATERAL CORTICOSPINAL (PYRAMIDAL) TRACT, TRACTUS CORTICOSPINALIS (PYRAMIDALIS) LATERALIS

These are conscious motor tracts – a person at his request performs various movements.



The bodies of the first motor neurons (I) are located in the precentral gyrus, gyrus precentralis, of the frontal lobe of cerebral hemisphere – in the motor homunculus. By the axons of these neurons information is transmitted to the motor nuclei of its own cranial nerves and the opposite side (to the nuclei of the VI, VII and VIII nerves – only to the opposite side):

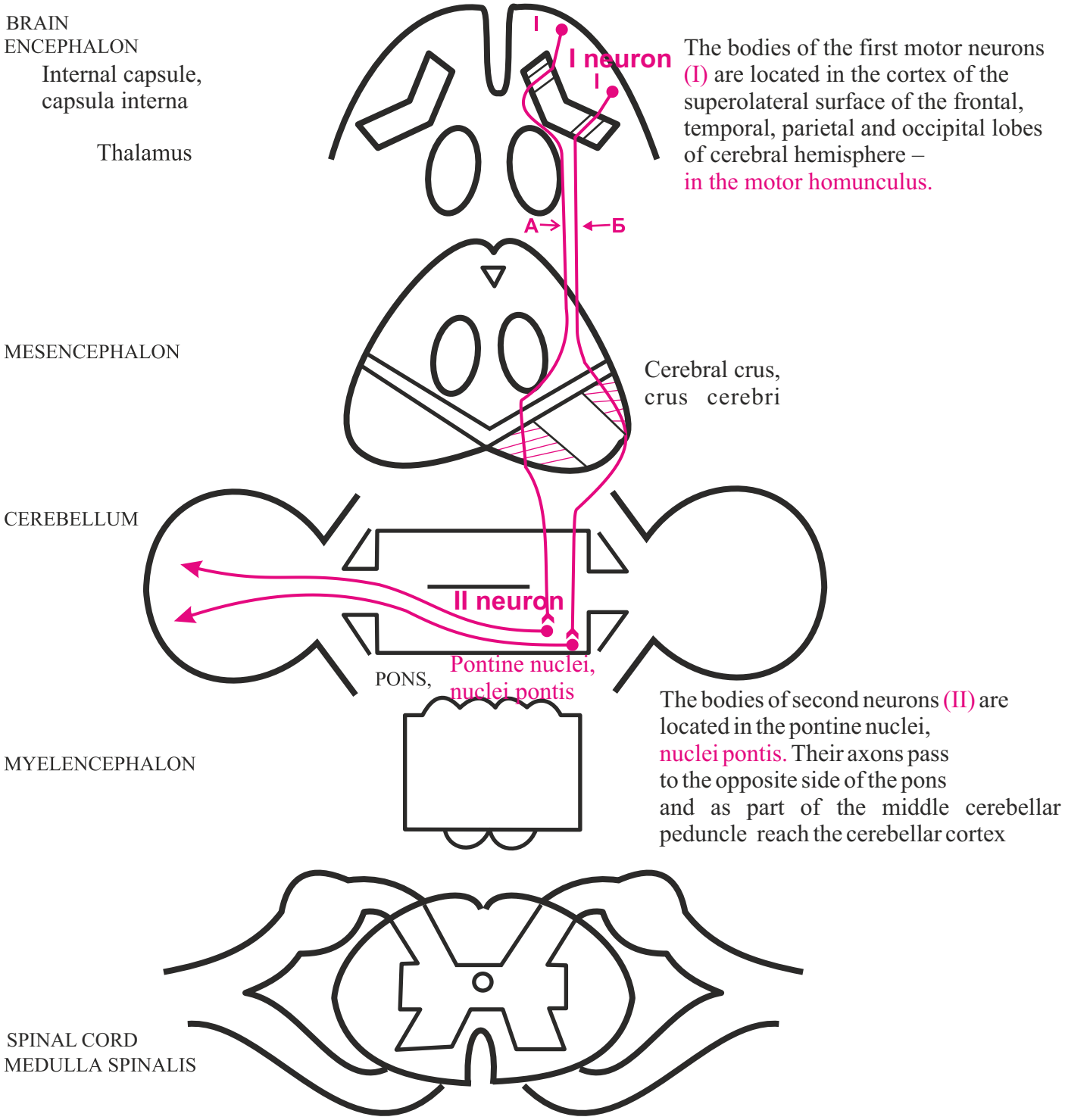
to the motor nuclei of the III and IV cranial nerves

to the motor nuclei of the V, VI and VII cranial nerves

to the motor nuclei of the IX, X, XI and XII cranial nerves

CORTICONUCLEAR TRACT, TRACTUS CORTICONUCLEARIS

Through this path, the "control" of the motor nucleus of the cranial nerves is carried out.



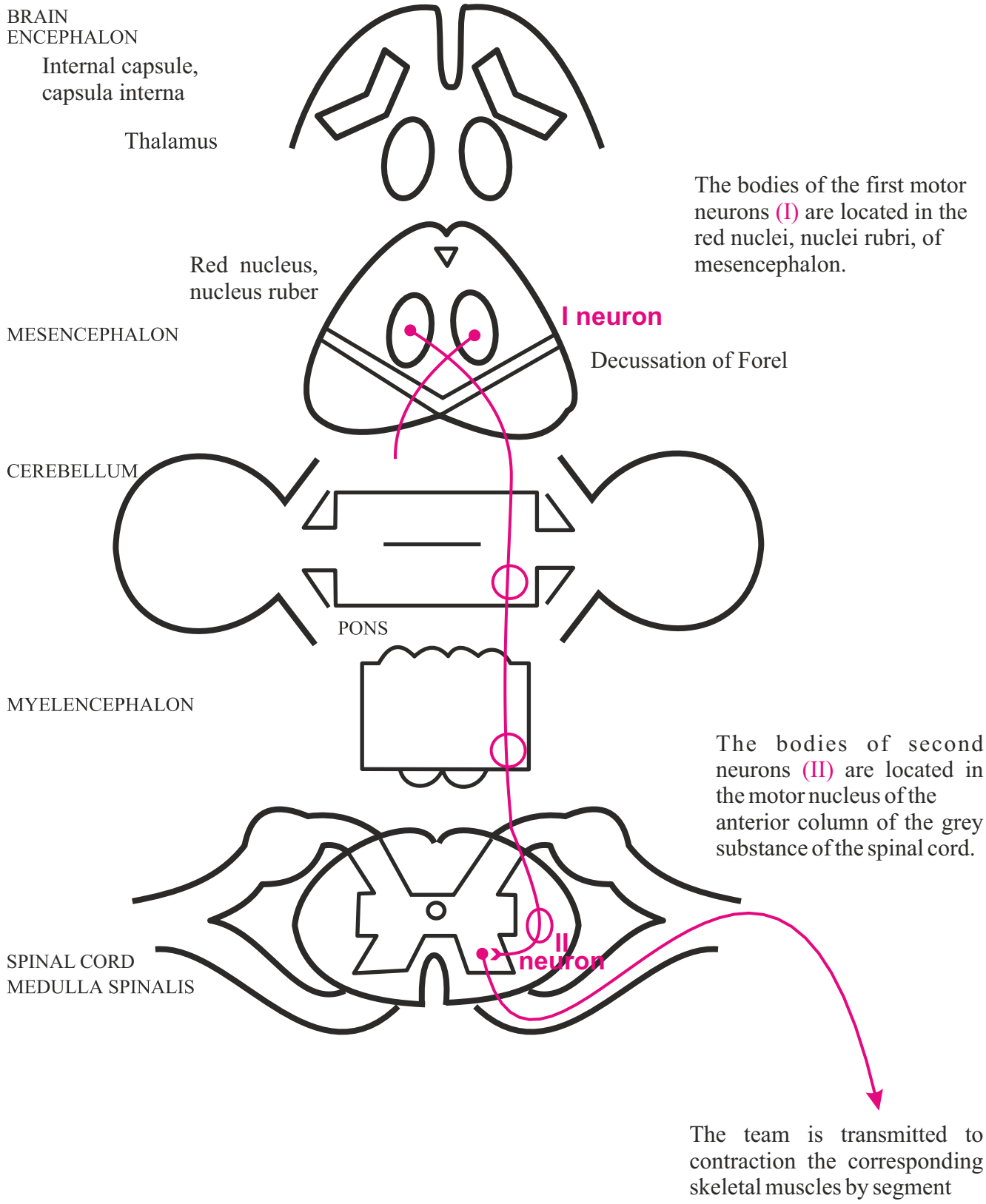
The bodies of the first motor neurons (I) are located in the cortex of the superolateral surface of the frontal, temporal, parietal and occipital lobes of cerebral hemisphere – in the motor homunculus.

The bodies of second neurons (II) are located in the pontine nuclei, nuclei pontis. Their axons pass to the opposite side of the pons and as part of the middle cerebellar peduncle reach the cerebellar cortex

CORTICOPONTOCEREBELLAR TRACT, TRACTUS CORTICOPONTOCEREBELLARIS

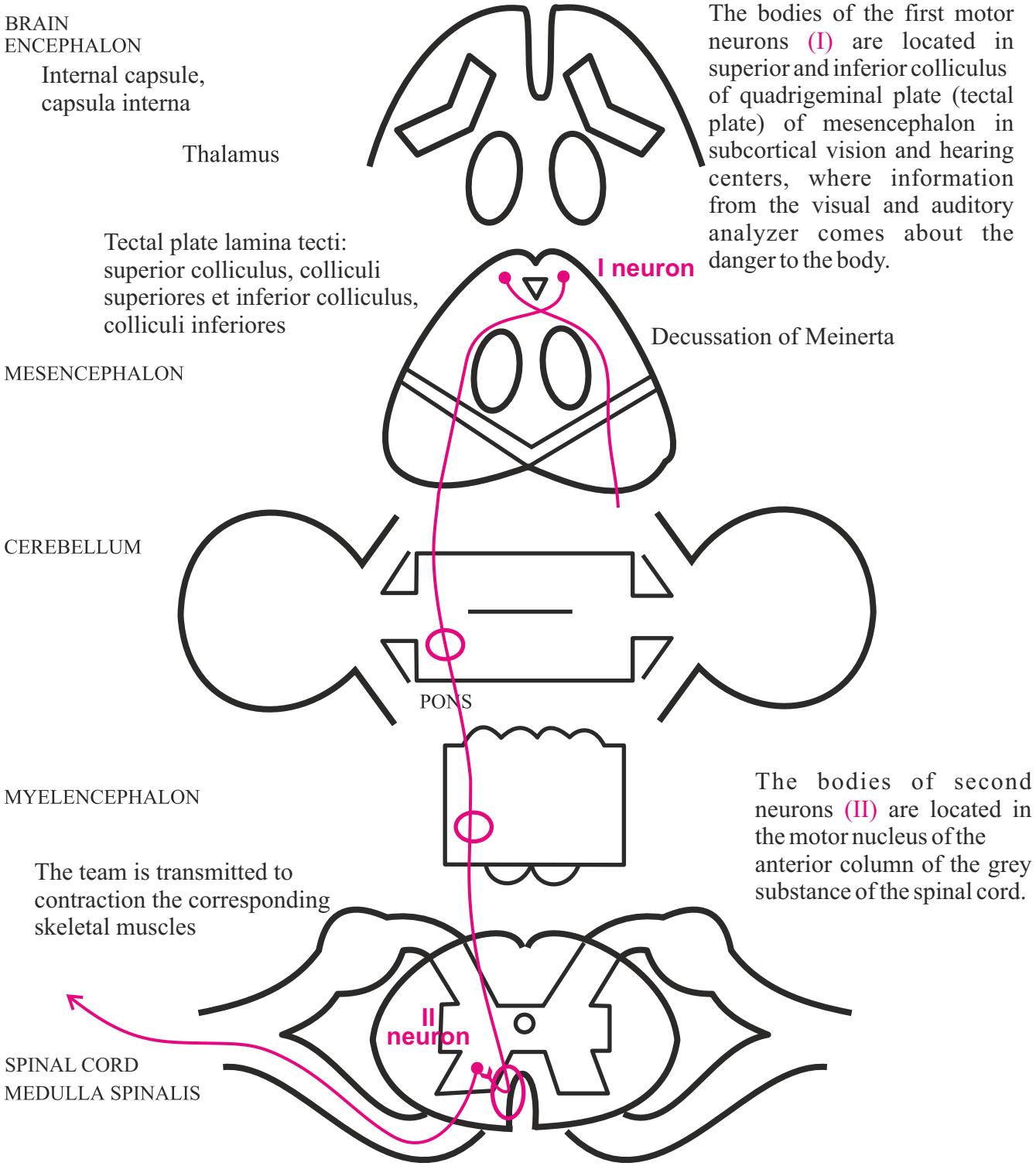
The first section of this tract – corticopontine tract, tractus corticopontinus, consists of two parts:
A – frontopontine fibres, fibrae frontopontinae;
B – parietotemporooccipitopontine fibres, fibrae parietotemporooccipitopontinae.
The second section of this tract – pontocerebellar tract, tractus pontocerebellaris.

Through this pathway, the cerebral cortex manages the functions of the cerebellum, in particular, by coordinating movements.



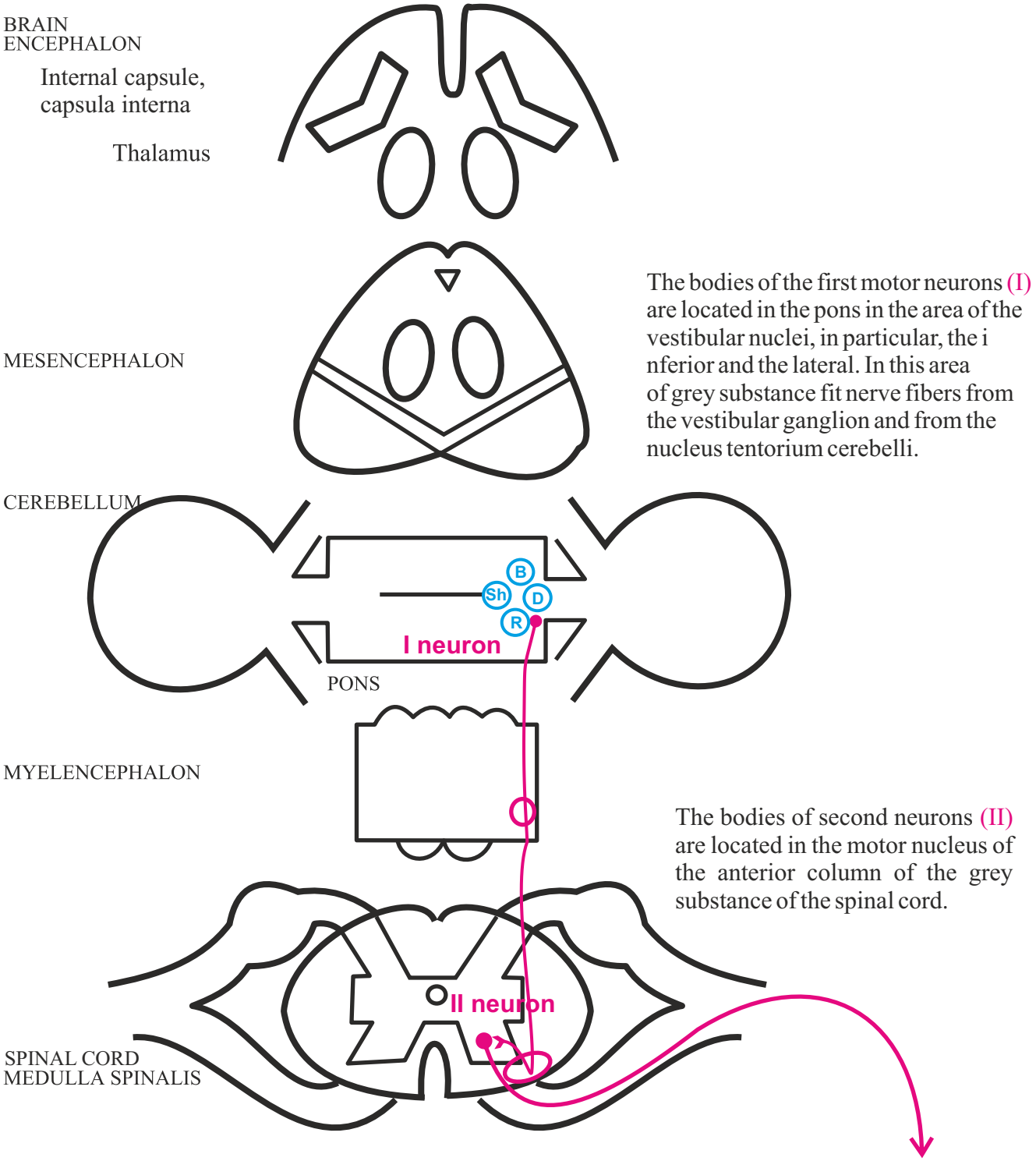
RUBROSPINAL TRACT, TRACTUS RUBROSPINALIS - UNCONSCIOUS (EXTRAPYRAMIDAL) MOVEMENT PATH

Through this path, automatic (unconscious) work of the muscles, in particular, body balance, coordination of movements is provided.



TECTOSPINAL TRACT, TRACTUS TECTOSPINALIS - UNCONSCIOUS MOVEMENT PATH

This path provides reflexive protection of the body from danger.



The bodies of the first motor neurons (I) are located in the pons in the area of the vestibular nuclei, in particular, the i nferior and the lateral. In this area of grey substance fit nerve fibers from the vestibular ganglion and from the nucleus tentorium cerebelli.

The bodies of second neurons (II) are located in the motor nucleus of the anterior column of the grey substance of the spinal cord.

The team is transmitted to contraction the corresponding skeletal muscles by segment

VESTIBULOSPINAL TRACT, TRACTUS VESTIBULOSPINALIS - UNCONSCIOUS MOVEMENT PATH

With this path, body balance is automatically provided, motor functions of the body are coordinated, in particular, the head, neck, and eyeballs. There is an appropriate connection with the cerebellum and the nuclei of the oculomotor nerves.

To the peripheral nervous system there are 12 pairs of **CRANIAL NERVES** and 31 pairs of **SPINAL NERVES**, and also vegetative (autonomic) partition.

These nerves are the constituent parts of the corresponding complex reflex arches.

CRANIAL NERVES by function are divided into:

SENSORY NERVES – consists of afferent nerve fibers, which transmits sensitive information to sensitive nuclei of the corresponding brain sections. In the schemes, the name of such nerves and their structural components is indicated by a blue color;

MOTOR NERVES – consists of efferent motor nerve fibers, on which is transmitted the command for contraction of skeletal muscles.

In the schemes, the name of such nerves and their structural components is indicated by a red color.

MIXED NERVES – consists of afferent sensory nerve fibers (blue color), efferent motor nerve fibers (red color) and efferent preganglionic and postganglionic parasympathetic fibers (green color). Parasympathetic postganglionic fibers innervates smooth muscles, glands and strained heart muscles.

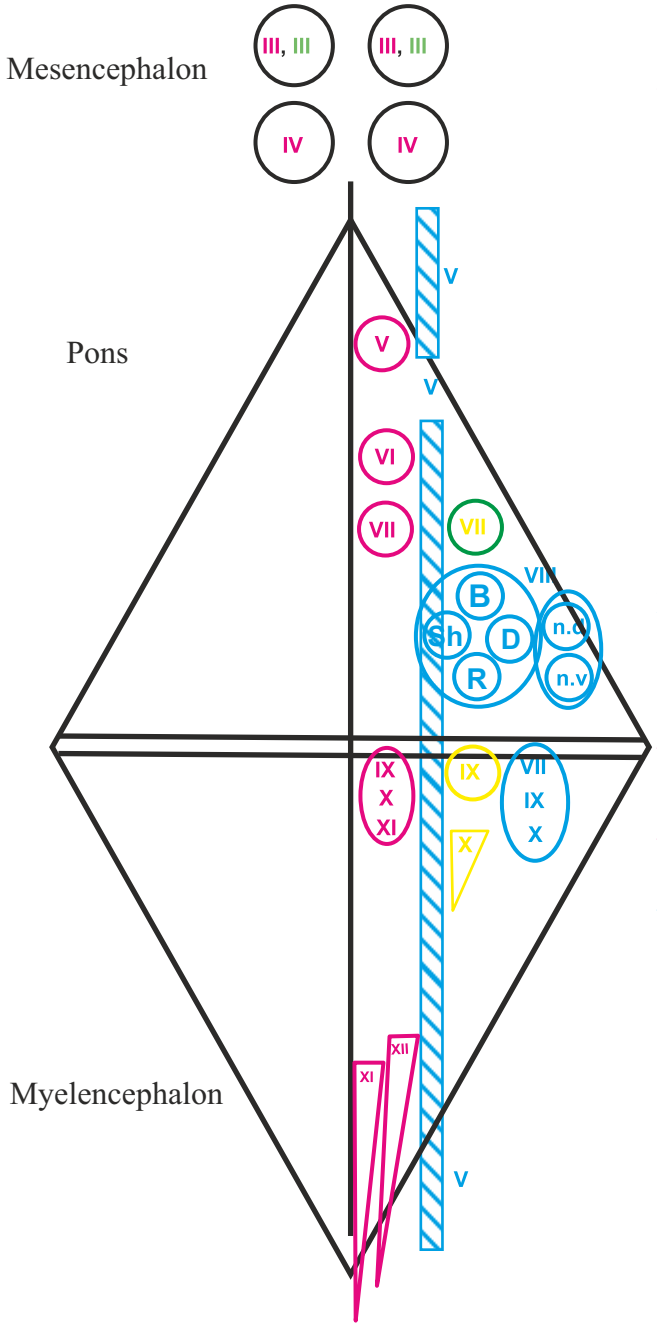
In the schemes, the name of the mixed nerve is marked in black.

On the first schemes of this section is presented the projection of the nucleus of cranial nerves on the dorsal surface of the mesencephalon and plane of rhomboid fossa. The motor nuclei are marked in red color, sensitive nuclei in blue, parasympathetic in green.

In studying the functional anatomy of cranial nerves the **student must**:

- know the name of the cranial nerve;
- give it a functional characteristic;
- call the nuclei of the cranial nerve and know their topography in the brain, as well as be able to project them to the corresponding surface of the brainstem;
- to be able to show on the preparation of the brain the localization of the cranial nerve, and on the skull notches through which the nerve and its branches pass;
- to name and show on the anatomical preparations the main branches of the cranial nerve and the areas of innervation.

PROJECTION OF THE NUCLEUS OF CRANIAL NERVES ON THE DORSAL SURFACE OF THE MESENCEPHALON AND PLANE OF RHOMBOID FOSSA



Red color – motor nuclei
Blue color – sensitive nuclei
Green – vegetative (autonomic) parasympathetic nuclei

XI. ACCESSORY NERVE, NERVUS ACCESSORIUS
Accessory nucleus, nucleus nervi accessorii
Nucleus ambiguous

XII. HYPOGLOSSAL NERVE, NERVUS HYPOGLOSSUS
Hypoglossal nucleus, nucleus nervi hypoglossi

III. OCULOMOTOR NERVE, NERVUS OCULOMOTORIUS
Nucleus of oculomotor nerve, nucleus nervi oculomotorii
Accessory nucleus of oculomotor nerve, nucleus accessorius nervi oculomotorii

IV. TROCHLEAR NERVE, NERVUS TROCHLEARIS
Nucleus of trochlear nerve, nucleus nervi trochlearis

V. TRIGEMINAL NERVE, NERVUS TRIGEMINUS
Motor nucleus of trigeminal nerve, nucleus motorius nervi trigemini
Mesencephalic nucleus of trigeminal nerve, nucleus mesencephalicus nervi trigemini
Principal sensory nucleus of trigeminal nerve, nucleus principalis nervi trigemini
Spinal nucleus of trigeminal nerve, nucleus spinalis nervi trigemini

VI. ABDUCENT NERVE, NERVUS ABDUCENS
Nucleus of abducens nerve, nucleus nervi abducentis

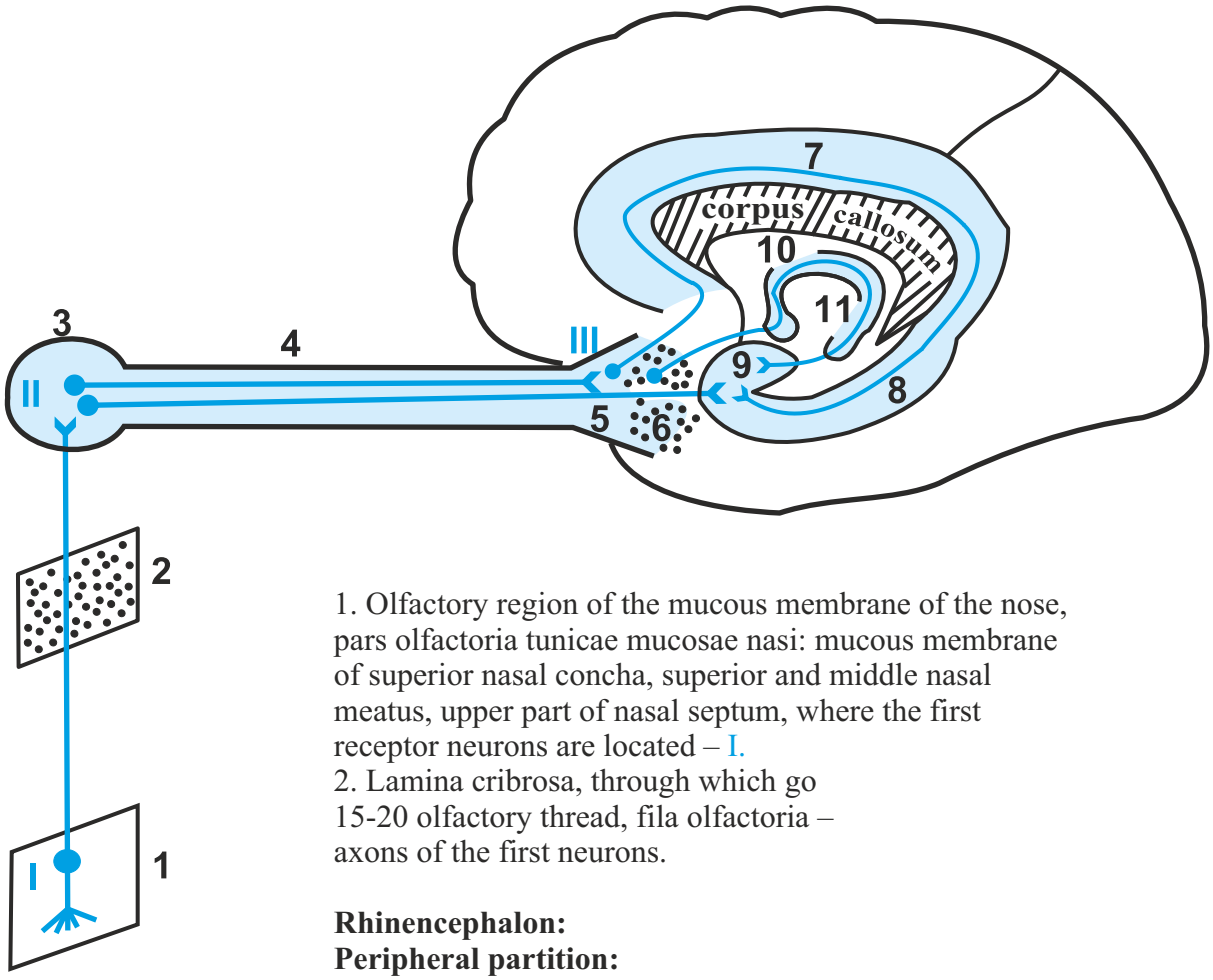
VII. FACIAL NERVE, NERVUS FACIALIS
Nucleus of facial nerve, nucleus nervi facialis
Superior salivatory nucleus, nucleus salivatorius superior
Nucleus of solitary tract, nucleus tractus solitarii

VIII. VESTIBULOCOCHLEAR NERVE, NERVUS VESTIBULOCOCHLEARIS
cochlear part, pars cochlearis:
Anterior (ventral) cochlear nucleus, nucleus cochlearis anterior (ventralis)
Posterior (dorsal) cochlear nucleus, nucleus cochlearis posterior (dorsalis)
vestibular part, pars vestibularis:
Medial vestibular nucleus, nucleus vestibularis medialis
Lateral vestibular nucleus, nucleus vestibularis lateralis
Superior vestibular nucleus, nucleus vestibularis superior
Inferior vestibular nucleus, nucleus vestibularis inferior

IX. GLOSSOPHARYNGEAL NERVE, NERVUS GLOSSOPHARYNGEUS
Nucleus ambiguus
Nucleus of solitary tract, nucleus tractus solitarii
Inferior salivatory nucleus, nucleus salivatorius inferior

X. VAGUS NERVE, NERVUS VAGUS
Nucleus ambiguus
Nucleus of solitary tract, nucleus tractus solitarii
Dorsal nucleus of vagus nerve, nucleus dorsalis nervi vagi

I. OLFACTORY NERVE, NERVUS OLFACTORIUS – sensitive by function, consists of sensitive nerve fibers

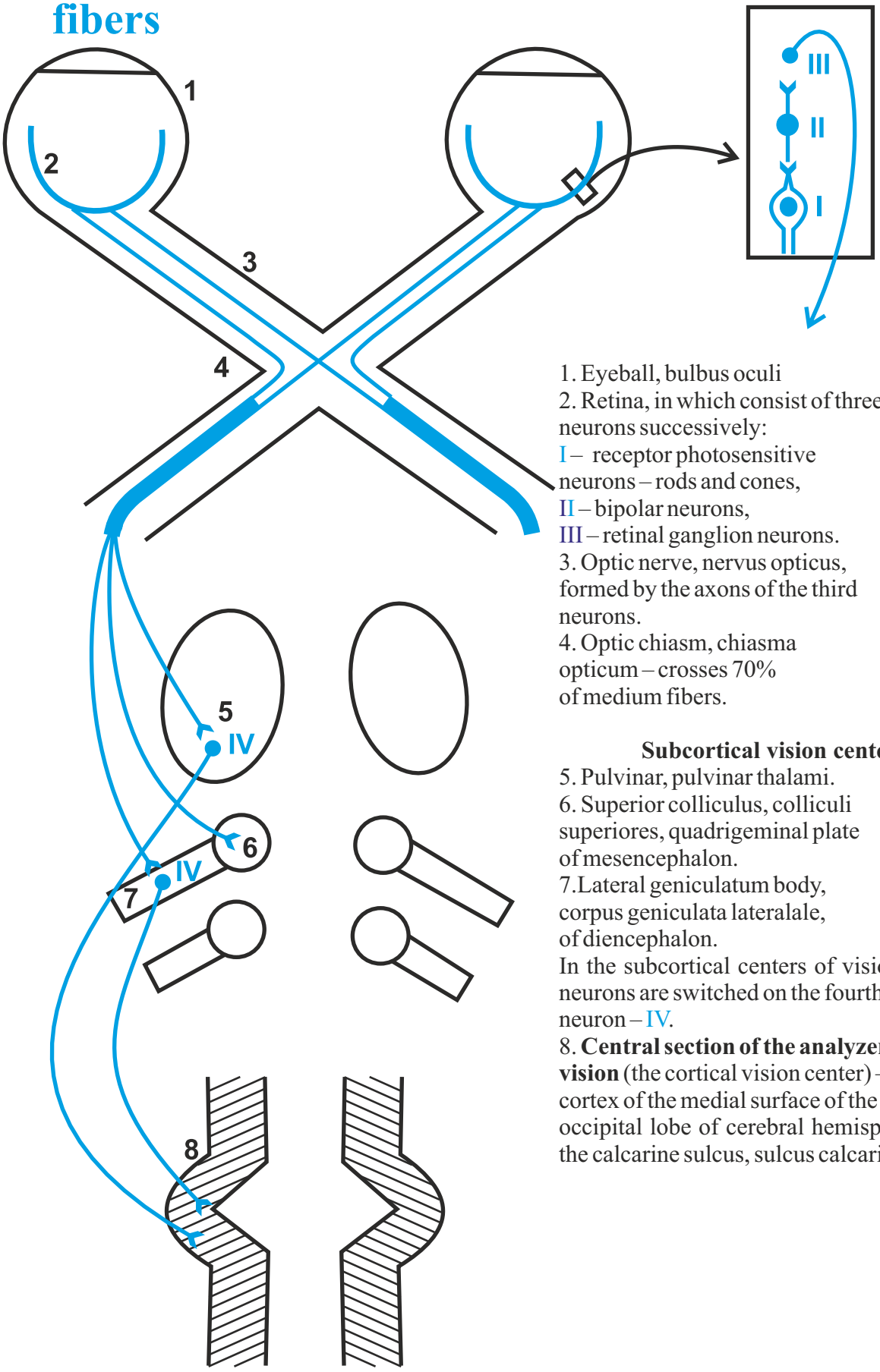


1. Olfactory region of the mucous membrane of the nose, pars olfactoria tunicae mucosae nasi: mucous membrane of superior nasal concha, superior and middle nasal meatus, upper part of nasal septum, where the first receptor neurons are located – I.
2. Lamina cribrosa, through which go 15-20 olfactory thread, fila olfactoria – axons of the first neurons.

Rhinencephalon:
Peripheral partition:
3. Olfactory bulb, bulbus olfactorius, where the second neurons are located – II.
4. Olfactory truct, tractus olfactorius, which is formed by the axons of second neurons.
5. Olfactory triangle, trigonum olfactorium.
6. Anterior permeated substance, substantia perforate anterior.
In the last two structures there are third neurons – III.

Central partition:
7. Cingulate gyrus, gyrus cinguli.
8. Parahippocampal gyrus, gyrus parahippocampalis.
9. Uncus – the cortical center of the smell.
10. Fornix.
11. Hippocampus and dentate gyrus, hippocampus and gyrus dentatus.

II. OPTIC NERVE, NERVUS OPTICUS – sensitive by function, consists of sensitive nerve fibers



1. Eyeball, bulbus oculi
2. Retina, in which consist of three neurons successively:
I – receptor photosensitive neurons – rods and cones,
II – bipolar neurons,
III – retinal ganglion neurons.
3. Optic nerve, nervus opticus, formed by the axons of the third neurons.
4. Optic chiasm, chiasma opticum – crosses 70% of medium fibers.

Subcortical vision centers:

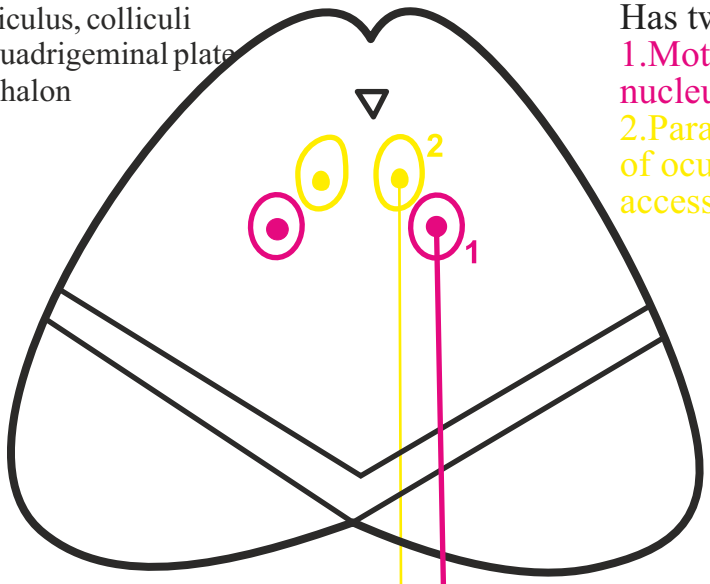
5. Pulvinar, pulvinar thalami.
6. Superior colliculus, colliculi superiores, quadrigeminal plate of mesencephalon.
7. Lateral geniculatum body, corpus geniculata lateralale, of diencephalon.

In the subcortical centers of vision, the third neurons are switched on the fourth neuron – IV.

8. **Central section of the analyzer of vision** (the cortical vision center) – the cortex of the medial surface of the occipital lobe of cerebral hemisphere around the calcarine sulcus, sulcus calcarinus.

III. OCULOMOTOR NERVE, NERVUS OCULOMOTORIUS – motor function, consists of motor and parasympathetic nerve fibers

Section at the level of superior colliculus, colliculi superiores, quadrigeminal plate of mesencephalon



Has two nucleus:
1.Motor: nucleus of oculomotor nerve, nucleus nervi oculomotorii
2.Parasympathetic: accessory nucleus of oculomotor nerve, nucleus accessorius nervi oculomotorii

Superior orbital fissure, fissura orbitalis superior

Motor nerve fibers innervate such extra-ocular muscles:

medial rectus muscle, m. rectus medialis,
superior rectus muscle, m. rectus superior,
inferior rectus muscle, m. rectus inferior,
inferior oblique muscle, m. obliquus inferior,

levator palpebrae superioris, m. levator palpebrae superioris

Ciliary ganglion, ganglion ciliarae

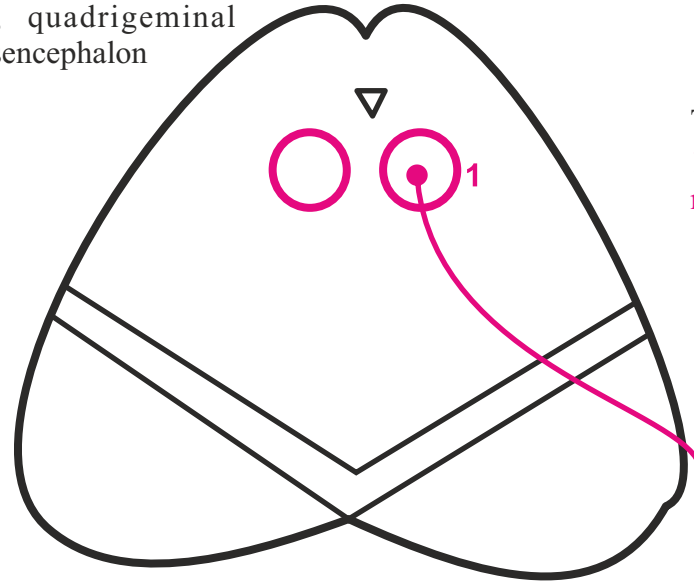
The parasympathetic postganglionic nerve fibers innervate such inner smooth muscles of the eyeball:

sphincter pupillae muscle, m. sphincter pupillae

ciliary muscle, m. ciliaris, which provides the process of accommodation

IV. TROCHLEAR NERVE, NERVUS TROCHLEARIS – motor function, consists of motor nerve fibers

) Section at the level of inferior colliculus, colliculi inferiores, quadrigeminal plate of mesencephalon

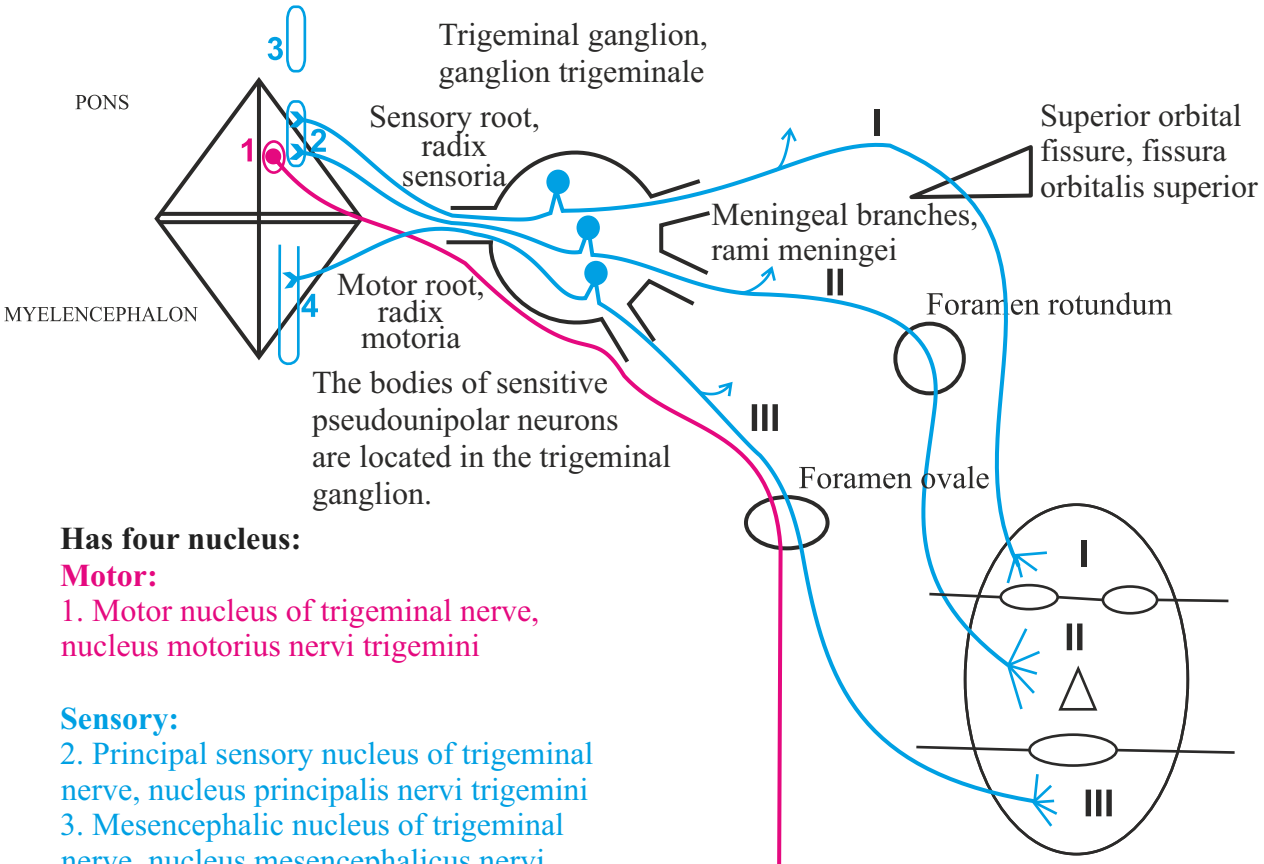


The nerve has one motor nucleus:
1. Nucleus of trochlear nerve, nucleus nervi trochlearis

Superior orbital fissure, fissura orbitalis superior

Motor nerve fibers innervate the superior oblique muscle of the eyeball, m. obliquus superior

V. TRIGEMINAL NERVE, NERVUS TRIGEMINUS – mixed function, consists of sensory and motor nerve fibers



Has four nucleus:

Motor:

1. Motor nucleus of trigeminal nerve, nucleus motorius nervi trigemini

Sensory:

2. Principal sensory nucleus of trigeminal nerve, nucleus principalis nervi trigemini
3. Mesencephalic nucleus of trigeminal nerve, nucleus mesencephalicus nervi trigemini
4. Spinal nucleus of trigeminal nerve, nucleus spinalis nervi trigemini

Has three branches:

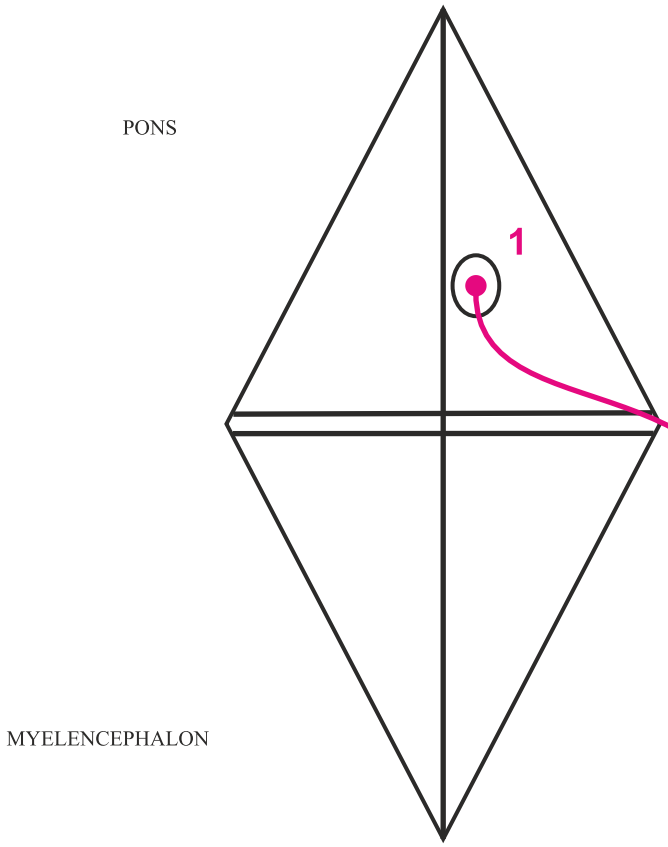
I. The first branch, sensitive – ophthalmic nerve, nervus ophthalmicus
II. The second branch, sensitive – maxillary nerve, nervus maxillaris
III. The third branch, mixed – mandibular nerve,nervus mandibularis. It has sensitive and motion fibers.

Sensitive nerve fibers transmit information on the general sensitivity of the skin of the face, mucous membranes of the oral and nasal cavity, conjunctiva of the eye, teeth, cranial dura mater, anterior 2/3 part of the tongue.

Motor fibers innervate:

- masseter muscle, m. masseter
- temporal muscle, m. temporalis
- lateral and medial pterygoid muscles, mm. pterygoidei lateralis and medialis
- tensor veli palatini, m. tensor veli palatine
- tensor tympani muscle, m. tensor tympani
- anterior belly of digastric muscle, venter anterior m. digastrici
- mylohyoid muscle, m. mylohyoideus

VI. ABDUCENT NERVE, NERVUS ABDUCENS – motor function, consists of motor nerve fibers



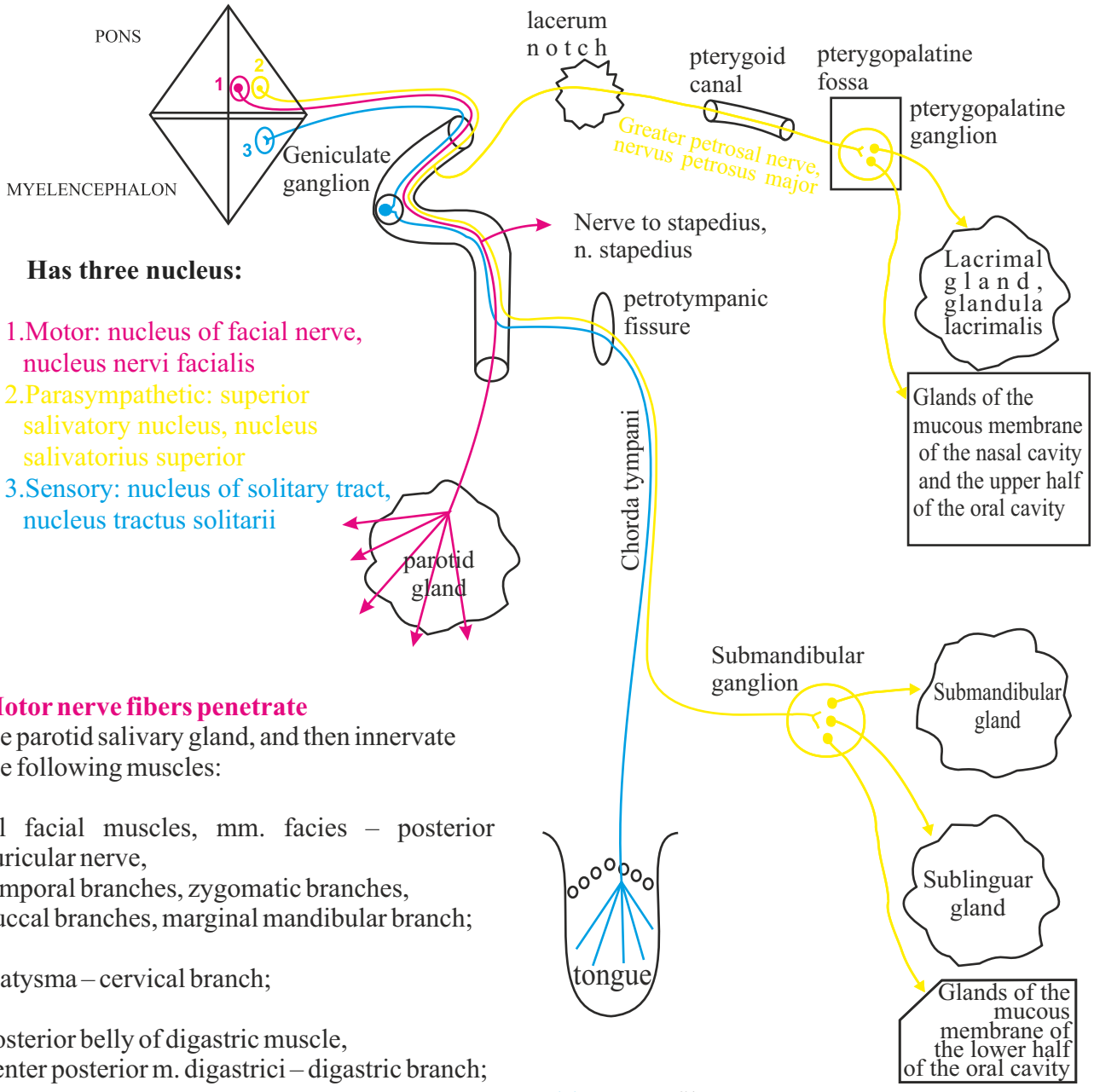
The nerve has one motor nucleus:

1. Nucleus of abducens nerve, nucleus nervi abducentis

Superior orbital fissure, fissura orbitalis superior

Motor nerve fibers innervate the lateral rectus muscle of the eyeball, m. rectus lateralis

VII. FACIAL NERVE, NERVUS FACIALIS – mixed function, consists of motor, parasympathetic and sensory nerve fibers



Has three nucleus:

1. Motor: nucleus of facial nerve, nucleus nervi facialis
2. Parasympathetic: superior salivatory nucleus, nucleus salivatorius superior
3. Sensory: nucleus of solitary tract, nucleus tractus solitarii

Motor nerve fibers penetrate the parotid salivary gland, and then innervate the following muscles:

all facial muscles, mm. facies – posterior auricular nerve,
temporal branches, zygomatic branches,
buccal branches, marginal mandibular branch;

platysma – cervical branch;

posterior belly of digastric muscle,
venter posterior m. digastrici – digastric branch;

stylohyoid muscle, m. stylohyoideus – stylohyoid branch;
stapedius muscle, m. stapedius – nerve to stapedius

Sensitive nerve fibers of the chorda tympani transmit taste information from the anterior 2/3 part of the tongue

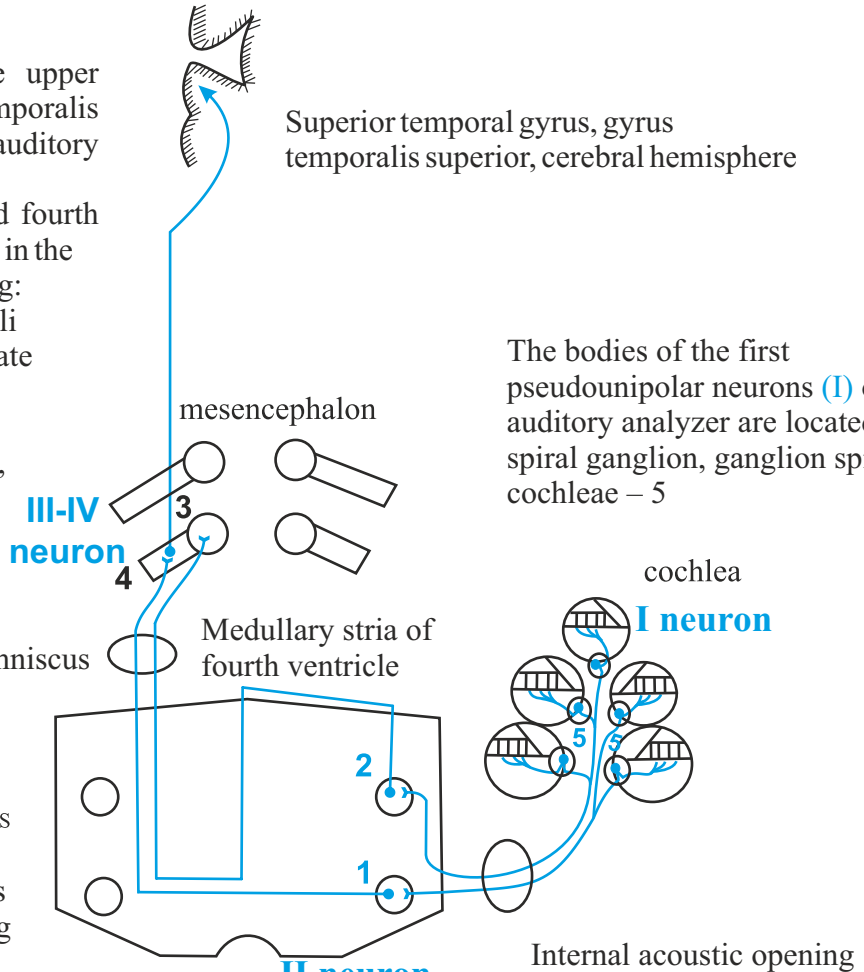
By parasympathetic branches of the facial nerve a team is sent to secretion of small glands and serous (protein) secretion by large salivary glands

VIII. VESTIBULOCOCHLEAR NERVE, NERVUS VESTIBULOCOCHLEARIS – sensitive by function, consists of sensitive nerve fibers

The nerve has two parts:
- cochlear nerve, nervus cochlearis;
- vestibular nerve, nervus vestibularis.

Cochlear nerve, nervus cochlearis - hearsay information is transmitted.

Axons of the fourth neurons end in the cortex of the upper temporal gyrus, gyrus temporalis superior - in a cortical auditory analyzer (center of hearing).
The bodies of the third and fourth neurons **(III, IV)** are located in the subcortical centers of hearing:
3. inferior colliculus, colliculi inferiores, quadrigeminal plate of mesencephalon;
4. medial geniculate body, corpora geniculata mediales, of diencephalon



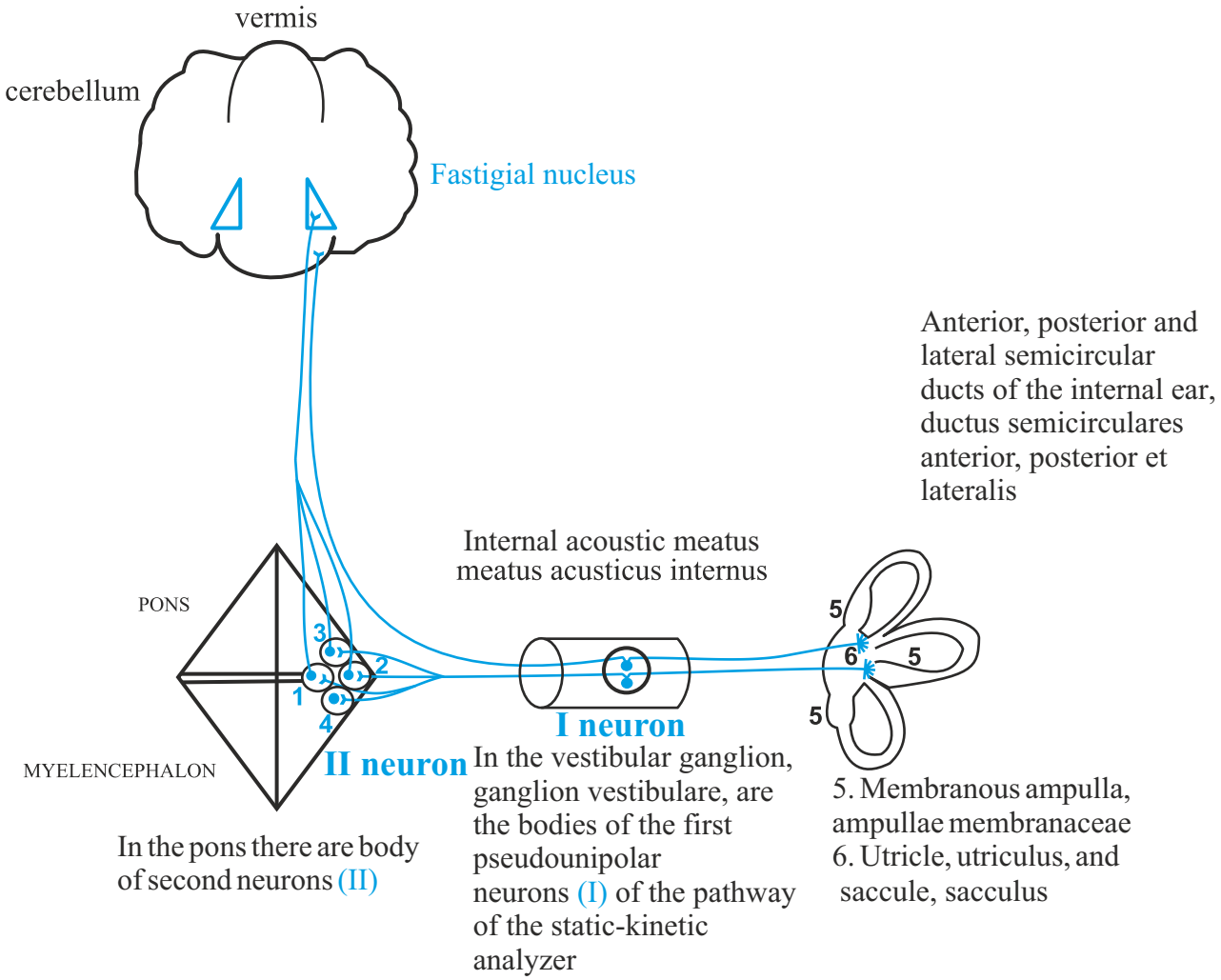
The axons of second neurons end in the subcortical hearing centers

The bodies of second neurons of the auditory analyzer are located in the

1. anterior (ventral) cochlear nucleus, nucleus cochlearis anterior (ventralis)
2. posterior (dorsal) cochlear nucleus, nucleus cochlearis posterior (dorsalis)

Sensory (receptor) elements of the cochlear nerve are cells that are located in the spiral organ of the cochlea.

Vestibular nerve, nervus vestibularis - it transmits static-kinetic information about the position of the body in space. This information is needed to maintain balance and maintain a certain position of the human body in space.



In the pons the vestibular nerve has four nucleus:
1. Medial vestibular nucleus, nucleus vestibularis medialis
2. Lateral vestibular nucleus, nucleus vestibularis lateralis
3. Superior vestibular nucleus, nucleus vestibularis superior
4. Inferior vestibular nucleus, nucleus vestibularis inferior

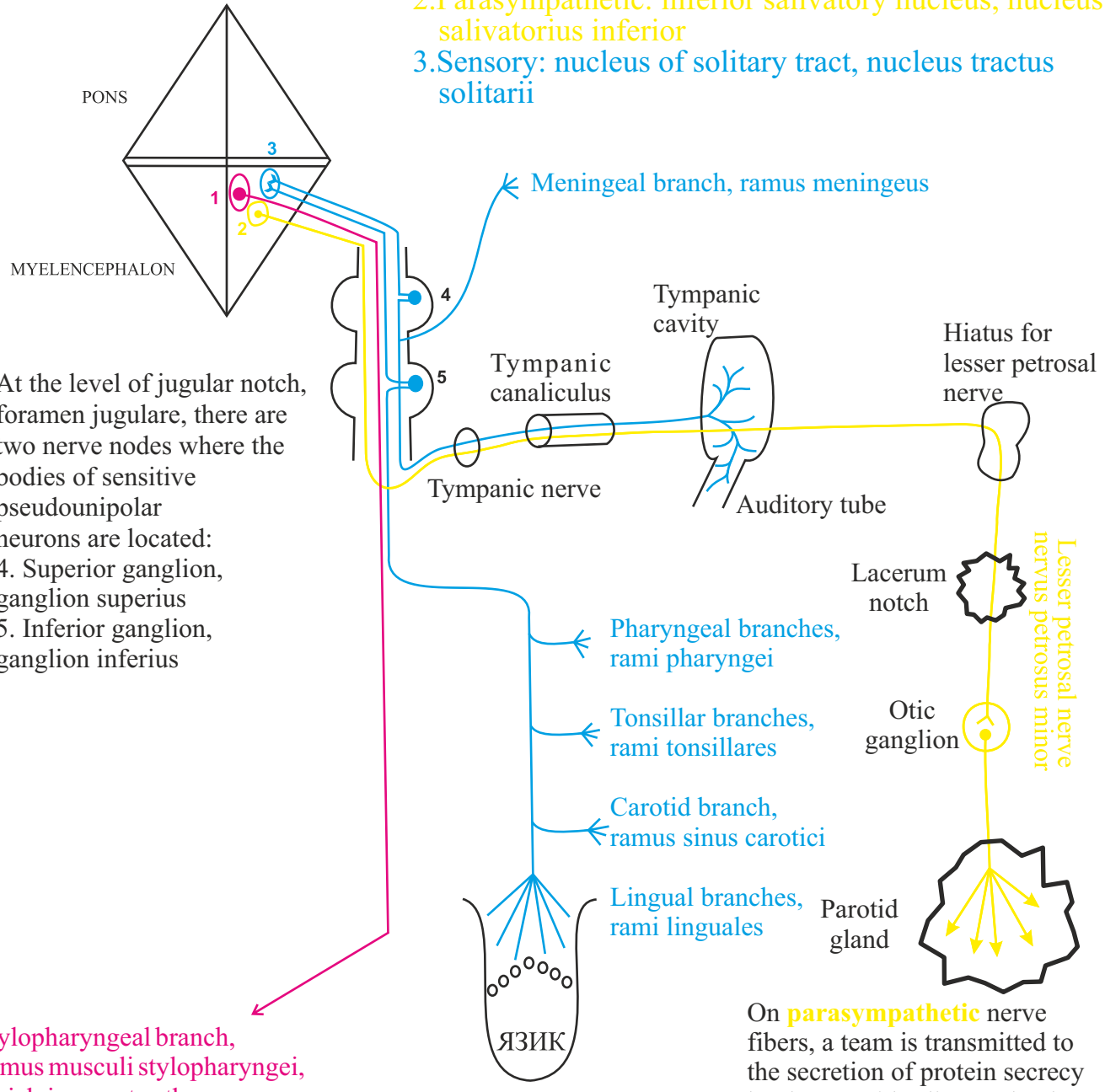
Sensory (receptor) elements of the vestibular nerve are cells that are located in the maculae of the membranous ampulla of semicircular ducts, utricle and saccule.

Attention! The statokinetic system has a connection with the cerebral cortex. In particular, from vestibular nuclei there is a crossed path to the thalamus. It contains the bodies of the III neurons of the path of a statokinetic analyzer, whose axons reach the cortex of the superolateral surface of the temporal lobe.

IX. GLOSSOPHARYNGEAL NERVE, NERVUS GLOSSOPHARYNGEUS – mixed function, consists of motor, parasympathetic and sensory nerve fibers

In the medulla oblongata nerve has three nucleus:

1. Motor: nucleus ambiguus
2. Parasympathetic: inferior salivatory nucleus, nucleus salivatorius inferior
3. Sensory: nucleus of solitary tract, nucleus tractus solitarii



At the level of jugular notch, foramen jugulare, there are two nerve nodes where the bodies of sensitive pseudounipolar neurons are located:
4. Superior ganglion, ganglion superius
5. Inferior ganglion, ganglion inferius

Stylopharyngeal branch, ramus musculi stylopharyngei, which innervates the same name muscle

Sensitive nerve fibers transmit sensitive information from the mucous membrane of the pharynx, palatine tonsils, intercarotid glomeruli, cranial dura mater, and on the tongue branches - about the taste and the general sensitivity of the back third of the tongue

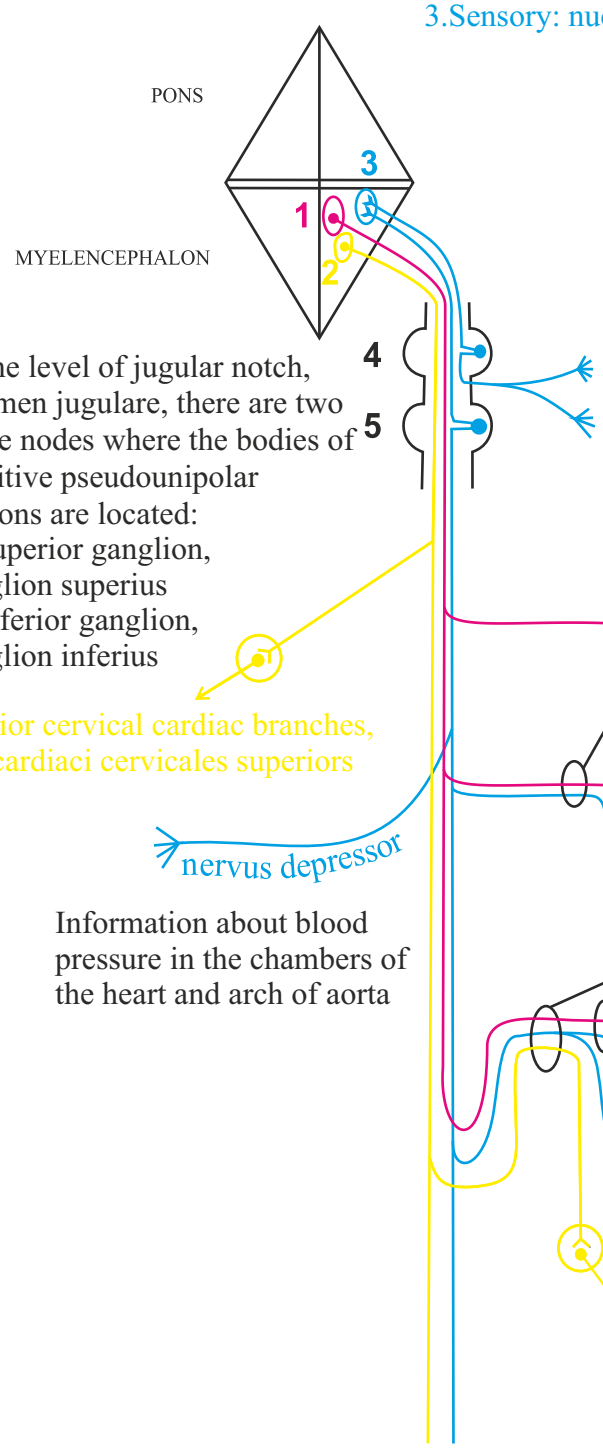
On **parasympathetic** nerve fibers, a team is transmitted to the secretion of protein secrecy by the parotid salivary gland

Attention! On sympathetic nerve fibers a team is sent to increase the secretion of enzymes and mucus (thick saliva) in large salivary glands

X. VAGUS NERVE, NERVUS VAGUS – mixed function, consists of motor, parasympathetic and sensory nerve fibers

In the medulla oblongata nerve has three nucleus:
1.Motor: nucleus ambiguus
2.Parasympathetic: dorsal nucleus of vagus nerve, nucleus dorsalis nervi vagi
3.Sensory: nucleus of solitary tract, nucleus tractus solitarii

The nerve has a head, cervical, thoracic and abdominal partition



At the level of jugular notch, foramen jugulare, there are two nerve nodes where the bodies of sensitive pseudounipolar neurons are located:
4. Superior ganglion, ganglion superius
5. Inferior ganglion, ganglion inferius

Superior cervical cardiac branches, rami cardiaci cervicales superiors

nervus depressor

Information about blood pressure in the chambers of the heart and arch of aorta

Head partition

Meningeal branch, ramus meningeus - there is a sensitive information from the cranial dura mater of the posterior cranial fossa.

Auricular branch, ramus auricularis - there is a sensitive information from the skin of the posterior wall of the external acoustic meatus stroke and partly the auricle

Cervical partition

Pharyngeal branch, ramus pharyngeus, motion, innervates the superior and middle constrictor of pharynx, the muscles of soft palate, except the tensor veli palatini.

Superior laryngeal nerve, nervus laryngeus superior: motor nerve fibers innervate inferior constrictor of pharynx and cricothyroid muscle of larynx; on **sensitive** fibers is information from the mucous membrane of the larynx above the vocal fold, the root of the tongue and the epiglottis.

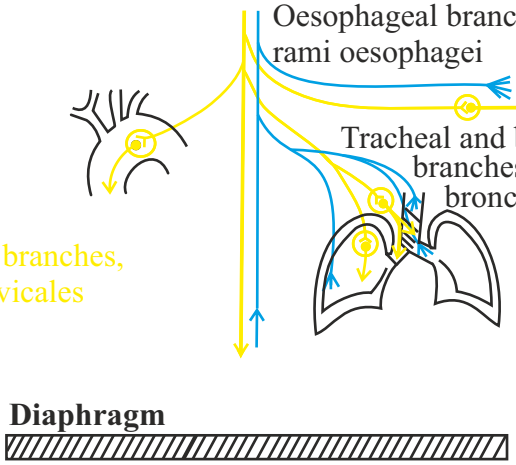
Thoracic partition

Recurrent laryngeal nerve, nervus laryngeus recurrens: inferior laryngeal nerve, nervus laryngeus inferior: **motor** nerve fibers innervate the muscles of the larynx (except cricothyroid muscle); on **sensitive** fibers is information from the mucous membrane of the larynx below the vocal fold.

Tracheal and oesophageal branches, rami tracheales et oesophagei - there is a sensitive information from the trachea and oesophagus

Inferior cervical cardiac branches, rami cardiaci cervicales inferiores

By **parasympathetic** cardiac branches, the command is sent to reduce the frequency and strength of cardiac contractions, narrowing of the vessels of the heart.



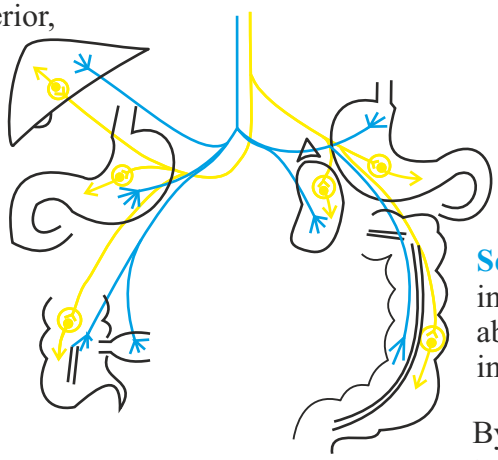
Sensitive fibers transmit sensitive information from the esophagus, trachea, bronchi, lungs, intestinal pleura.

By **parasympathetic** fibers the team is sent to smooth muscles to reduce the caliber of the esophagus, bronchi, bronchioles; on the secretion of secrecy of the mucous glands.

Abdominal partition

The left and right vagus nerves form the nerve plexus around the lower part of esophagus, from which the corresponding output follows:

anterior vagal trunk, truncus vagalis anterior, which form on the anterior wall of the stomach anterior gastric plexus, plexus gastricus anterior



posterior vagal trunk, truncus vagalis posterior, which form on the posterior wall of the stomach posterior gastric plexus, plexus gastricus posterior

Sensitive fibers transmit sensitive information from the organs of the abdominal cavity (to the level of entry into the small pelvis).

By **parasympathetic** fibers a team is sent to intensification peristalsis, relaxing sphincter muscles, secretion of secrecy by glands.

From anterior and posterior gastric plexus leaves sensitive and parasympathetic fibers to the organs of the abdominal cavity (to the descending colon including).

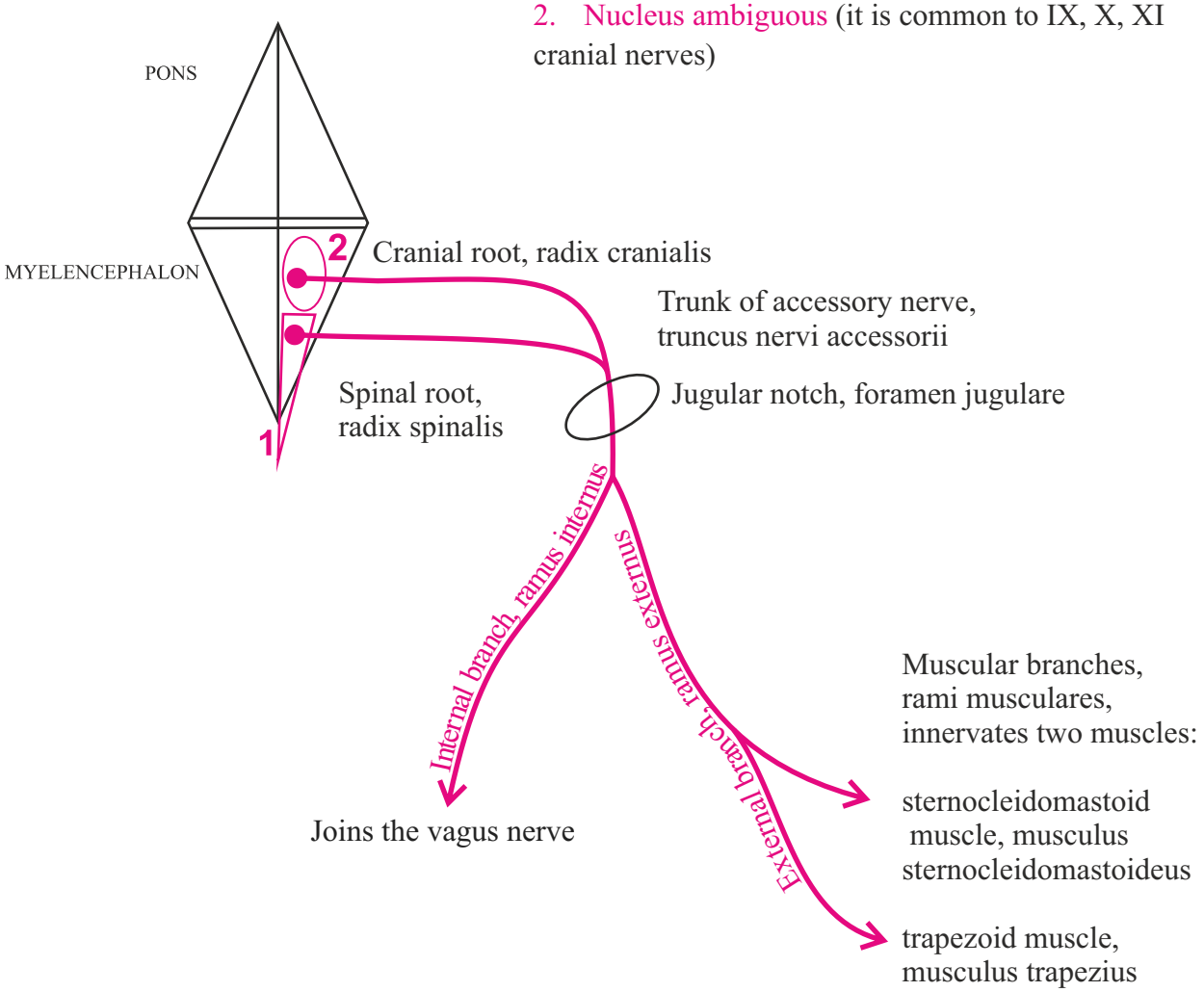
Note:

1. **The vessels of the stomach and intestines are innervated only with sympathetic nerve fibers.**
2. **On the parasympathetic fibers of the autonomic nervous system a team is sent to expand the blood vessels of the cranial dura mater and the external genital organs.**

XI. ACCESSORY NERVE, NERVUS ACCESSORIUS – motor function, consists of motor nerve fibers

The nerve has two motor nucleus:

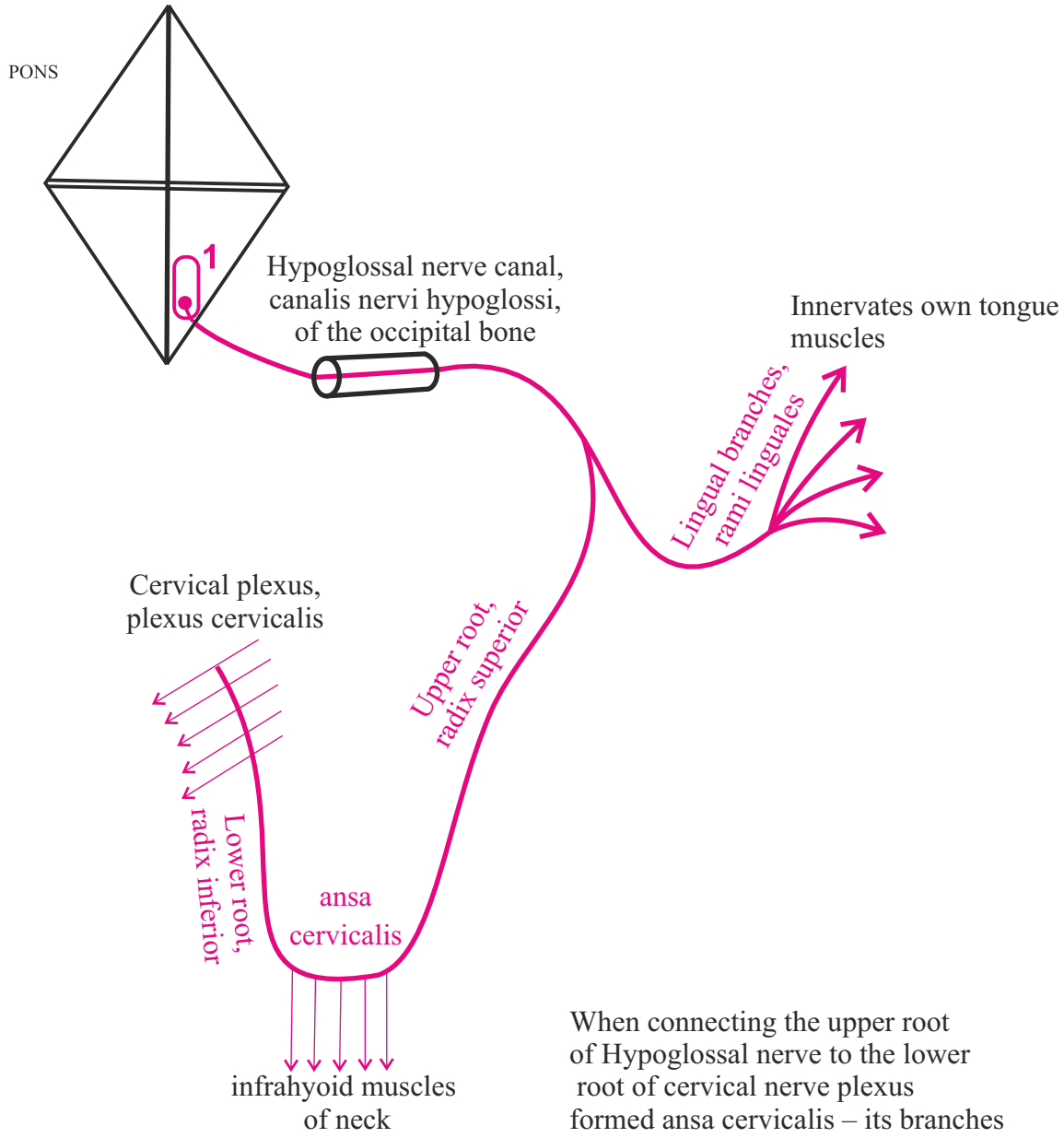
1. Accessory nucleus, nucleus nervi accessorii
2. Nucleus ambiguous (it is common to IX, X, XI cranial nerves)



Totality of neuronal axons of nucleus ambiguus forms a vagal part (pars vagalis), or cranial roots (radices craniales).
Totality of neuronal axons of accessory nucleus forms a spinal part (pars spinalis), or spinal roots (radices spinales).

XII. HYPOGLOSSAL NERVE, NERVUS HYPOGLOSSUS – motor function, consists of motor nerve fibers

The nerve has one motor nucleus:
1. Hypoglossal nucleus,
nucleus nervi hypoglossi



When connecting the upper root of Hypoglossal nerve to the lower root of cervical nerve plexus formed ansa cervicalis – its branches innervates infrahyoid muscles of neck