組織學實驗：神經系統
Histology Lab : Nervous system

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Please preview these slides before the class!

Sources of the Pictures & Text

- **Histology: A Text and Atlas** (4th ed), M.H. Ross & W. Pawlina
- **Human Anatomy** (5th ed), Marieb, Mallatt, Wilhelm
- **Wheater's Functional Histology** (5th ed), B. Young & J.W.Heath.

Photomicrograph of slides:

Department of anatomy,
Kaohsiung Medical University

Learning Objectives

- To identify the different patterns of nervous tissues.
- To identify the different characteristics of CNS and PNS.

Slides List

PNS

1. Multipolar neurons :
93W3617, Giant Multipolar Motor Neurons, sm, Mb&P;

2. Pseudounipolor neuron in the spinal ganglion :
93W3696, Spinal cord (and spinal ganglion), *cs*, H&E;

3. Sympathetic ganglion :
93W3715, Sympathetic ganglion, human, H&E;

4. Parasympathetic ganglion :
93W6748, Esophagus ,middle portion, *cs*, H&E;

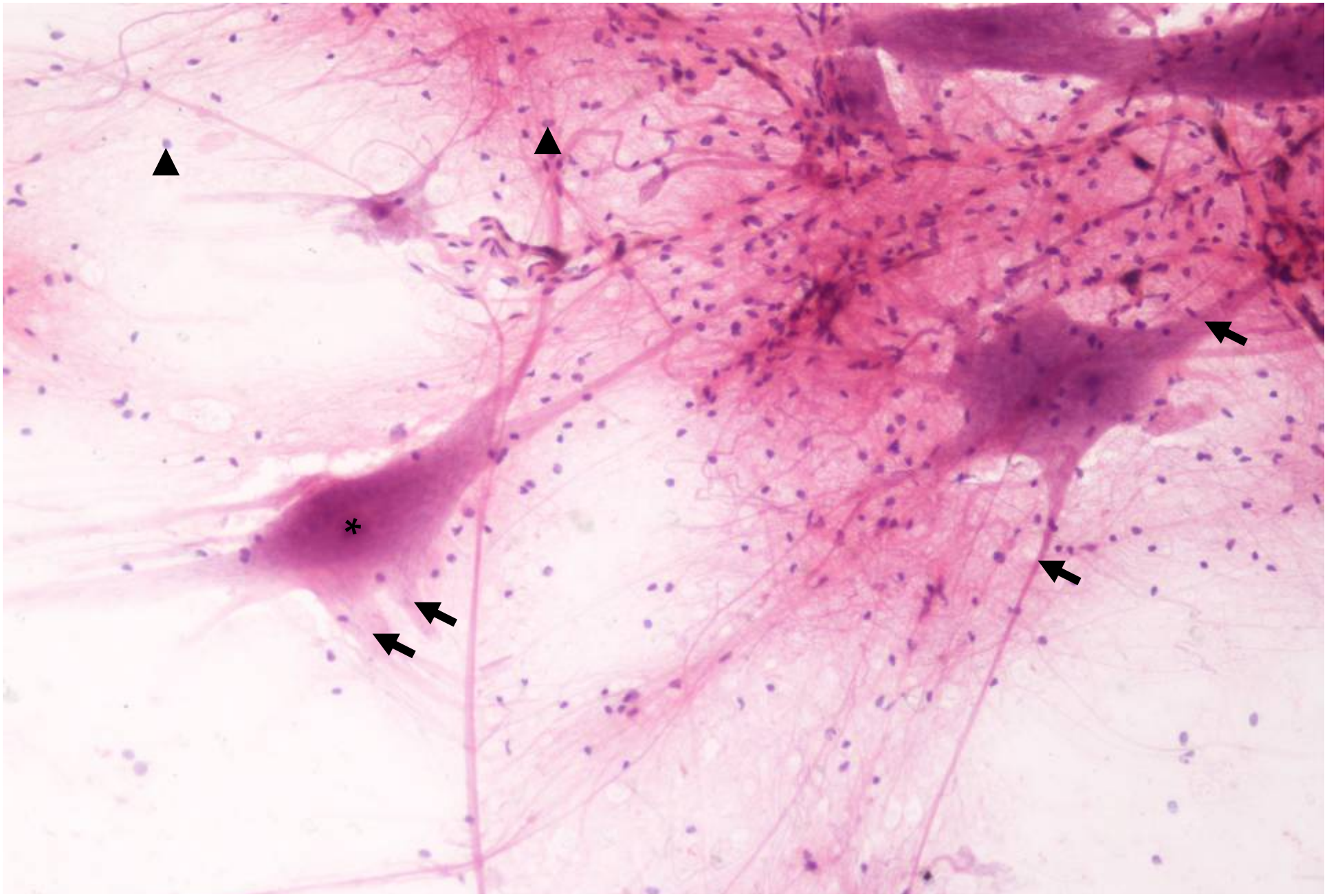
5. Peripheral nerve :
F-3-k(or F-3-i), Peripheral nerve, *cs* & *ls*, OsO_4
NF-1-c, Human skin, H&E;
YL-02 Mice footpad skin, Immunohistochemistry.
YL-03 Neuromuscular junctions, Histochemistry & IHC.

CNS

6. Spinal cord :
93W3696, Spinal cord, *cs*, H&E

7. Cerebrum :
93W6400, Brain, Composite, H&E
YL-01 Mice cerebrum (Microglia), Immunohistochemistry

8. Cerebellum :
93W6412, Cerebellum, H&E



Supporting cell (arrow head); Nucleus of neuron (*); Processes (arrow)

Fig.1 Giant Multipolar Motor Neurons, sm, Mb&P (93W3617)

Fig. 1. Micrograph of multipolar neurons. Multipolar neurons were smear with phloxine staining and counterstain with the methylene blue for neuronal nucleus. A typical multipolar neuron have multiple processes and surrounded by the numerous supporting cells.

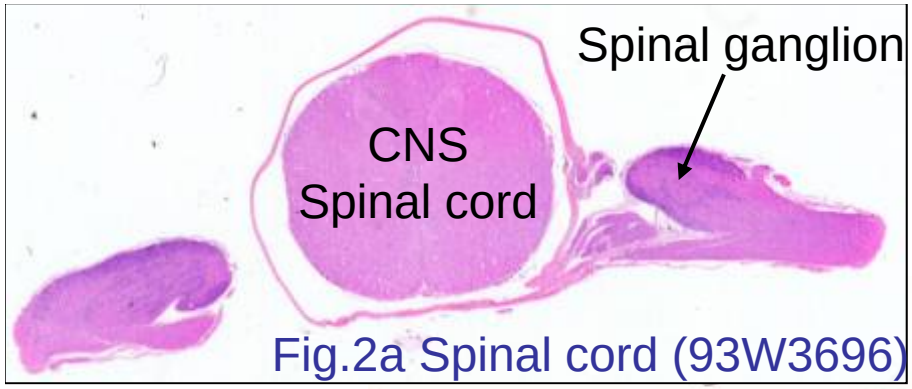
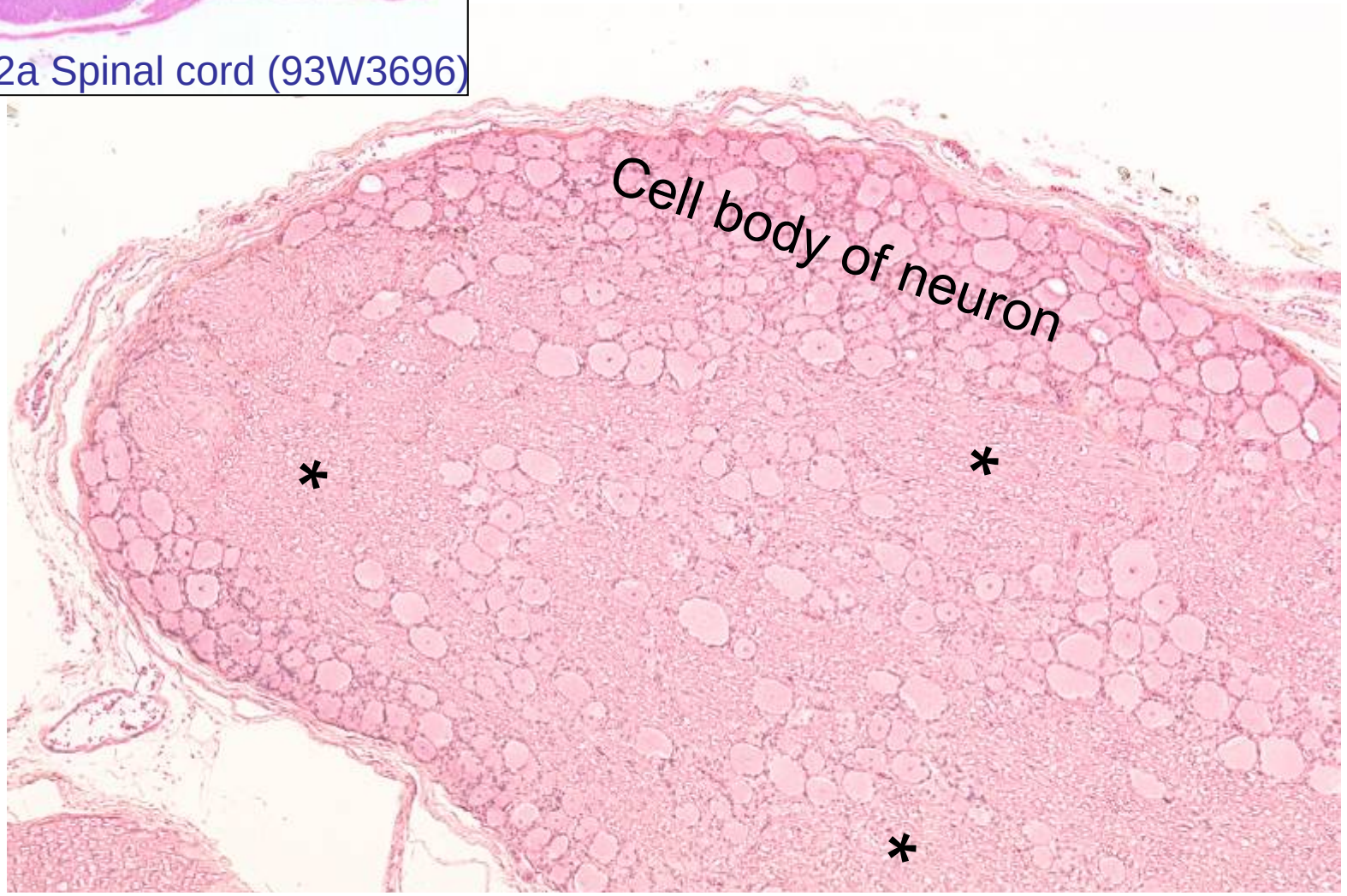


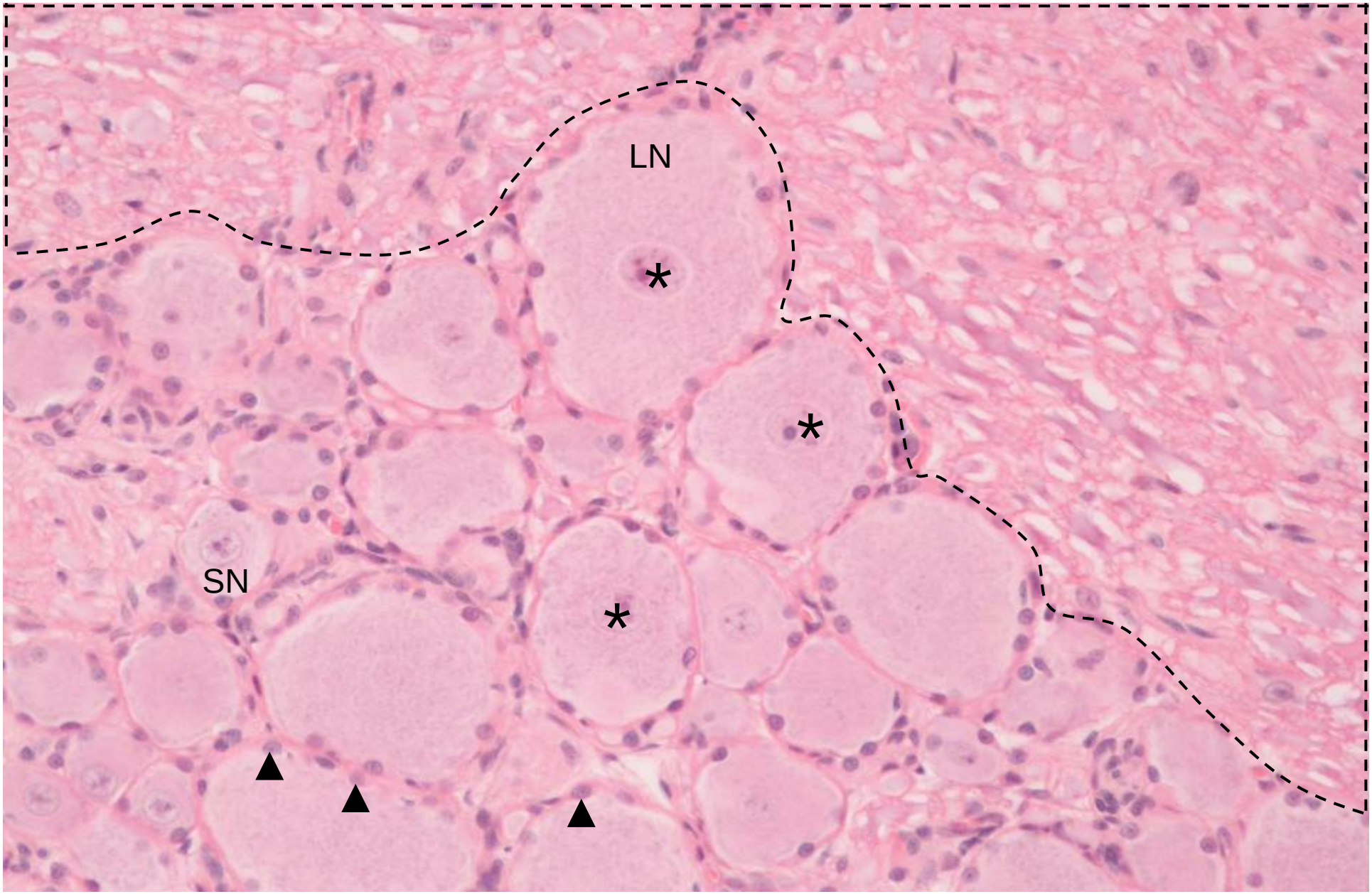
Fig.2a Spinal cord (93W3696)



Nerve fiber (*)

Fig.2b Spinal ganglion (93W3696)

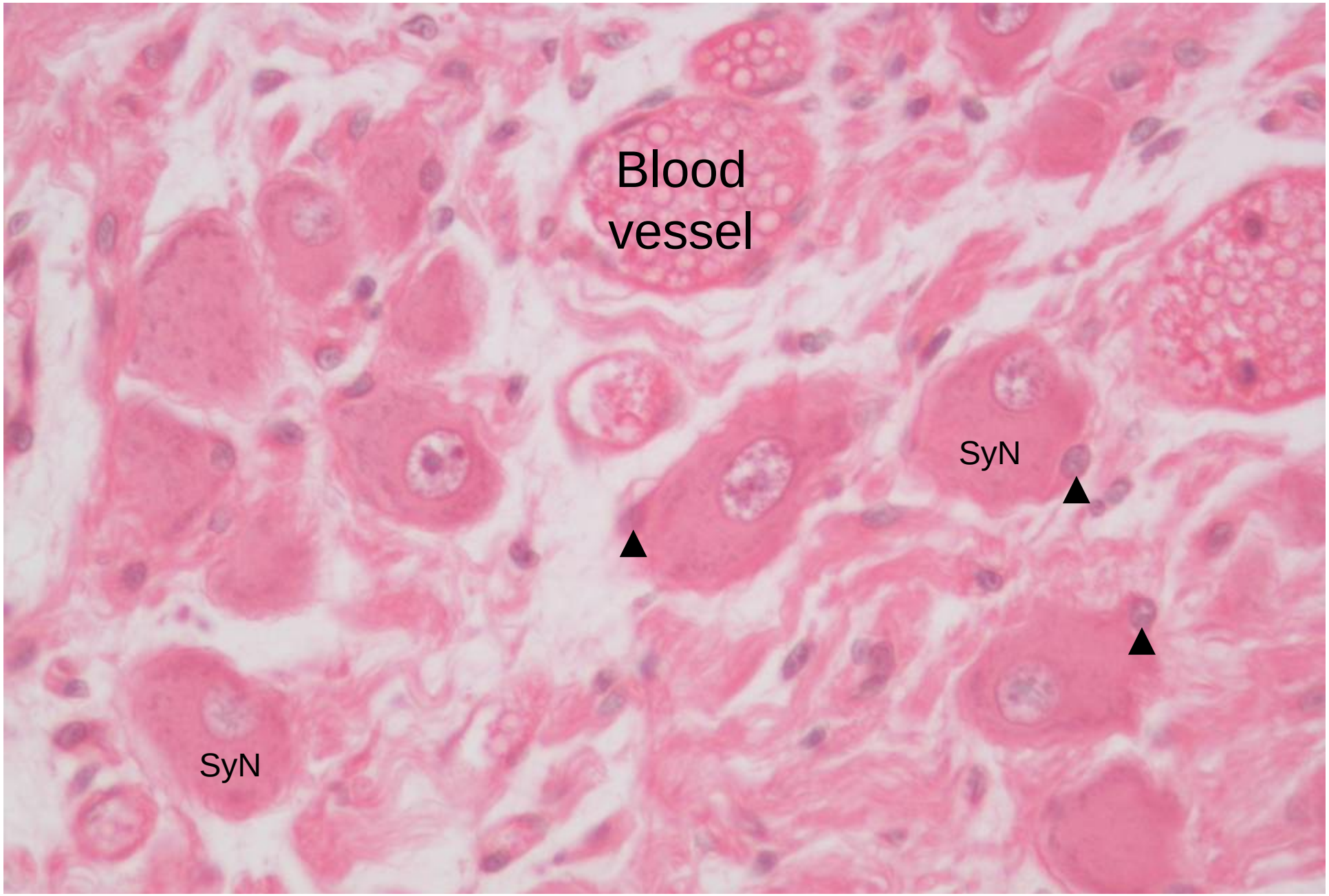
Fig. 2 Micrograph of spinal ganglion. Spinal ganglia (also called dorsal root ganglion) located next to the spinal cord. Spinal ganglion is the gathering of pseudounipolar sensory neurons with central and peripheral processes that terminated on dorsal horn of spinal cord and the periphery, respectively. Typical spinal ganglion section shows different diameter of sensory neurons and mingles with nerve processes (asterisk) that originated from those sensory neurons.



Satellite cells (arrow head); Nucleus of neuron (*); Nerve fibers (dashed line)
Large neuron (LN); Small neuron (SN)

Fig.3 Neuron of spinal ganglion (93W3696)

Fig. 3 Higher magnification of the spinal ganglion.The spinal ganglion is composed of large (LN) and small (SN)-diameter sensory neurons and neighboring with their central and peripheral processes (dashed line). There are numerous of satellite cells (arrowhead) surround the cell body of the sensory neurons.



Satellite cells (arrow head); Sympathetic neuron (SyN)

Fig.4 Neuron of sympathetic ganglion (93W3715)

Fig. 4 Micrograph of sympathetic ganglion. Sympathetic neurons (SyN) are multipolar neurons that surrounded with the satellite cells (arrowhead). Notice there is fewer of satellite cells in the sympathetic ganglion that compared with those in the spinal ganglions. (Compare with Fig.3)

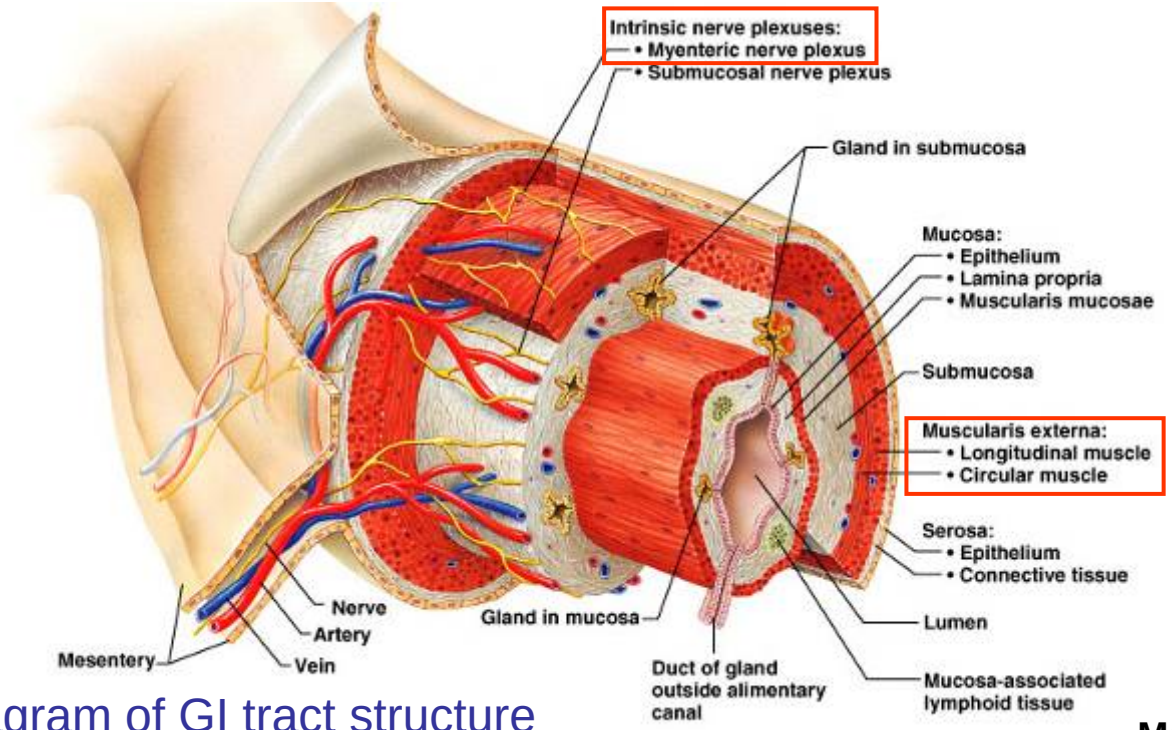


Fig.5a Diagram of GI tract structure

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Marieb, Mallatt, Wilhelm

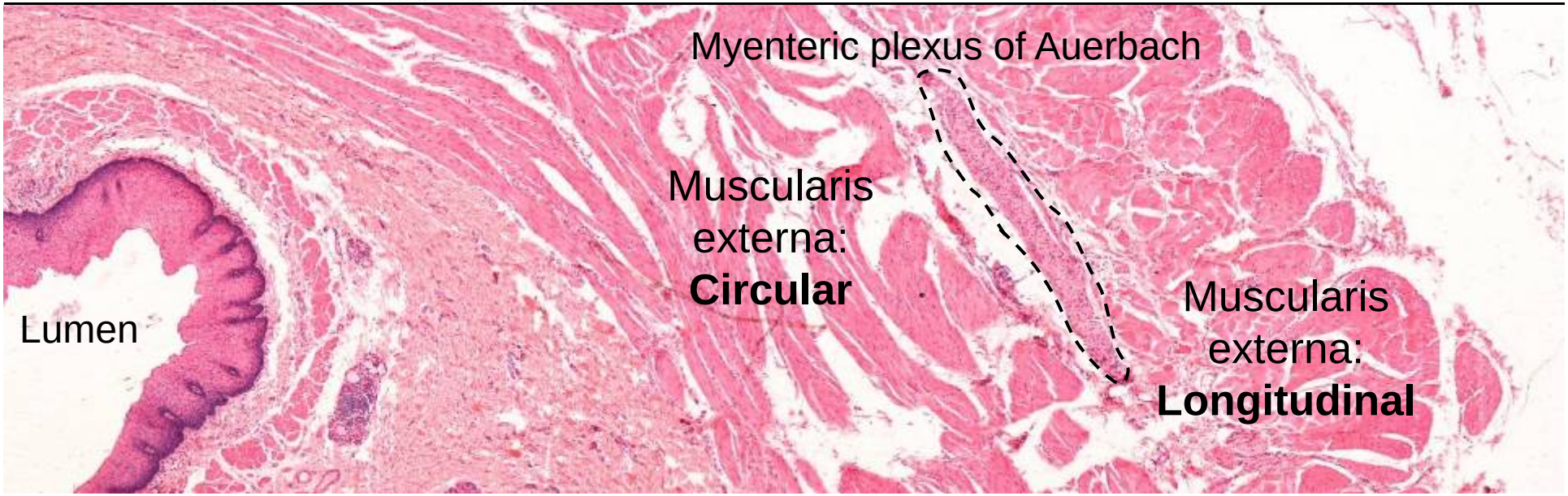


Fig.5b Esophagus ,middle portion (93W6748)

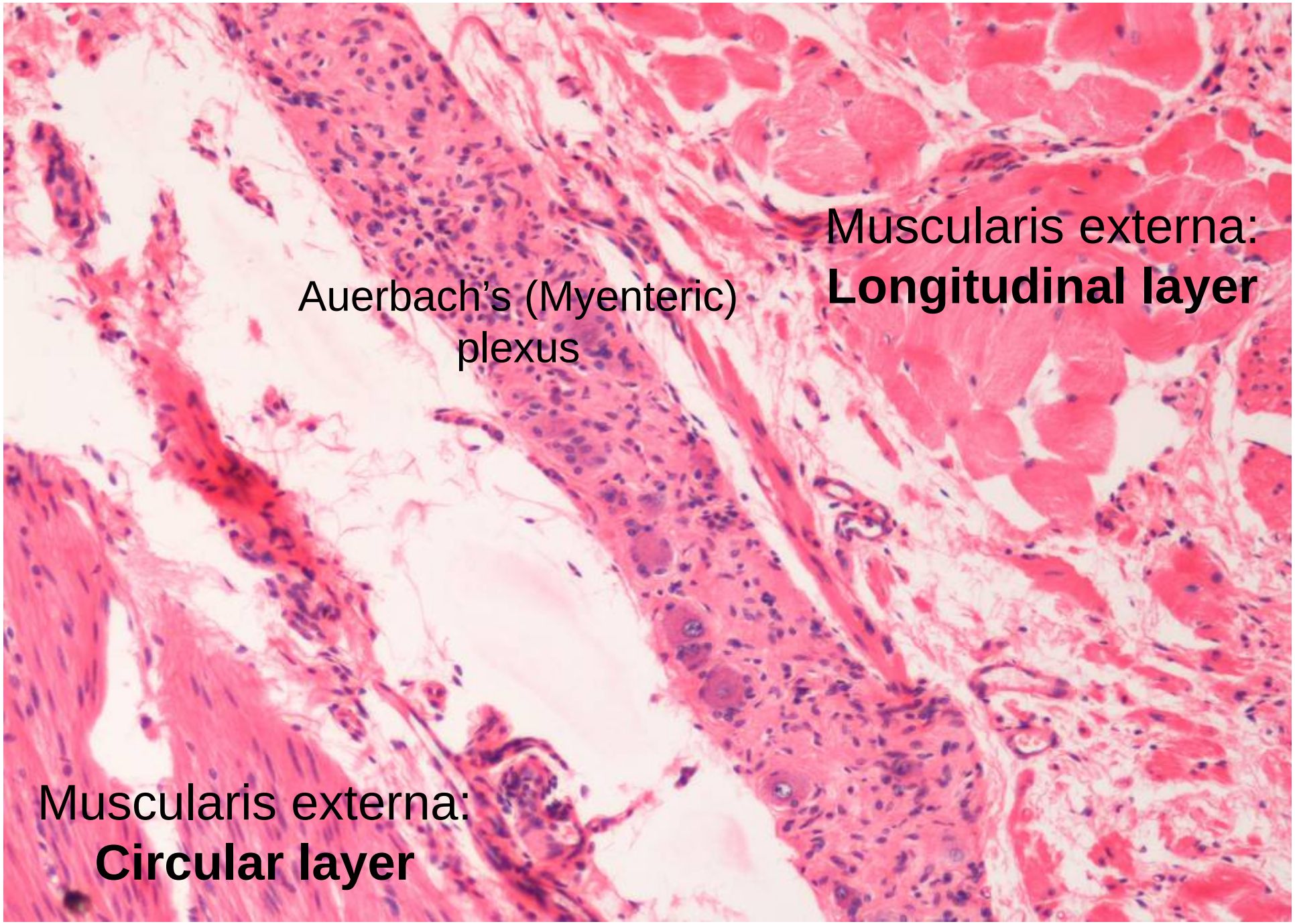
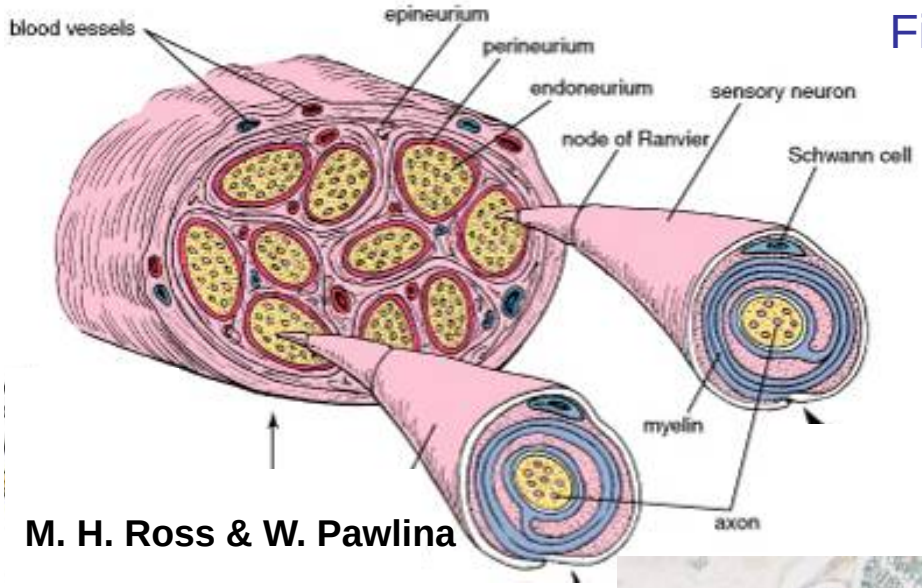


Fig.5c Myenteric plexus of Auerbach (93W6748)

Fig. 5 Micrograph of Auerbach’s (myenteric) plexus. The Auerbach’s plexus is the postsynaptic ganglion of parasympathetic system that located between the space of circular and longitudinal layers of muscularis externa of gastrointestinal tract. The function of those plexus modulate motor function of GI tract and regulation of exocrine and endocrine secretion.



M. H. Ross & W. Pawlina

Fig.6a Diagram of nerve bundle

Fig.6b Peripheral nerve, cs (F-3-k or i)

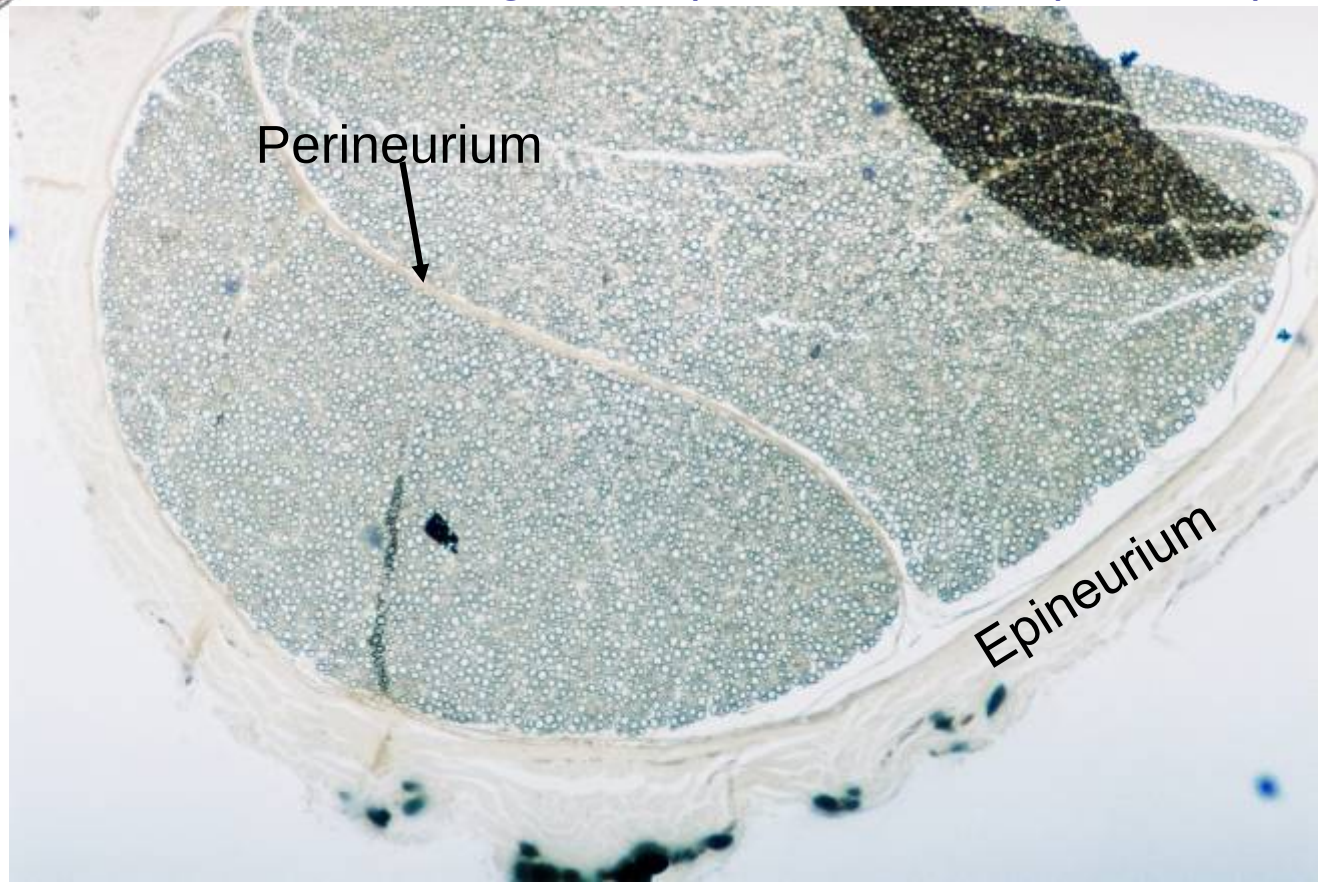
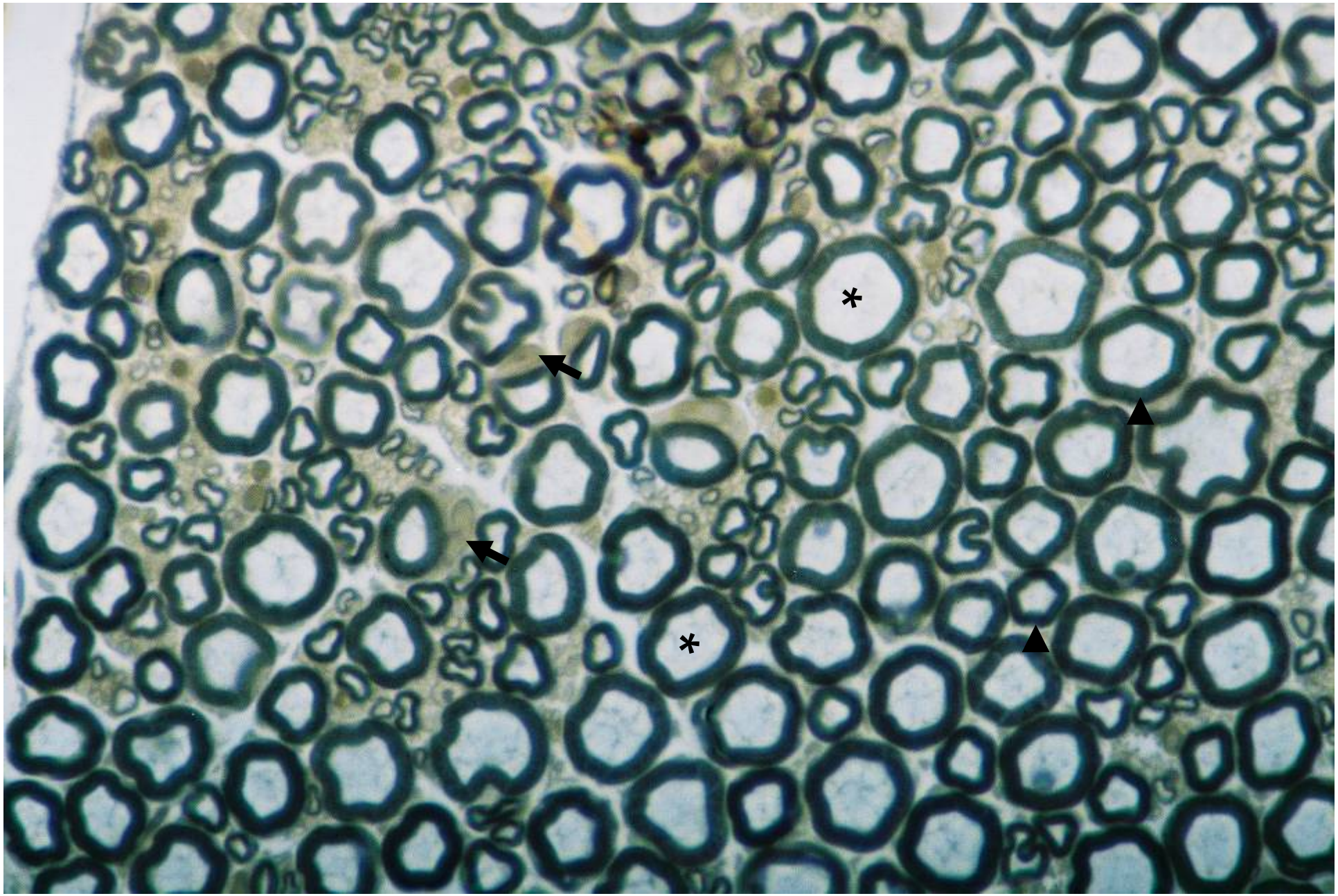


Fig. 6a Diagram of architectures of single nerve bundle. Each nerve bundle surrounded by the dense irregular connective tissue (epineurium), subdividing into perineurium that enclosed nerve fasciculi. Each fasciculi is composed of numerous nerves fibers that surrounded by the loose connective tissues (endoneurium).

Fig. 6b Cross section of nerve bundle. Notice the relative location of epineurim and perineurium.



Myeline sheath (arrow head); Axon (*); Nucleus of Schwann cells (arrow)

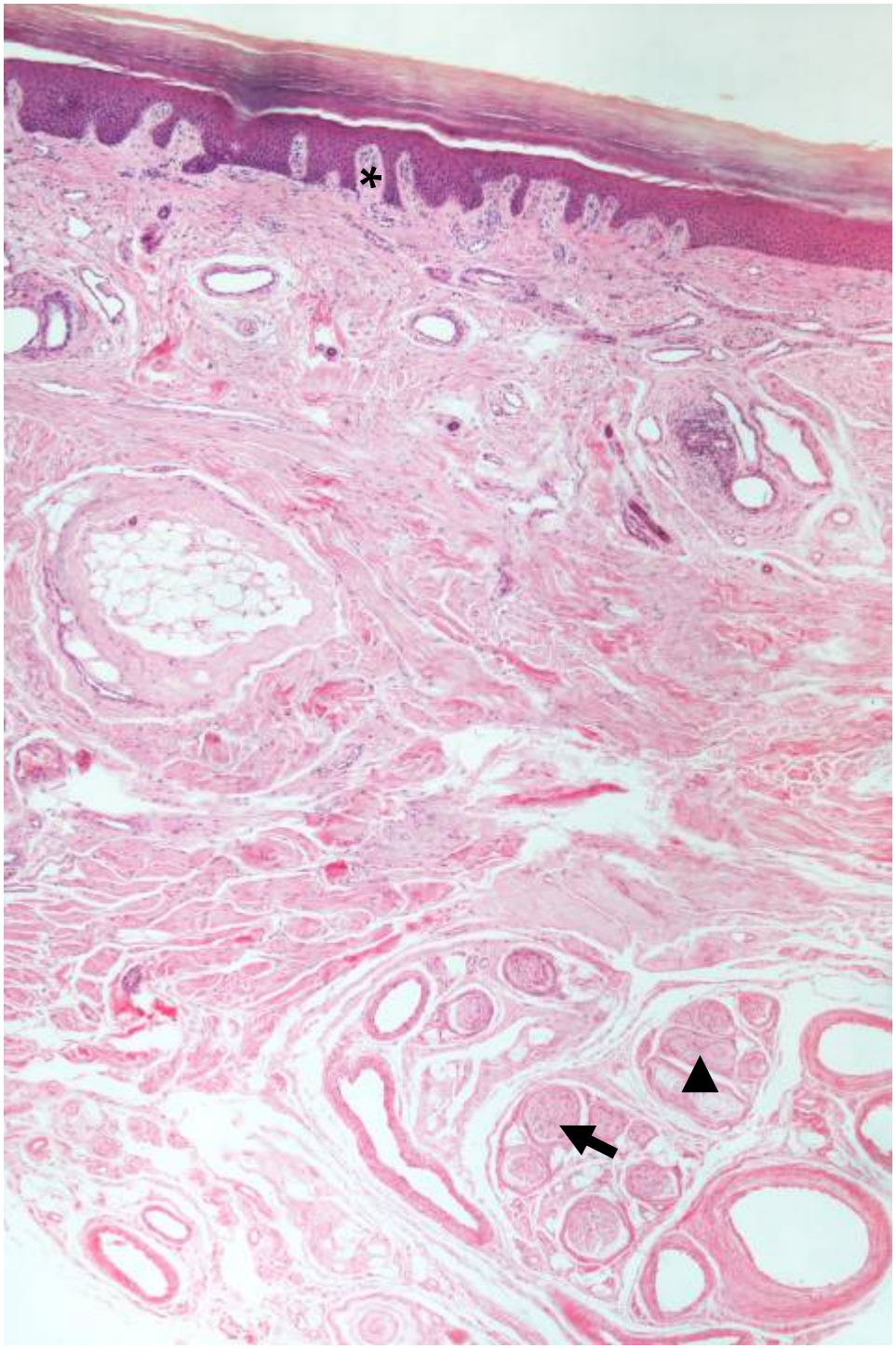
Fig.7 Peripheral nerve, cs, OsO_4 (F-3-k or i)

Fig. 7 Cross section of myelinated nerves. Myelin sheath (arrowhead) is fixed with the OsO_4 and axon (asterisk) that appeared paled and clear staining stained. Notice some of Schwann cells nucleus can be observed (arrow).

Fig.8a Peripheral nerve, ls (F-3-k or i)

Fig.8b (F-3-k or i) Myeline sheath (arrow); Node of Ranvier (arrowhead)

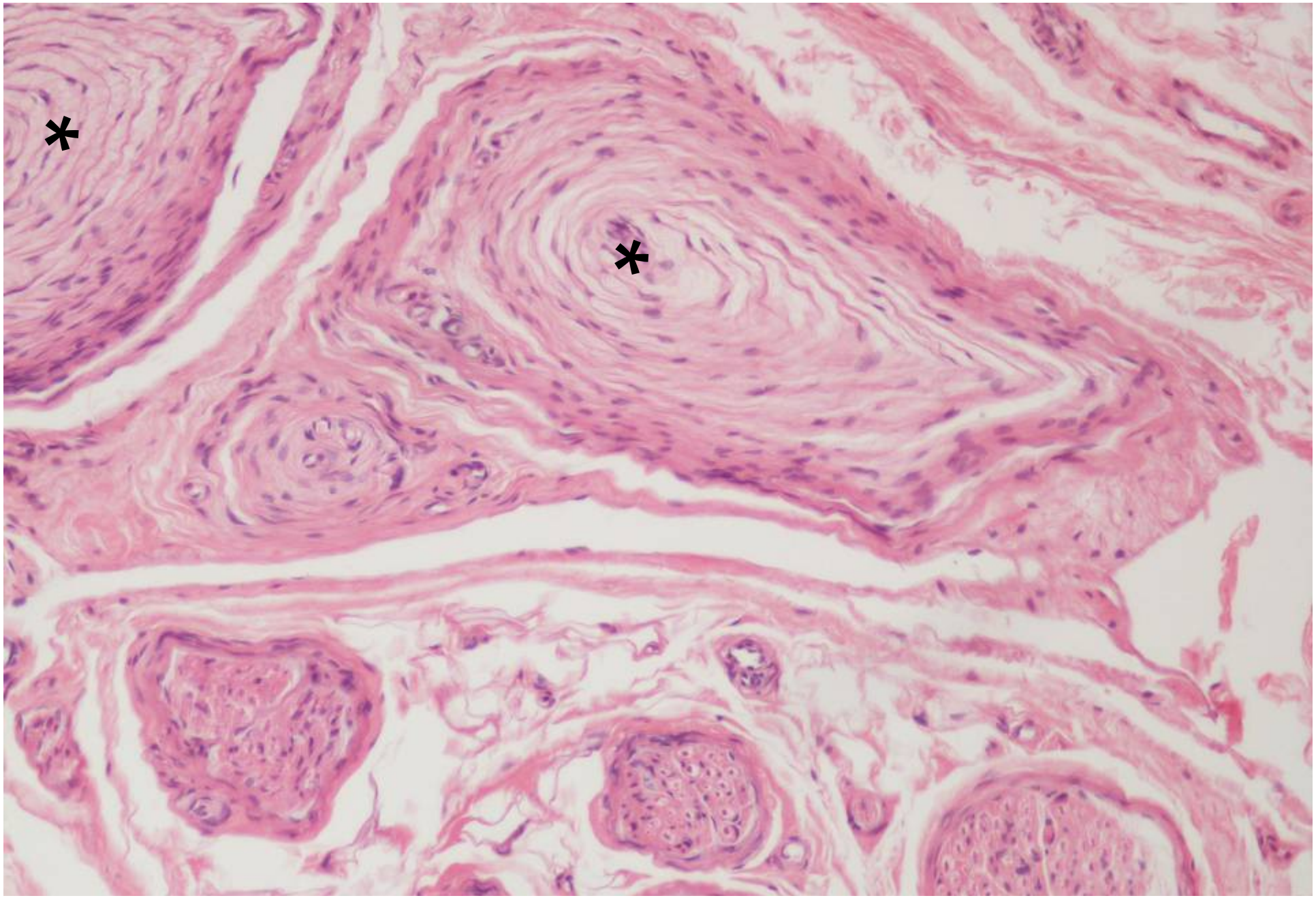
Fig. 8 Longitudinal section of myelinated nerves. Axons (asterisk) are surrounded by the myelin sheath (arrow) and the space lacks myelin sheath called the nodes of Ranvier (arrowhead).



Pacinian corpuscle (arrow head);
Meissner's corpuscle (*);
Nerve bundles (arrow)

Fig.9 Human skin, H&E (NF-1-c)

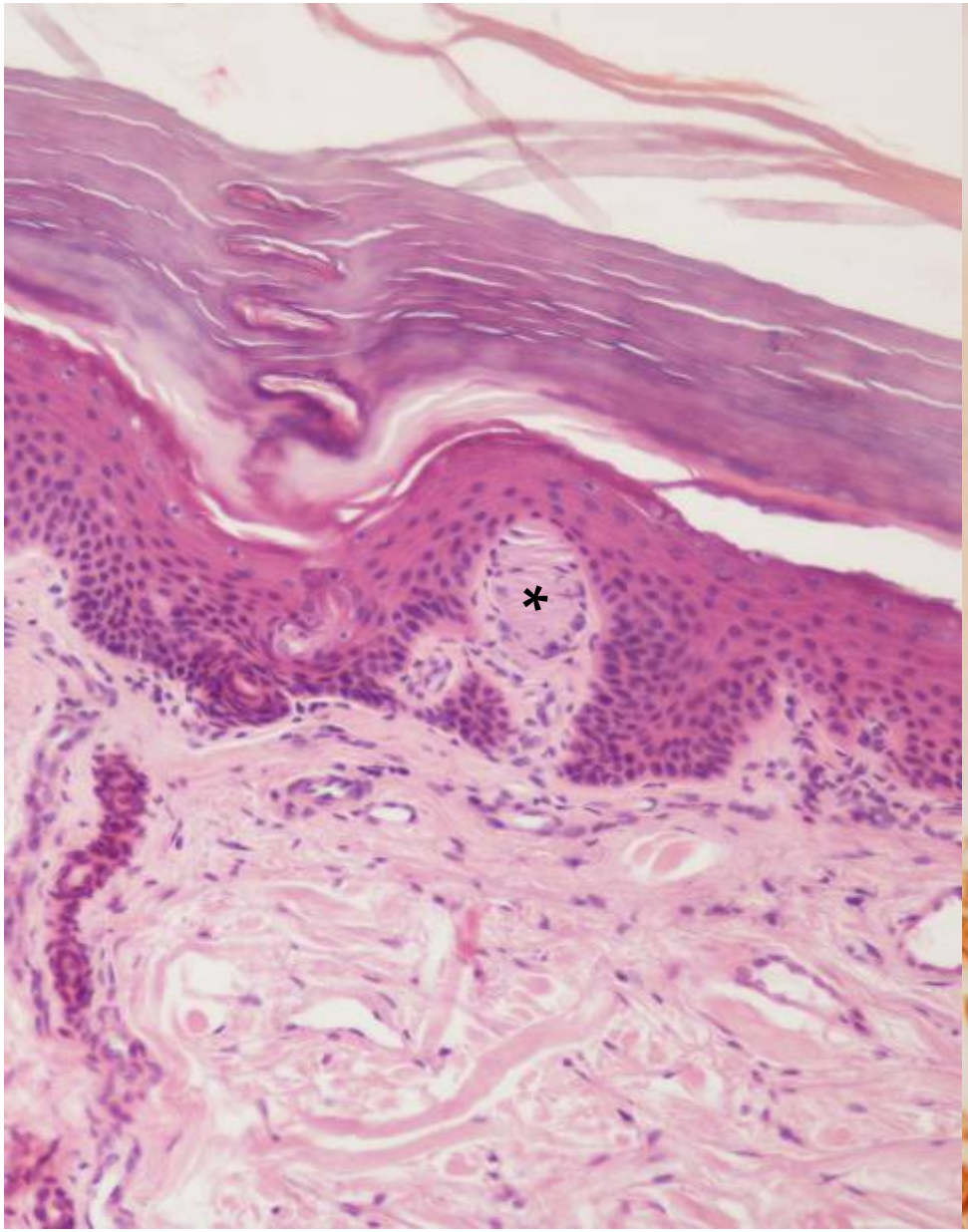
Fig. 9 Tangential section of skin. Skin is composed of epidermis and underlay dermis. Dermis have the finger-like protrusion into the epidermis, called dermal papillae and the Meissner’s corpuscle (asterisk) housed in the apical of dermal papillae. Pacinian corpuscles (arrowhead) and nerve bundle (arrow) are found in the deep layer of dermis.

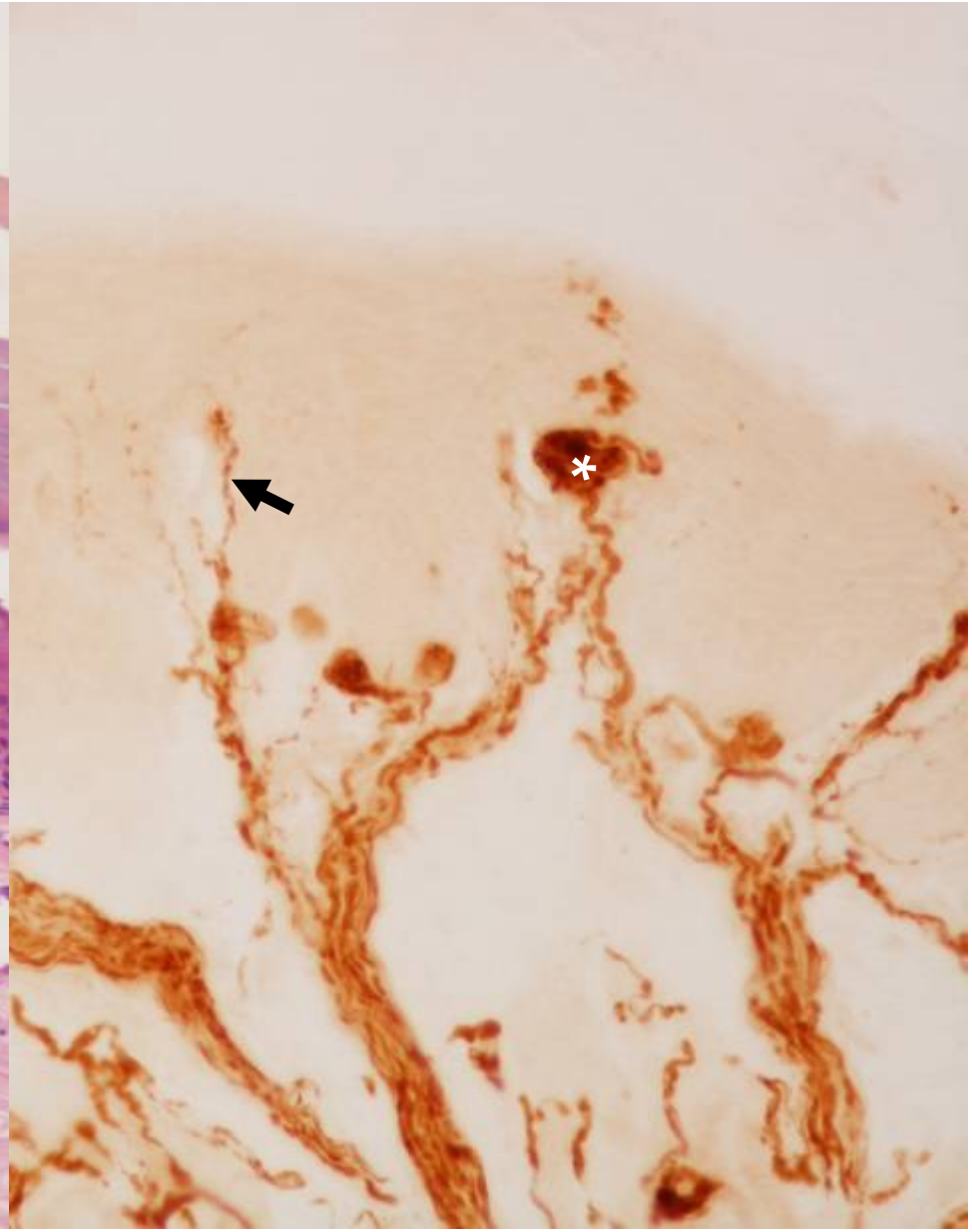


Pacinian corpuscle (*)

Fig.10 Pacinian corpuscle (NF-1-c)

Fig. 10 High magnification of Pacinian corpuscles. Pacinian corpuscle is large ovoid structures that composed of multilayer capsule and innervated by the myelinated nerves. Notice the concentric lamellae is reminiscent of the cut surface of a hemisected onion. Pacinian corpuscles respond to pressure and vibration and there are several of nerve bundles adjacent to the corpuscle.



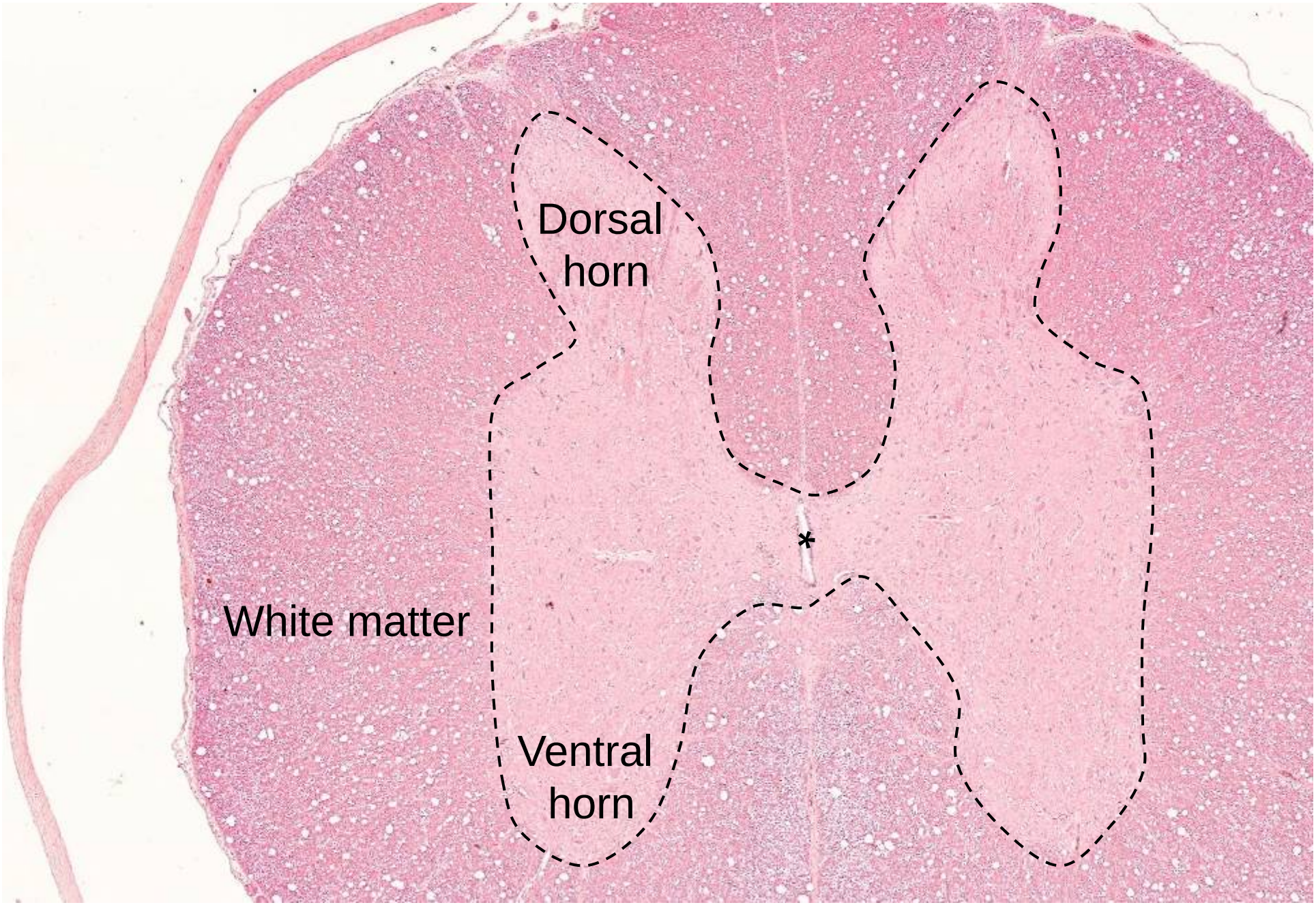


Meissner’s corpuscle (*); Free nerve ending in epidermis (arrow)

Fig.11a Meissner’s corpuscles, H&E (NF-1-c)

Fig.11b Meissner’s corpuscles, Immunohistochemistry (YL-02)

Fig. 11 Photomicrograph of Meissner’s corpuscles. Meissner’s corpuscle housed in the apical of dermal papillae and only lamellae cells of Meissner’s corpuscle could be observed with the H&E staining (Fig. 11a). Meissner’s corpuscle was innervated by nerve fibers that demonstrated with the pan-axonal (Fig. 11b).



Central canal (*); Gray matter of spinal cord (dash line)

Fig.12 Spinal cord (93W3696)

Fig. 12 Cross-sectioned of spinal cord. Spinal cord is composed of inner part of gray matter that neuronal cell body-gathering and outer white matter that contained numerous ascending and descending tract. The gray matter of the spinal cord appears roughly in butterfly-shape, with dorsal horn that sensory input and ventral horn that motor fiber leave. The central canal lies in the central commissure of gray matter.

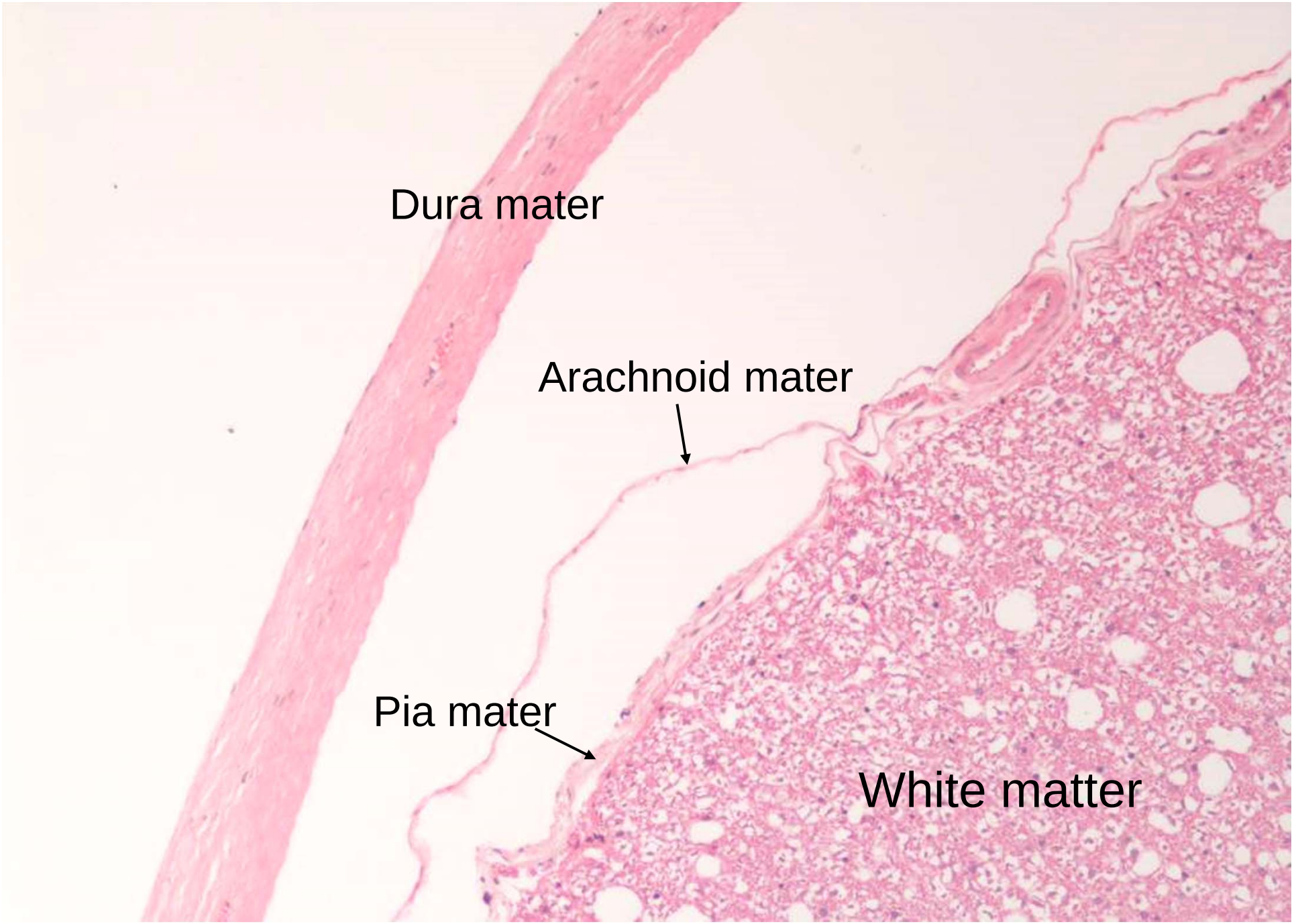
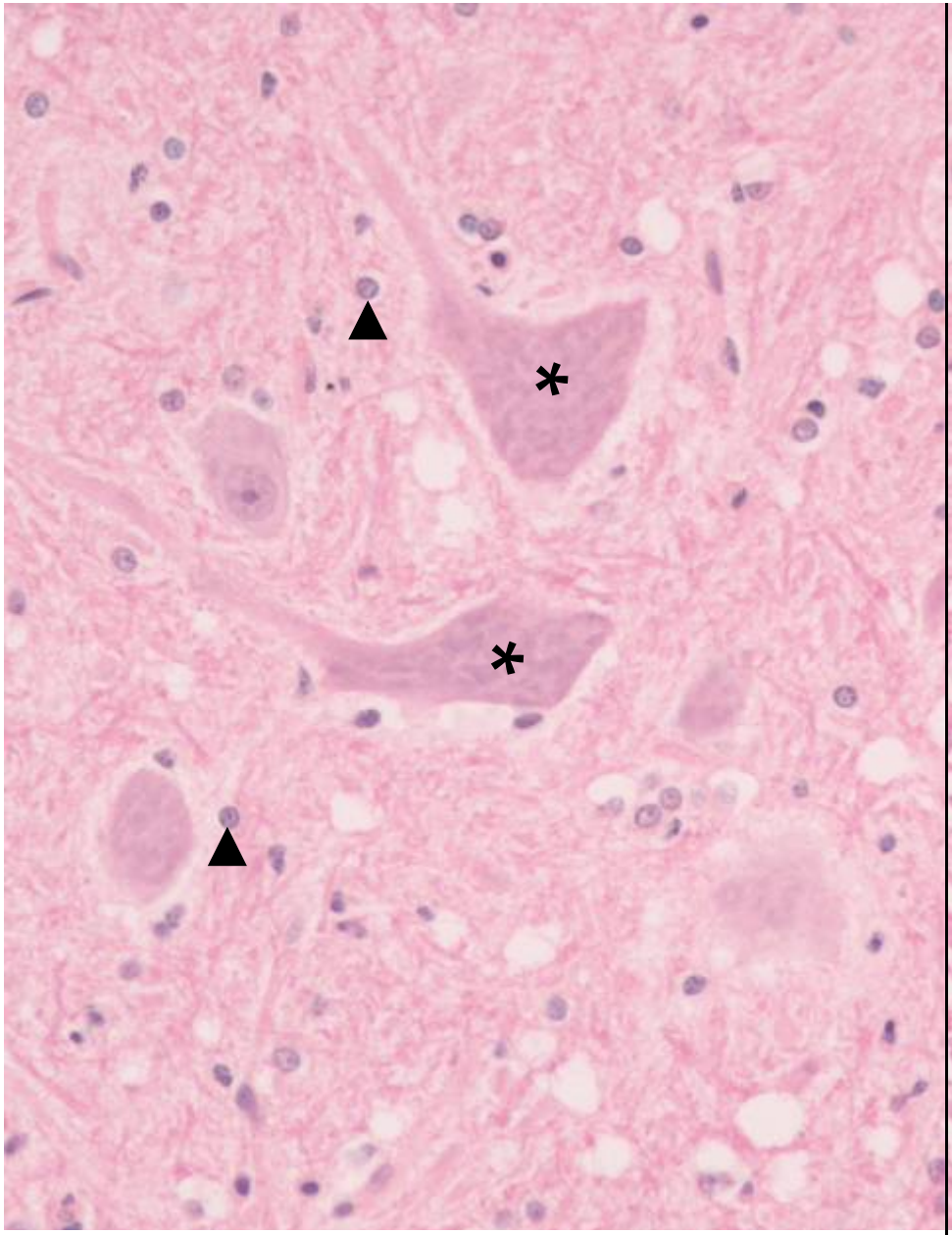


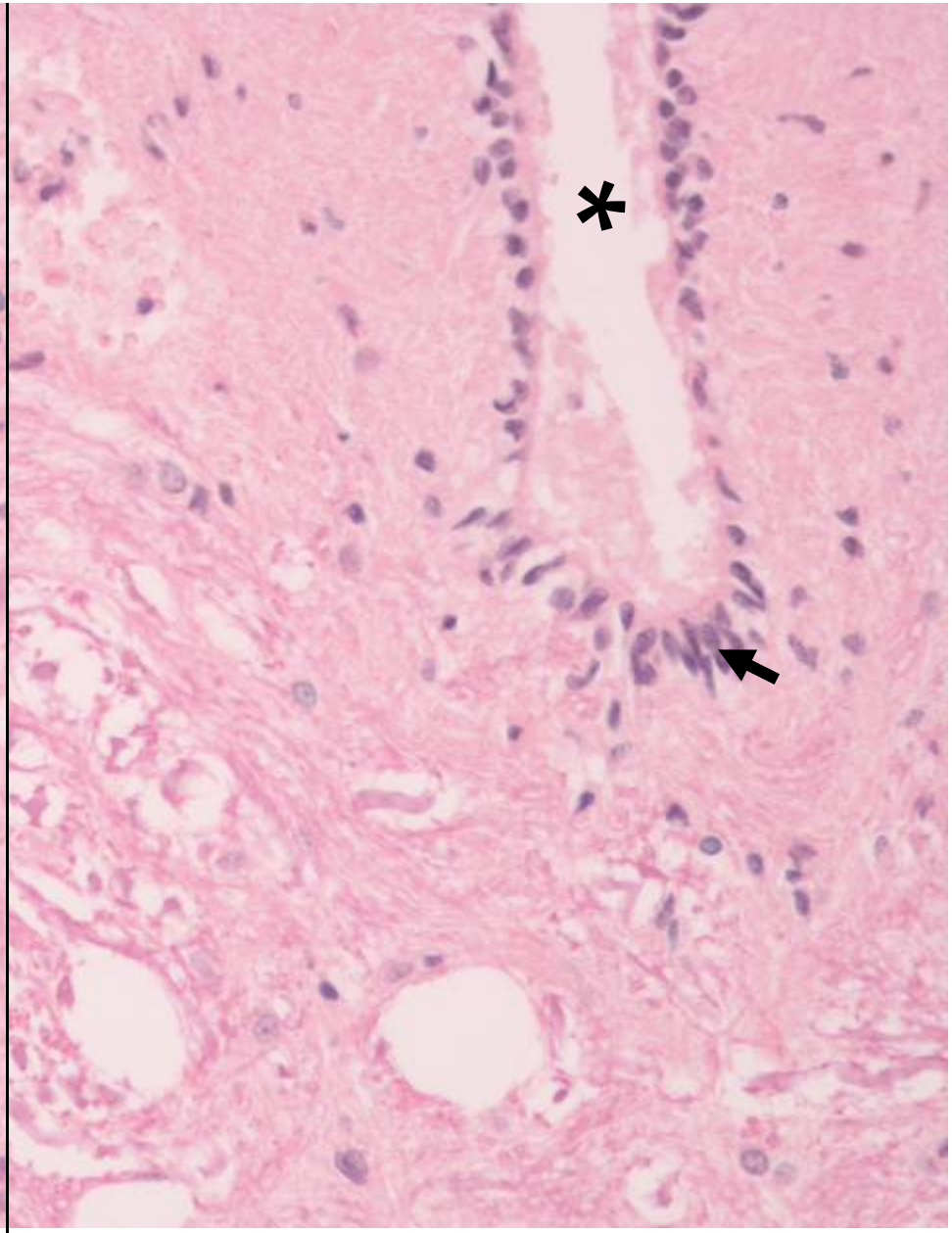
Fig.13 Meninges (93W3696)

Fig. 13 Meninges of central nervous system. The brain and spinal cord are covered by three layers of meninges. The surface of the nervous tissue is covered by a delicate layer called the pia mater. Overlying the pia mater is a thicker fibrous layer, the arachnoid mater. The space between the pia and arachnoid layers is called the subarachnoid space. External to the arachnoid mater is a dense fibroelastic layer called the dura mater. Note the white matter in the spinal cord is composed of myelinated axons.



Multipolar neuron (*);
Glial cells (arrow head)

Fig.14a Ventral horn (93W3696)



Central canal(*); Ependymal cells (arrow)

Fig.14b Central canal (93W3696)

Fig. 14a High magnification of ventral horn of spinal cord. The ventral horn of the spinal cord contains large cell bodies of multipolar motor neurons. The nuclei of neuroglial cells are also evident, but their cytoplasm is not easily to identified.

Fig. 14b High magnification of ependymal cells. The ependymal cells are cuboid or columnar cell, arranging in a single layer pattern that is lining the central canal.

Fig.15a Cerebrum, brain stem, and cerebellum (93W6400)

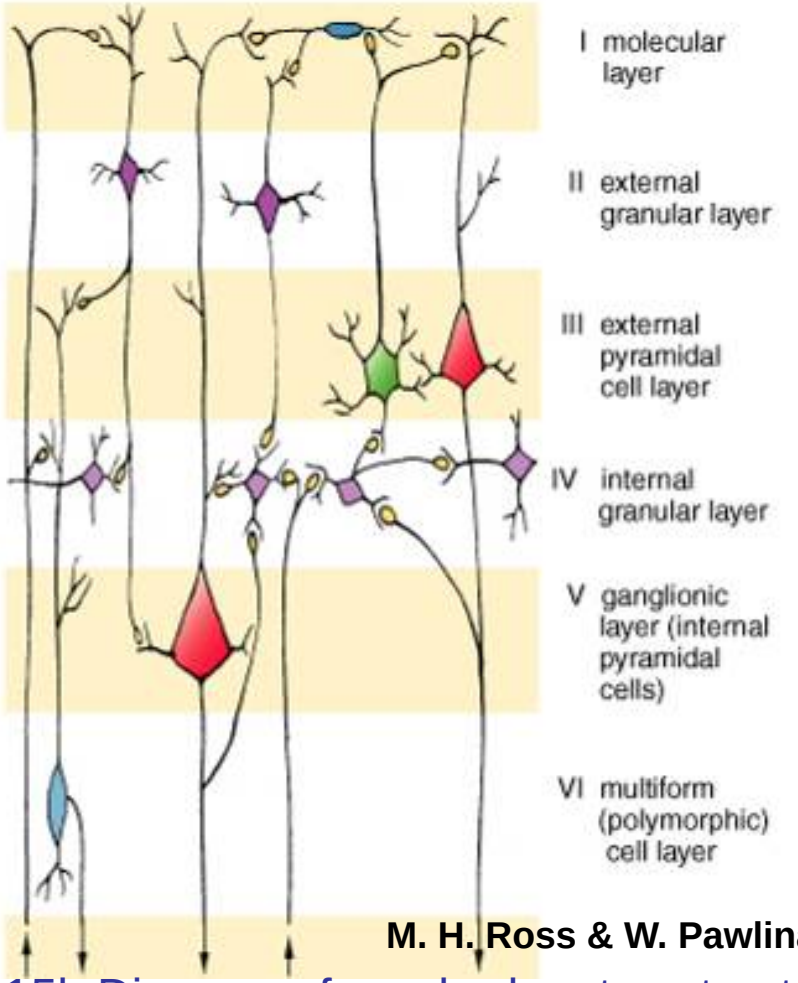


Fig.15b Diagram of cerebral cortex structure

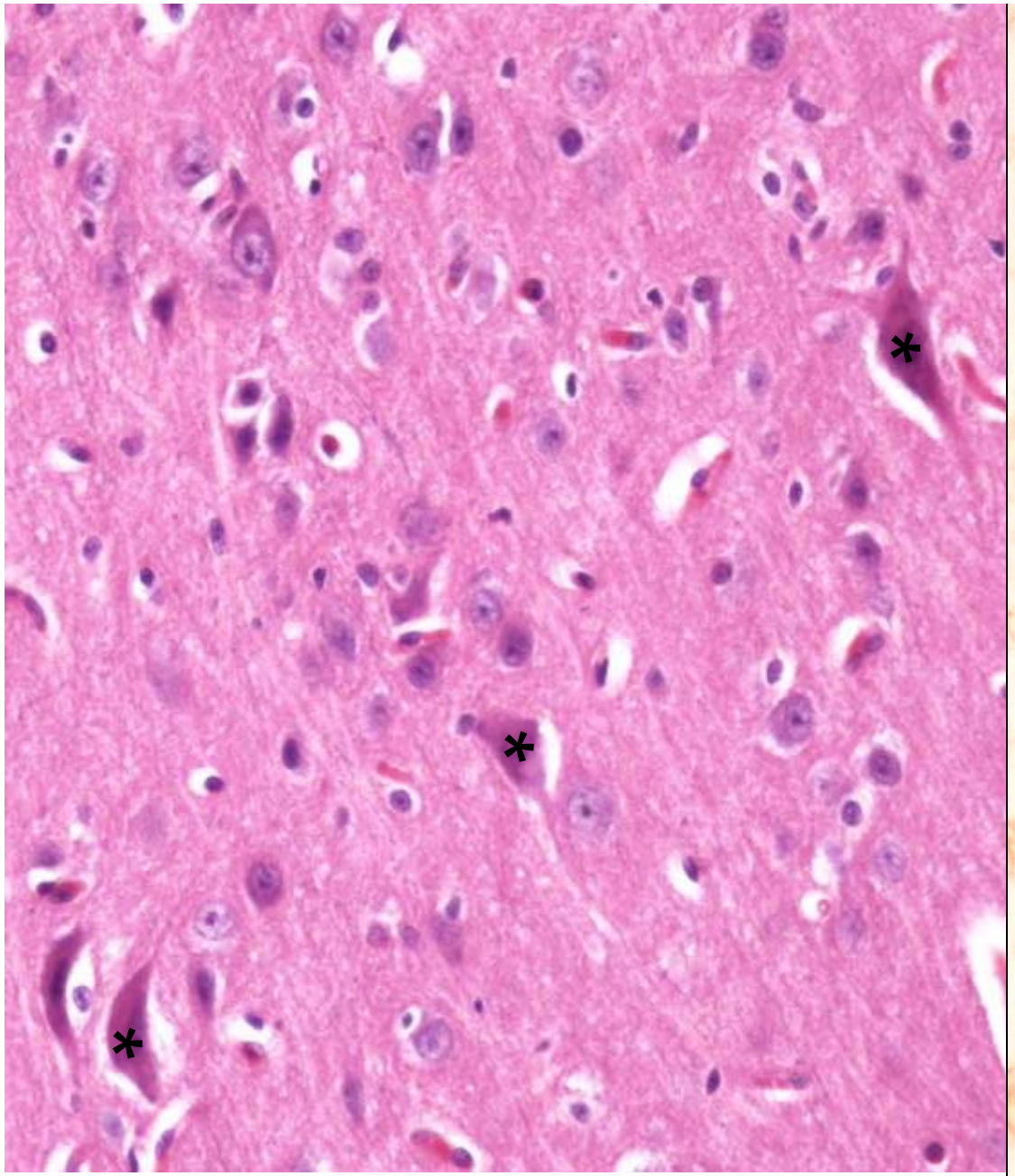
Cortex (Gray matter) :

- Molecular layer
- External granular layer
- External pyramidal cell layer
- Internal granular layer
- Internal pyramidal cell layer
- Multiform cell layer

Medulla (White matter)

Fig. 15a Low magnification of cerebrum, brain stem, and cerebellum sections.

Fig. 15b Diagram of arrangement of neuronal cells in the cortex of cerebral hemispheres. Those neurons arranged in six layers patterns that is distinguishable in some H&E sections.



Pyramidal cells (*)

Fig.16a Pyramidal cells (93W6400)

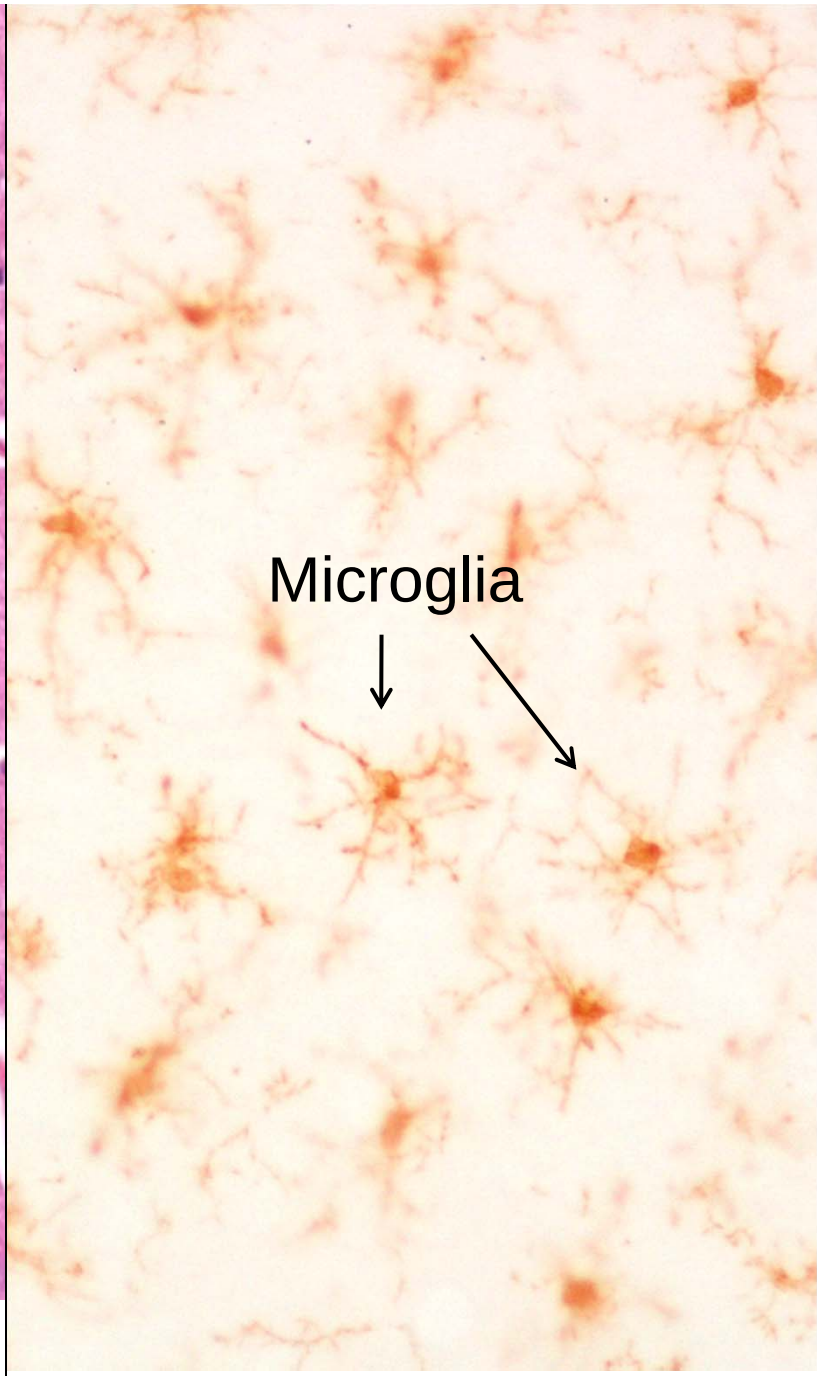


Fig.18b Microglia (YL-01)

Fig. 16a High magnification of pyramidal cells in cerebral cortex. Pyramidal cells are multipolar neurons with pyramidal appearance of cell bodies. Their processes can receives input and send information to other layer of cerebral cortex.

Fig. 16b Numerous ramified microglia in cerebral cortex were labeled with microglia marker, OX-42.

Fig.17a Choroid plexus in ventricle (93W6400)

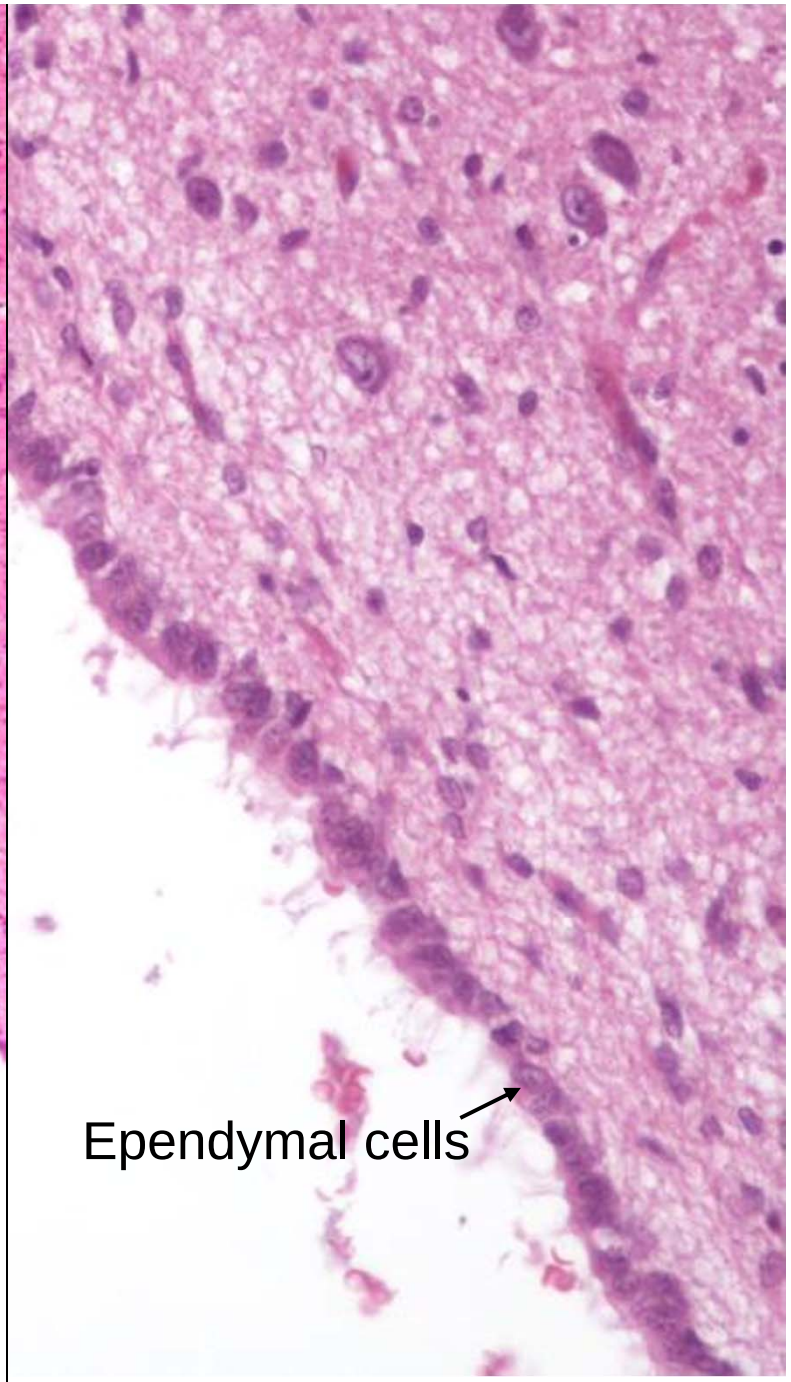


Fig.17b Ependymal cells (93W6400)

Fig. 17a Low magnification of the choroid plexus. The choroid plexus is a vascular structure arising from the wall of ventricles of the brain and responsible for the production of cerebrospinal fluid (CSF). Each choroid plexus is composed of cuboidal or columnar epithelium and adjacent capillary.

Fig. 17b High magnification of ependymal cells. Ependymal cells formed the lining of the ventricles and spinal canal. Ependymal cells lack base membrane and with numerous cilia and microvilli that projected in the the lumen of ventricles.

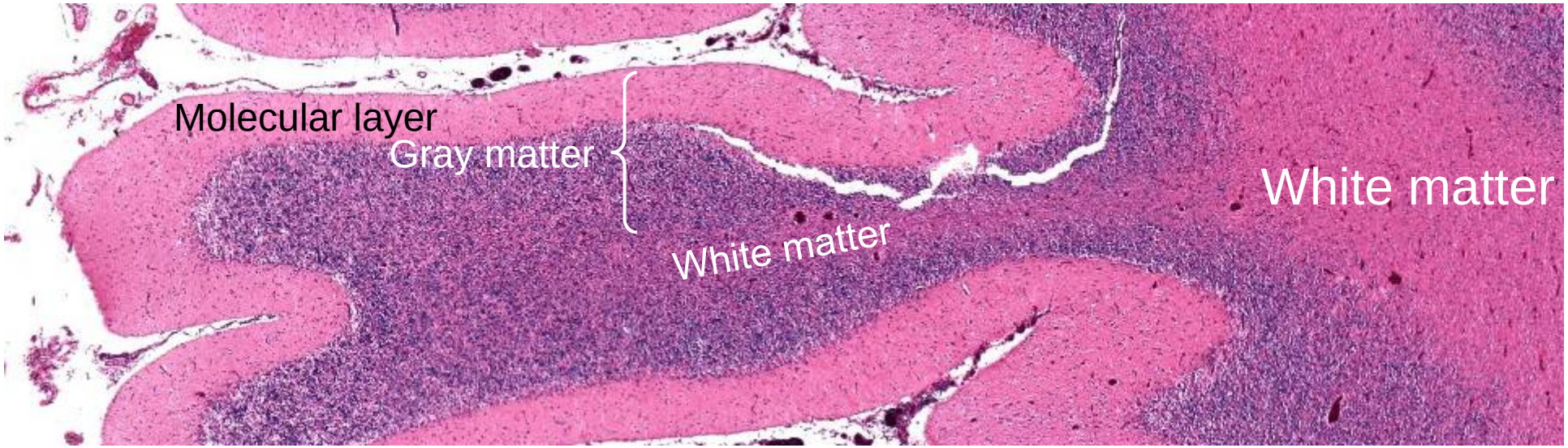


Fig.18a Cerebellum (93W6412, 93W6400)

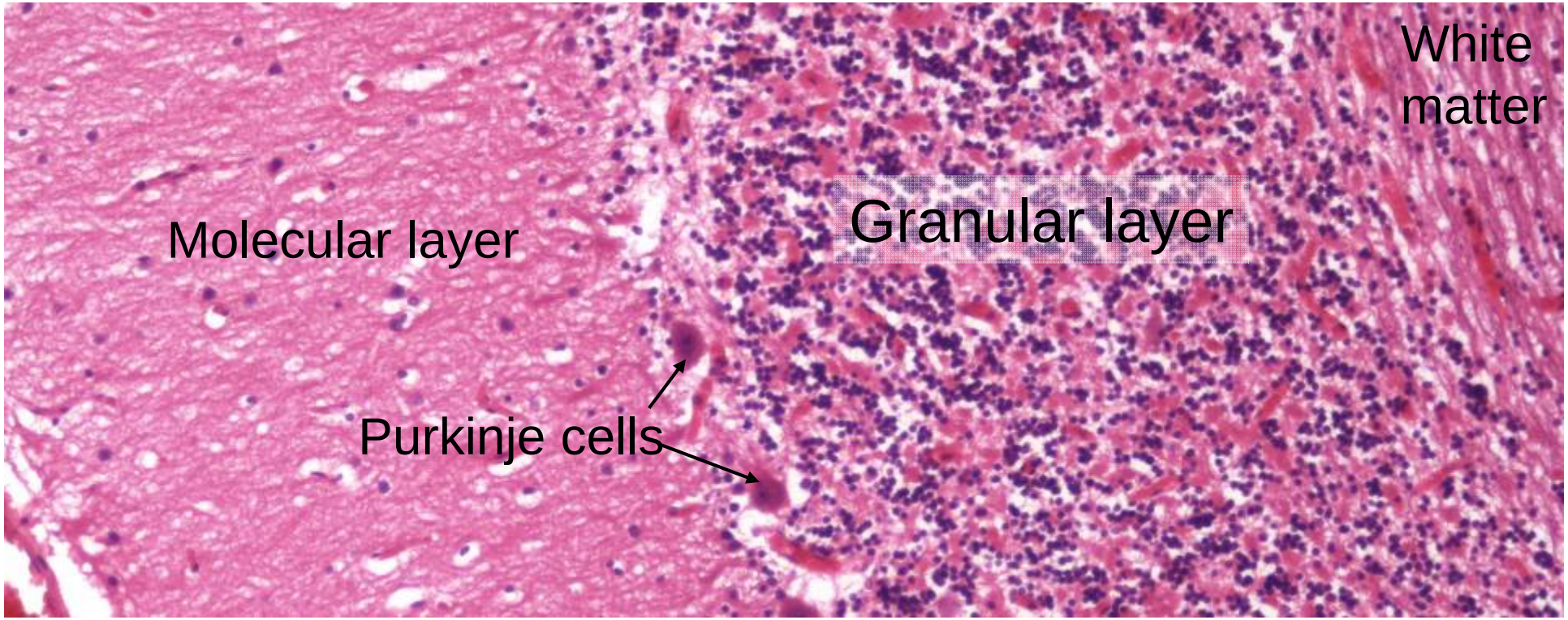


Fig.18b Cerebellum cortex (93W6412, 93W6400)

Fig. 18 Photomicrograph of cerebellar hemispheres. A. Low magnification of cerebellar hemisphere. B. High magnification of cerebellar hemisphere. Cerebellar cortex is composed of outer of molecular layer, middle of purkinje cell layer and underlies of granular layer. Deep to the cerebellar cortex is the white matter.

Summary

93W3617 Giant Multipolar Motor Neurons	Observe the shape of multipolar neuron, Dendrite, Axon, Supporting cell, Nucleus of neuron
93W3696, Spinal ganglion	Spinal ganglion, Nucleolus, Satellite cells, Myelin sheath, Node of Ranvier
93W3715, Sympathetic ganglion	Sympathetic ganglion, Satellite cells, Nerve fiber bundle
93W6748, Esophagus ,middle portion	Myenteric plexus of Auerbach, Muscularis externa,
F-3-k(or F-3-i), Peripheral nerve	Epineurium, Perineurium, Schwann cells, Myeline sheath, Node of Ranvier, Axon

NF-1-c, Human skin	Meissner’s corpuscle, Pacinian corpuscle, Nerve bundle
93W3696, Spinal cord	Dura mater, Arachnoid mater, Pia mater, Gray matter, Dorsal horn, Ventral horn, White matter, Neuroglial cells, Central canal, Ependymal cells
93W6400, Brain, Composite	Cerebrum: White matter, Gray matter, Molecular layer, Pyramidal cell Brain stem: Choroid plexus, Ependymal cells
93W6412, Cerebellum	White matter, Gray matter, Molecular layer, Purkinje cells, Granular layer