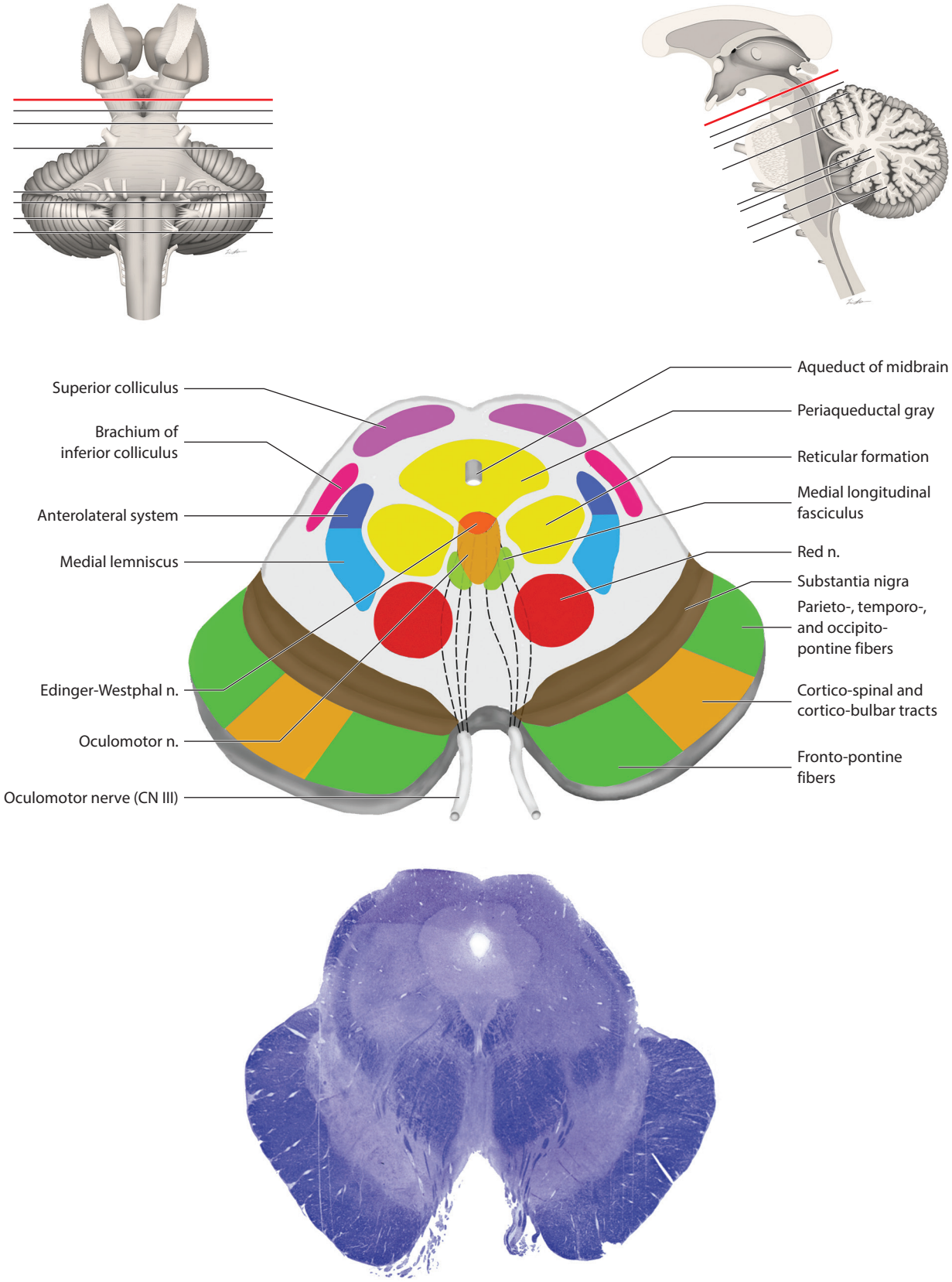


FIGURE A.3: Upper Midbrain: Cross-Section (schematic and histology)

FIGURE A.4—LOWER MIDBRAIN: CROSS-SECTION (SCHEMATIC AND HISTOLOGY)

This cross-section includes the cerebral peduncles, still located anteriorly, and the substantia nigra located immediately behind these fibers. The unique feature in the lower midbrain is the decussation (crossing) of the superior cerebellar peduncles that occupies the central area of the section; this identifies the section as the inferior collicular level. Posteriorly, the aqueduct is surrounded by the periaqueductal gray, and behind the aqueduct is the inferior colliculus. Often, the cross-section at this level includes some of the pontine nuclei (as seen in the histological section in the lower part of the figure). Therefore, one may see a somewhat confusing mixture of structures.

The arrangement of the fibers in the cerebral peduncle is the same as found in the upper midbrain. The tegmentum contains the ascending tracts, the medial lemniscus, the trigeminal pathway, and the anterolateral fibers (system), which are situated together at the outer edge of the lower midbrain (see Figure 6.11).

In sections through the lower levels of the midbrain, there is a brief appearance of a massive fiber system (as seen with a myelin-type stain) occupying the central region of the lower midbrain. These fibers are the continuation of the superior cerebellar peduncles, which are crossing (decussating) at this level (see Figure 3.3 and Figure 6.11). The fibers are coming from the deep cerebellar nuclei (the intracerebellar nuclei), mainly the dentate nucleus, and are headed for the ventral lateral nucleus of the thalamus and then on to the motor cortex (discussed with Figure 5.18). Some of the fibers that come from the intermediate deep cerebellar nucleus synapse in the red nucleus.

The nuclei of the reticular formation found in the central region (the tegmentum) at this level are functionally part of the ascending reticular activating system (**ARAS**) and play a significant role in consciousness (see Figure 3.6A and Figure 3.6B). Between the cerebral peduncles is a small nucleus, the interpeduncular nucleus, which belongs with the limbic system. The periaqueductal gray surrounding the aqueduct of the midbrain is involved with pain and also with the descending pathway for the modulation of pain (see Figure 5.6).

The nucleus of CN IV, the trochlear nucleus, is located in front of the periaqueductal gray, next to the midline. Because it supplies only one extra-ocular muscle, it is a smaller nucleus than the oculomotor nucleus. CN IV heads dorsally and exits from the brainstem below the inferior colliculus (see Figure 6.12), on the posterior aspect of the brainstem. The medial longitudinal fasciculus (MLF) lies just anterior to the trochlear nucleus. Some unusually large round cells are often seen at the edges of the periaqueductal gray; these cells are part of the **mesencephalic nucleus** of the trigeminal nerve, CN V (see Figure 3.4).

The lateral lemniscus, the ascending auditory pathway, is still present at this level and its fibers are terminating in the inferior colliculus, a relay nucleus in the auditory pathway (see Figure 6.1 and Figure 6.2). After synapsing here, the fibers are relayed to the medial geniculate nucleus via the brachium of the inferior colliculus, seen at the upper midbrain level (see Appendix Figure A.3).

CLINICAL ASPECT

The presence of the pain and temperature fibers that are found at this level at the outer edge of the midbrain has prompted the possibility, in very select cases, to sever the sensory ascending pathways surgically at this level. This highly dangerous neurosurgical procedure would be done particularly for patients with cancer who are suffering from intractable pain. Nowadays, it would be considered only as a measure of last resort. Pain control is currently managed through the use of drugs, either as part of palliative care or in the setting of a pain "clinic," accompanied by other measures.

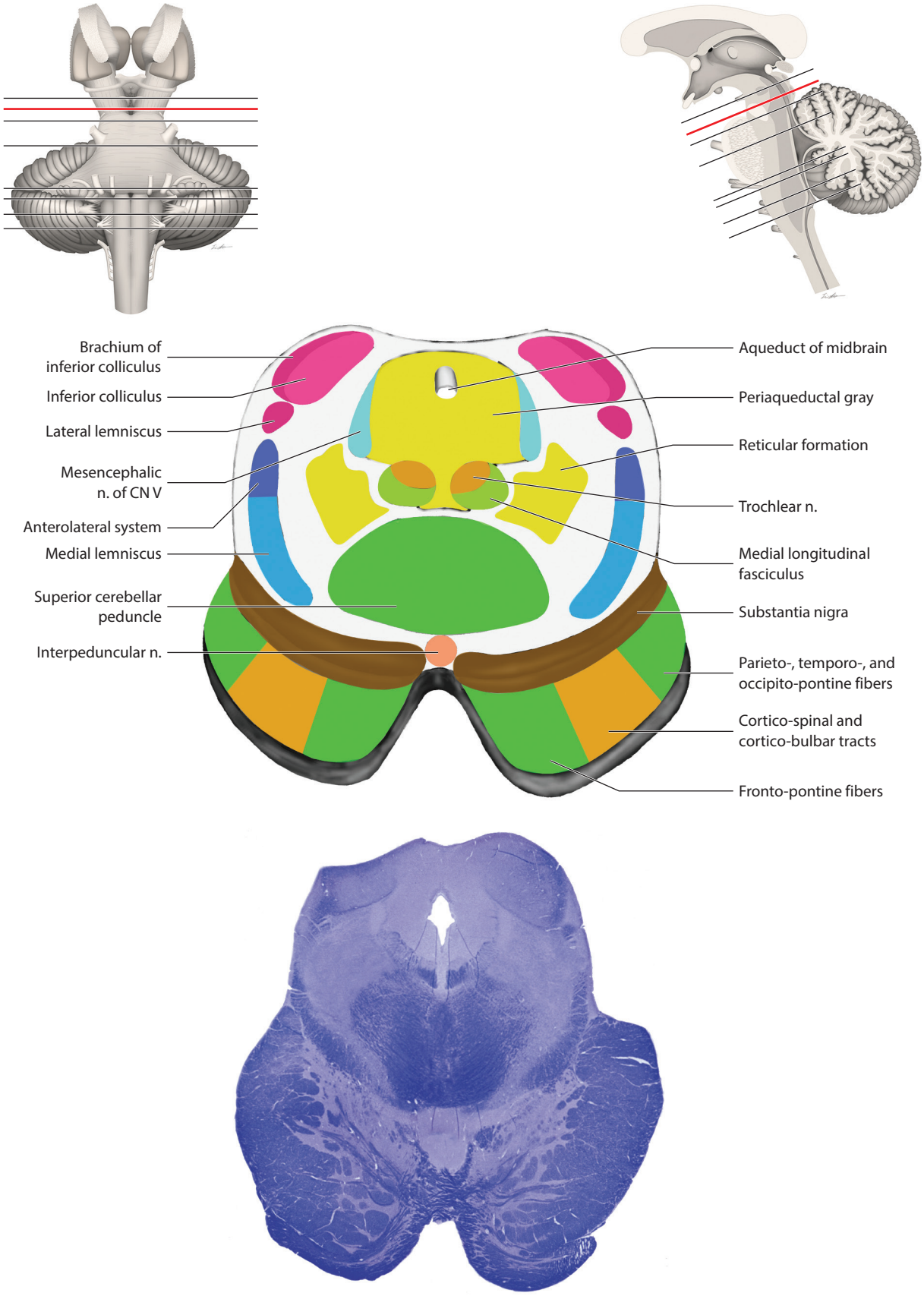


FIGURE A.4: Lower Midbrain: Cross-Section (schematic and histology)

FIGURE A.5—UPPERMOST PONS: CROSS-SECTION (SCHEMATIC AND HISTOLOGY)

This level is presented mainly to allow an understanding of the transition of midbrain to pons. This particular section is taken at the uppermost pontine level, where the trochlear nerve, cranial nerve IV (CN IV), exits (below the inferior colliculus; see Figure 1.9, Figure 3.3, and Figure 5.17). This is the only cranial nerve that exits posteriorly; its fibers cross (decussate) before exiting (see Figure 6.12).

Anteriorly, the pontine nuclei are beginning to be found. Cortico-pontine fibers are terminating in the pontine nuclei. From these cells, a new tract is formed that crosses and projects to the cerebellum to form the middle cerebellar peduncle (see Figure 5.15). The cortico-spinal fibers become dispersed between these nuclei and course in bundles between them (see Figure 5.9 and Figure 6.12).

The ascending tracts include the medial lemniscus and anterolateral system (somatosensory from the body; see Figure 5.2, Figure 5.3, and Figure 6.11), the ascending trigeminal pathway (see Figure 5.4 and Figure 6.11), and the lateral lemniscus (auditory; see Figure 6.1). The fibers of the trigeminal system that have crossed in the pons (discriminative touch from the principal nucleus of CN V), and those of pain and temperature (from the descending nucleus of CN V) that crossed in the medulla join together in the upper pons with the medial lemniscus (see Figure 5.4, Figure 5.5, and Figure 6.11). The medial lemniscus is located midway between its more central position inferiorly and the lateral position found in the midbrain (see Figure 6.11). In sections stained for myelin, it has a typical "comma-shaped" configuration. The auditory fibers are located dorsally, just before terminating in the inferior colliculus in the lower midbrain (see Figure 6.2 and Figure 6.11). Centrally, the cerebral aqueduct is beginning to enlarge, becoming the 4th ventricle. The medial longitudinal fasciculus (MLF) is found in its typical location ventral to the 4th ventricle, next to the midline.

The nuclei of the reticular formation are located in the tegmentum (see Figure 3.6A and Figure 3.6B). The special nucleus at this level, the locus ceruleus, is located in the dorsal part of the tegmentum not too far from the edges of the 4th ventricle. The nucleus derives its name from its bluish color in fresh specimens (see Figure 4.2B). As explained, the pigment is lost when the tissue is processed for histological examination. The locus ceruleus is usually considered part of the reticular formation (as discussed with Figure 3.6B) because of its widespread connections with virtually all parts of the brain. (It has therefore been color-coded in yellow.) It is also unique because norepinephrine is its catecholamine neurotransmitter substance.

The superior cerebellar peduncle is found within the tegmentum of the pons. These fibers carry information from the cerebellum to the thalamus and the red nucleus. The fibers, which are the axons from the deep cerebellar nuclei, leave the cerebellum and course in the roof of the 4th ventricle (the superior medullary velum; see Figure 1.10 and Figure 5.3). They then enter the pontine region and move toward the midline, finally decussating in the lower midbrain (see Figure 5.17 and Appendix Figure A.4).

The uppermost part of the cerebellum is found at this level. One of the parts of the vermis, the midline portion of the cerebellum, is identified, and that is the lingula. This particular lobule is a useful landmark in the study of the cerebellum and is identified when the anatomy of the cerebellum is explained (see Figure 3.7).

ADDITIONAL DETAIL

Several very large neurons belonging to the mesencephalic nucleus of the trigeminal may be found near the edges of the 4th ventricle (see Figure 3.4). This small cluster of cells may not be found in every cross-section of this particular region.

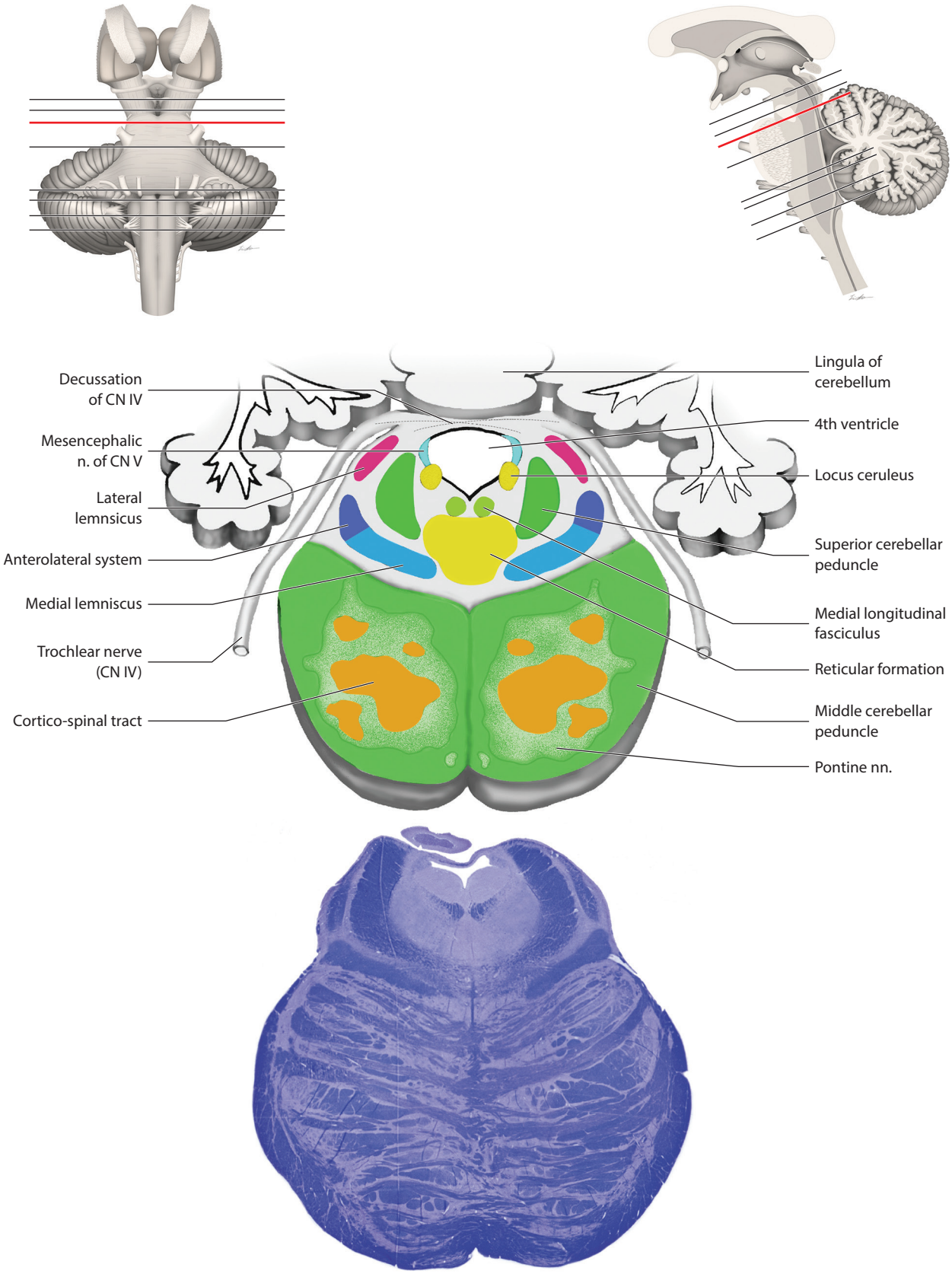


FIGURE A.5: Uppermost Pons: Cross-Section (schematic and histology)

FIGURE A.6—MID-PONS: CROSS-SECTION (SCHEMATIC AND HISTOLOGY)

This section is taken through the level of the attachment of the trigeminal nerve (CN V). Anteriorly, the pontine nuclei and the bundles of cortico-spinal fibers are easily recognized. The pontine cells (nuclei) and their axons, which cross and then become the middle cerebellar peduncle, are particularly numerous at this level (see Figure 5.15). The cortico-spinal fibers are seen as distinct bundles that are widely dispersed among the pontine nuclei at this level (see Figure 5.9 and Figure 6.12).

The trigeminal nerve enters and exits the brainstem along the course of the middle cerebellar peduncle. Cranial nerve (CN) V has several nuclei with different functions (see Figure 3.4 and Figure 5.4). This level contains only two of its four nuclei—the principal (or main) sensory nucleus and the motor nucleus. The principal (main) sensory nucleus subserves discriminative touch sensation and accounts for the majority of fibers; the face area is extensively innervated, particularly the lips, and also the surface of the tongue. The motor nucleus supplies the muscles of mastication and usually is found as a separable nerve as it exits alongside the large sensory root (see Figure 6.12). Within the pons, these nuclei are separated by the fibers of CN V; the sensory nucleus (with smaller cells) is found more laterally, and the motor nucleus (with larger cells) is located more medially.

The ascending fiber systems are easily located at this cross-sectional level. The medial lemniscus has moved away from the midline as it ascends (see Figure 6.11). The anterolateral fiber system has become associated with it by this level. In addition, the ascending trigeminal pathway joins with the medial lemniscus. The lateral lemniscus is seen as a distinct tract, lying just lateral to the medial lemniscus. The medial longitudinal fasciculus (MLF) is found in its typical location anterior to the 4th ventricle.

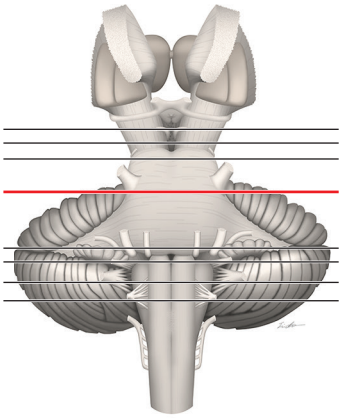
The core area of the tegmentum is occupied by the nuclei of the reticular formation. Some of the nuclei here are called the oral portion of the pontine reticular formation (see Figure 3.6B). This "nucleus" contributes fibers to a descending medial reticulo-spinal tract that is involved in the indirect voluntary pathway for motor control, and it plays a major role in the regulation of muscle tone (discussed with Figure 5.12B).

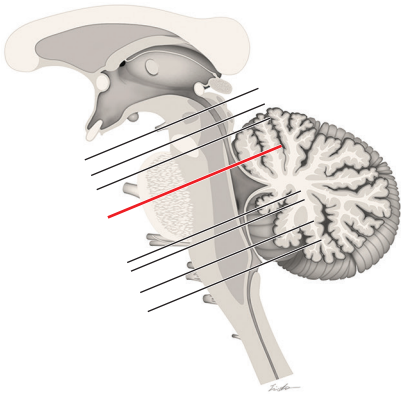
The 4th ventricle has become quite wide at this level. The superior cerebellar peduncles are found at its edges, exiting from the cerebellum and heading toward the midbrain (red nucleus) and thalamus. The thin sheet of white matter that connects these peduncles is called the superior medullary velum (see Figure 3.3). The cerebellum, which is quite large at this level, is situated behind the ventricle. The lingula of the cerebellum is again labeled and is sometimes seen actually intruding into the ventricular space.

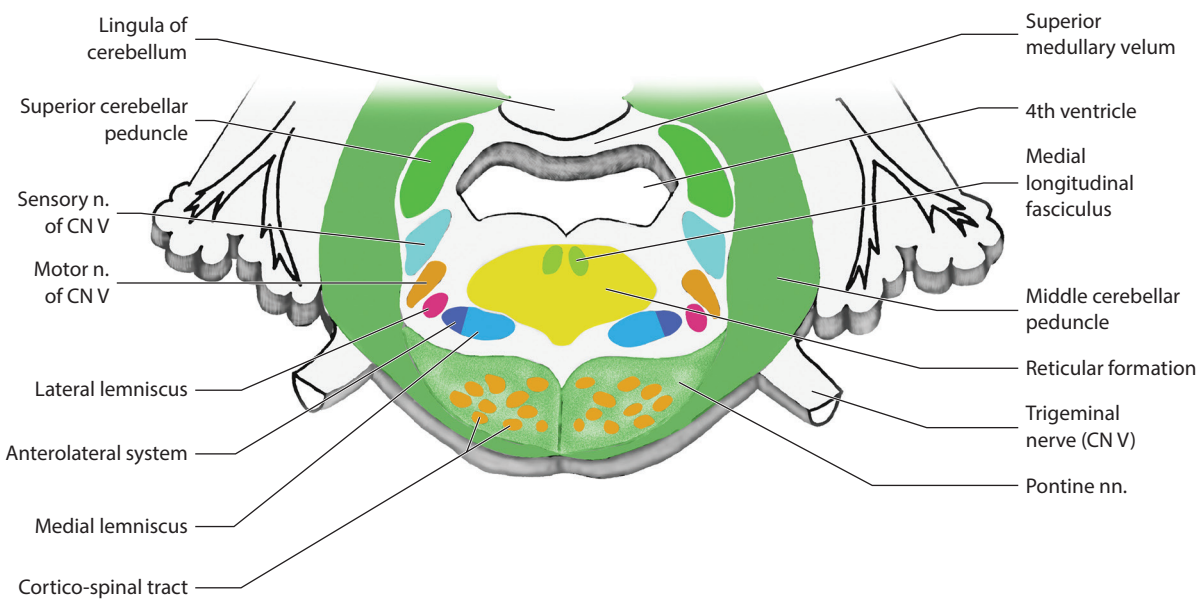
ADDITIONAL DETAIL

The superior cerebellar peduncles and the superior medullary velum can be located in a specimen (such as the one shown in Figure 1.9) in a dorsal view of the isolated brainstem. These structures would be found below the inferior colliculi, just below the exiting fibers of CN IV dorsally.

Note to the Learner: The cerebellum is usually not included in the histological sections of the pons because of the technical difficulty of sectioning such a large fragment of tissue, transferring the section through the various staining solutions, and mounting the section on large slides.







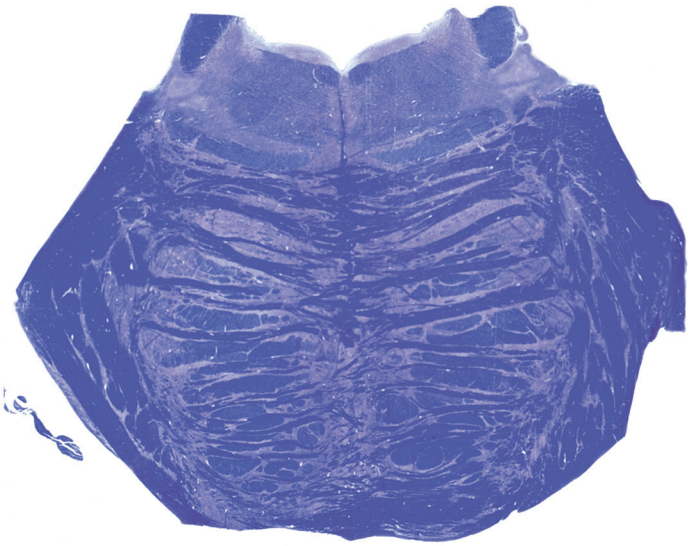


FIGURE A.6: Mid-Pons: Cross-Section (schematic and histology)

FIGURE A.7—LOWERMOST PONS: CROSS-SECTION (SCHEMATIC AND HISTOLOGY)

This section is very complex because of the number of nuclei related to the cranial nerves located in the tegmental portion, including CN V, VI, VII, and VIII. Some of the tracts are shifting in position or are forming, or both. Anteriorly, the pontine nuclei have all but disappeared, and the fibers of the cortico-spinal tract are regrouping into a more compact bundle that will become the pyramids in the medulla (see Appendix Figure A.8).

- **CN V**: The fibers of the trigeminal nerve carrying pain and temperature, that entered at the mid-pontine level, form the descending trigeminal tract, also called the spinal tract of V; medial to it is the corresponding nucleus (see Figure 3.4). The descending fibers synapse in this nucleus as this pathway continues through the medulla, cross, and then ascend (see Figure 5.4), eventually joining the medial lemniscus in the upper pons (see Figure 5.5).
- **CN VI**: The abducens nucleus, motor to the lateral rectus muscle of the eye (see Figure 3.5), is located in front of the ventricular system. The medial longitudinal fasciculus (MLF) is found just anterior to these nuclei, near the midline. Some of the exiting fibers of CN VI may be seen (see below) as the nerve emerges anteriorly, at the junction of pons and medulla.
- **CN VII**: The motor neurons of the facial nerve nucleus, supplying the muscles of facial expression, are located in the ventrolateral portion of the tegmentum. As explained (see Figure 6.12), the fibers of CN VII form an internal loop over the abducens nucleus. The diagram is drawn as if the whole course of this nerve is present in a single section, but only part of this nerve is found on an actual section through this level of the pons.
- **CN VIII**—cochlear division: CN VIII enters the brainstem slightly lower, at the ponto-cerebellar angle (see Figure 1.8 and Figure 3.1). The auditory fibers synapse in the dorsal and ventral cochlear nuclei, which is seen in the medulla in a section just below this level (see also Figure A.8). The two distinctive parts of this nerve at this histological level are the crossing fibers that form the trapezoid body and the superior olivary complex (see Figure 6.1 and Figure 6.9). After one or more synapses, the fibers then ascend and form the lateral lemniscus, which actually commences at this level.
- **CN VIII**—vestibular division: Of the four vestibular nuclei (see Figure 6.8 and Figure 6.9), three are found at this level. The lateral vestibular nucleus, with its giant cells, is located at the lateral edge of the 4th ventricle; this nucleus gives rise to the lateral vestibulo-spinal tract (see Figure 5.13). The medial vestibular nucleus is also present at this level, an extension of the medullary region. There is also a small superior vestibular nucleus in this region. The latter two nuclei contribute fibers to the MLF, thus relating the vestibular sensory information to eye movements (discussed with Figure 6.9).

The tegmentum of the pons also includes the ascending sensory tracts and the reticular formation. The medial lemniscus, often somewhat obscured by the fibers of the trapezoid body, is situated close to the midline, but it has changed its orientation from that seen in the medullary region (see Figure 6.11; see also cross-sections of the medulla; Appendix Figure A.9 and Appendix Figure A.10). The anterolateral system is too small to be identified. The nuclei of the reticular formation include the caudal portion of the pontine reticular formation, which also contributes to the pontine reticulo-spinal tract (see Figure 5.12A).

The 4th ventricle is very large but often seems smaller because the lobule of the cerebellar vermis called the nodulus (part of the flocculonodular lobe; refer to Figure 3.7) impinges on its space. The MLF is found anterior to it, near the midline.

The lowermost part of the middle cerebellar peduncle can still be identified at this level. Also present is the inferior cerebellar peduncle, which enters the cerebellum at a lower level (see Figure 1.8); it is found more internally within the cerebellum. The intracerebellar (deep cerebellar) nuclei are also found at this cross-sectional level and are located within the white matter of the cerebellum (discussed with Figure 3.8 and Figure 5.16).

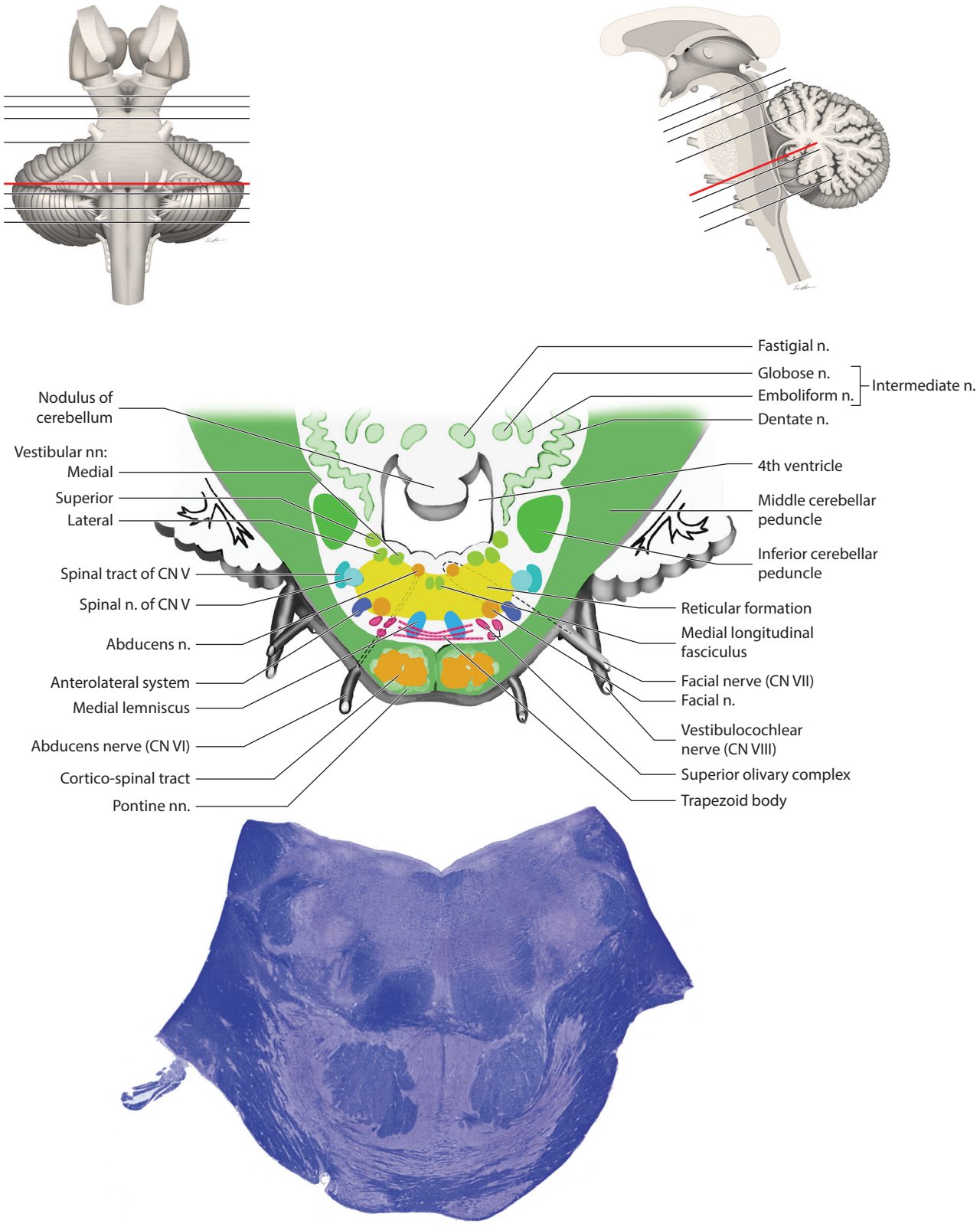


FIGURE A.7: Lowermost Pons: Cross-Section (schematic and histology)

FIGURE A.8—UPPER MEDULLA: CROSS-SECTION (SCHEMATIC AND HISTOLOGY)

This section has the characteristic features of the medullary region, namely, the pyramids anteriorly with the inferior olivary nucleus situated just laterally and behind.

The cortico-spinal voluntary motor fibers from areas 4 and 6 go through the white matter of the hemispheres, funnel via the internal capsule (posterior limb), continue through the cerebral peduncles of the midbrain and the pontine region, and emerge as a distinct bundle in the medulla within the pyramids. The cortico-spinal tract is in fact often called the pyramidal tract because its fibers form the pyramids (discussed with Figure 5.9).

The medial lemniscus is the most prominent ascending (sensory) tract throughout the medulla, and it carries the modalities of discriminative touch, joint position, and vibration (see Figure 5.2 and Figure 6.11). The tracts are located next to the midline, oriented in the antero-posterior (ventrodorsal) direction (see Figure 6.11), just behind the pyramids; they change orientation and shift more laterally in the pons. Dorsal to them, also along the midline, are the paired tracts of the medial longitudinal fasciculus (MLF), situated in front of the 4th ventricle. The anterolateral tract, conveying pain and temperature, lies dorsal to the olive, although it is not of sufficient size to be clearly identified (see Figure 5.3 and Figure 6.11). Both the medial lemniscus and the anterolateral system are carrying fibers from the opposite side of the body at this level. The descending nucleus and tract of CN V are present more laterally, carrying fibers (pain and temperature) from the ipsilateral face and oral structures, before decussating (see Figure 5.4 and Figure 6.11).

The other prominent tract in the upper medullary region is the inferior cerebellar peduncle. This tract is conveying fibers to the cerebellum, both from the spinal cord and from the medulla, including the inferior olivary nucleus (discussed with Figure 5.15).

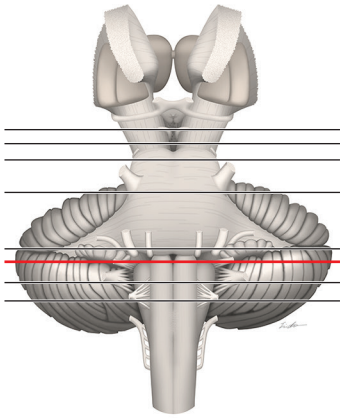
Cranial nerve VIII enters the medulla at its uppermost level, at the cerebello-pontine angle, and passes over the inferior cerebellar peduncle. The nerve has two nuclei along its course, the ventral and dorsal cochlear nuclei (see Figure 3.4). The auditory fibers synapse in these nuclei and then go on to the superior olivary complex in the lower pons region. The crossing fibers are seen in the lowermost pontine region as the trapezoid body (see Figure 6.1 and Figure 6.11).

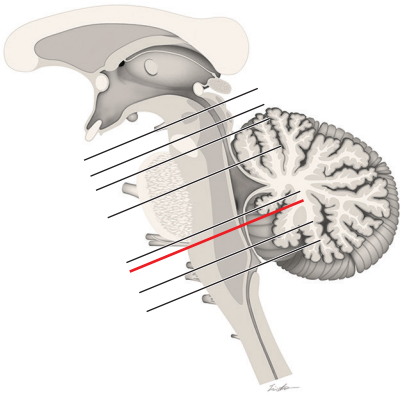
The vestibular part of CN VIII is represented at this level by two nuclei, the medial and inferior vestibular nuclei (see Figure 6.8). Both these nuclei lie in the same position as the vestibular nuclei in the pontine section, adjacent to the lateral edge of the 4th ventricle. The inferior vestibular nucleus is rather distinct because of the many axon bundles that course through it. The vestibular nuclei contribute fibers to the MLF (discussed with Figure 6.9).

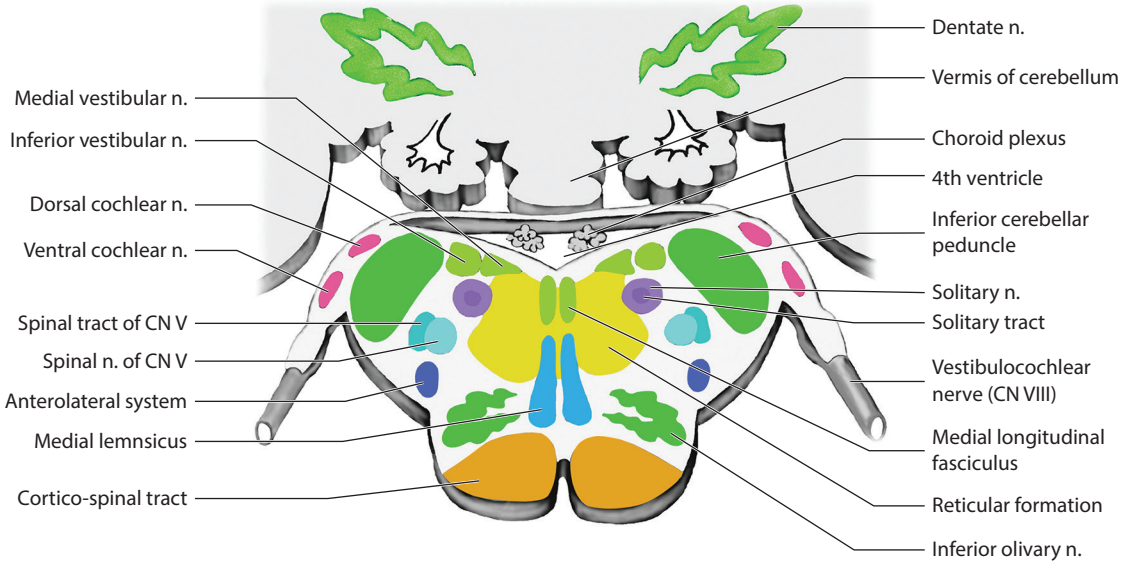
The solitary nucleus is found at this level, surrounding a tract of the same name. This nucleus is the synaptic station for incoming taste fibers (mainly with CN VII, but also with CN IX), and for visceral afferents entering with CN IX and CN X from the gastrointestinal tract and other viscera. The solitary nucleus and tract are situated just beside (anterior to) the vestibular nuclei.

The core area is occupied by the cells of the reticular formation (see Figure 3.6A and Figure 3.6B). The most prominent of its nuclei at this level is the gigantocellular nucleus (noted for its large neurons), which gives rise to the lateral reticulo-spinal tract (see Figure 5.12B). The other functional aspects of the reticular formation should be reviewed at this point, including the descending pain system from the nucleus raphe magnus (discussed with Figure 5.6).

The 4th ventricle is still quite large at this level. The lower portion of its roof has choroid plexus (see Figure 7.8); a fragment of this is present with the histological section, although the roof is torn. Behind the ventricle is the cerebellum, with the vermis (midline) portion and the cerebellar hemispheres. The dentate nucleus, the largest of the intracerebellar nuclei, is present at this level (see Figure 3.8). Again, the cerebellum has not been processed with the histological specimen.







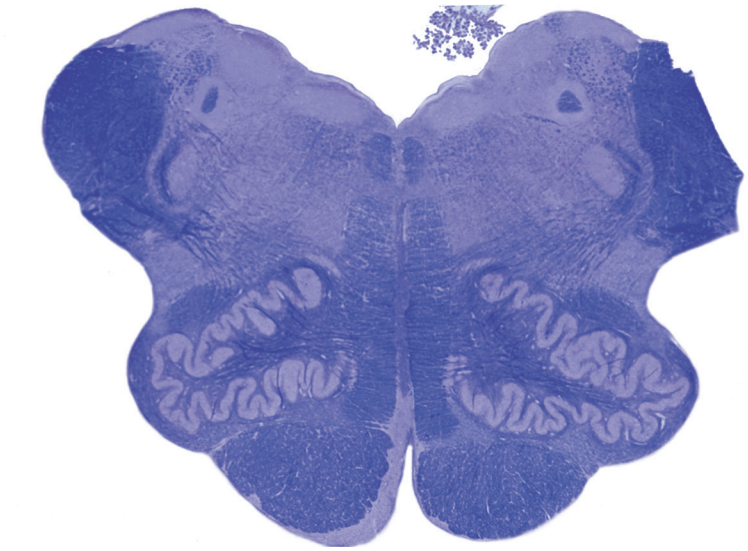


FIGURE A.8: Upper Medulla: Cross-Section (schematic and histology)

FIGURE A.9—MID-MEDULLA: CROSS-SECTION (SCHEMATIC AND HISTOLOGY)

This is a classic level for descriptive purposes. The pyramids and inferior olive are easily recognized anteriorly.

The medial lemniscus occupies the area between the olives, on either side of the midline (see Figure 6.11). The medial longitudinal fasciculus (MLF) lies behind (dorsal) to the medial lemniscus, also situated adjacent to the midline. The fibers of the anterolateral system are situated dorsal to the olive. The descending nucleus and tract of the trigeminal system have the same location as seen previously in the lateral aspect of the tegmentum.

The hypoglossal nucleus (CN XII) is found near the midline and in front of the ventricle; its fibers exit anteriorly, between the pyramid and the olive (see Figure 1.8 and Figure 3.1). CN IX and CN X are attached at the lateral aspect of the medulla (see Figure 1.8 and Figure 3.1). Their efferent fibers are derived from two nuclei (indicated by the dashed lines): the dorsal motor nucleus of the vagus (CN X), which is parasympathetic, and the nucleus ambiguus, which is motor to the muscles of the pharynx and larynx (see Figure 3.5). The dorsal motor nucleus lies adjacent to the 4th ventricle just lateral to the nucleus of CN XII. The nucleus ambiguus lies dorsal to the olivary nucleus; in a single cross-section only a few cells of this nucleus are usually seen, thus making its identification difficult (i.e., "ambiguous") in actual sections. The taste and visceral afferents that are carried in these nerves synapse in the solitary nucleus, which is located in the posterior aspect of the tegmentum, surrounded by the tract of the same name.

The reticular formation occupies the central core of the tegmentum; the nucleus gigantocellularis is located in this part of the reticular formation (see Figure 3.6B). These cells give rise to a descending tract, the lateral reticulospinal tract, as part of the indirect voluntary motor system (see Figure 5.12B); there is also a strong influence on the excitability of the lower motor neuron, influencing the stretch reflex and muscle tone.

The inferior cerebellar peduncle is found at the lateral edge of this section, posteriorly, and it carries fibers to the cerebellum (see Figure 5.15). The 4th ventricle is still a rather large space, behind the tegmentum, with the choroid plexus attached to its roof in this area; often the ventricle appears "open," likely because this thin tissue has been torn. The other possibility is that there is no cerebellar tissue posteriorly because the section is below the level of the cerebellum (see the sagittal schematic accompanying this figure).

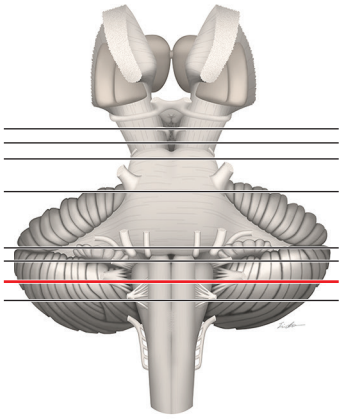
CLINICAL ASPECT

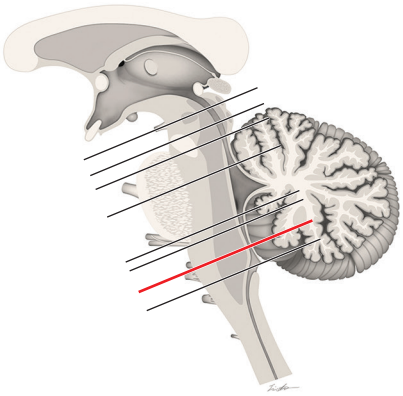
Vascular lesions in this area of the brainstem are not uncommon. The midline area is supplied by the paramedian branches from the vertebral artery (see Figure 8.1). The structures included in this territory are the corticospinal fibers, the medial lemniscus, and the hypoglossal nucleus.

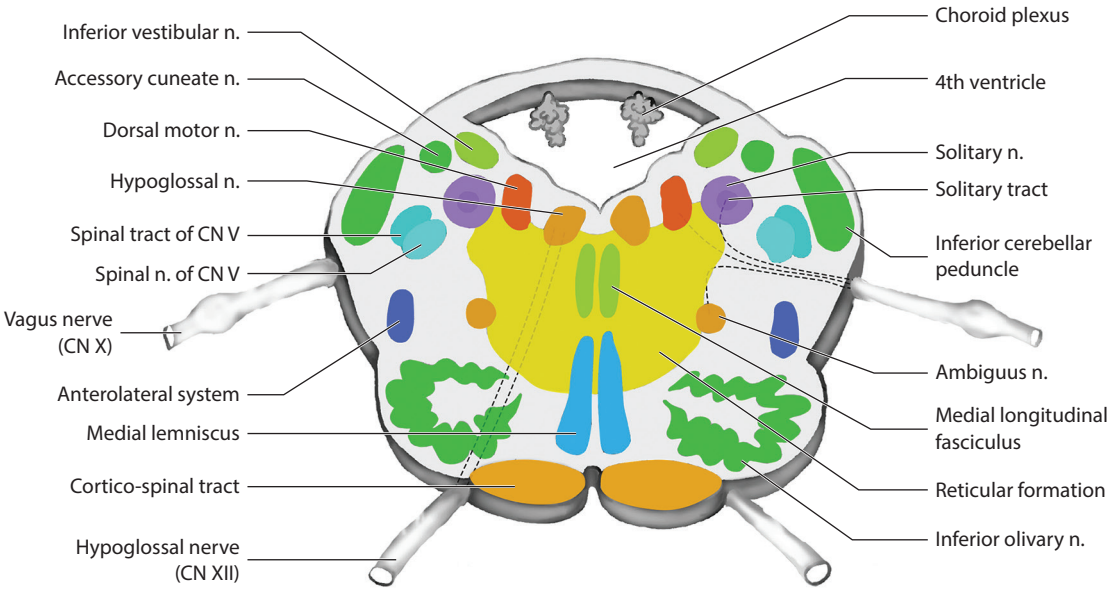
The lateral portion is supplied by the posterior inferior cerebellar artery, a branch of the vertebral artery (see Figures 8.1, Figure 8.2, and Figure 8.5), called by its abbreviation **PICA** by neuroradiologists. This artery is apparently quite prone to infarction, for some unknown reason (perhaps its tortuosity). Included in its territory are the cranial nerve nuclei and fibers of CN IX and CN X, the descending trigeminal nucleus and tract, fibers of the anterolateral system, and the solitary nucleus and tract, as well as descending autonomic fibers. The inferior cerebellar peduncle or vestibular nuclei, or both, may also be involved. The whole clinical picture is called the **lateral medullary syndrome** (of Wallenberg; also discussed with Figure 6.11).

Interruption of the descending autonomic fibers gives rise to a clinical condition called **Horner's syndrome**. In this syndrome (also discussed with Figure 6.7), there is loss of the autonomic sympathetic supply to one side of the face, ipsilaterally. This leads to drooping of the upper eyelid (ptosis), dry skin, and constriction of the pupil. The pupillary change results from the competing influences of the parasympathetic fibers, which are still intact. Other lesions elsewhere that interrupt the sympathetic fibers in their long course can also give rise to Horner's syndrome.

Note to the Learner: It is instructive for a student to work out the clinical symptoms of both these vascular lesions and to indicate which function is lost with each of the tracts or nucleus involved in the lesion, and which side of the body would be affected. A clinical problem with these syndromes will be included with the Clinical Cases.







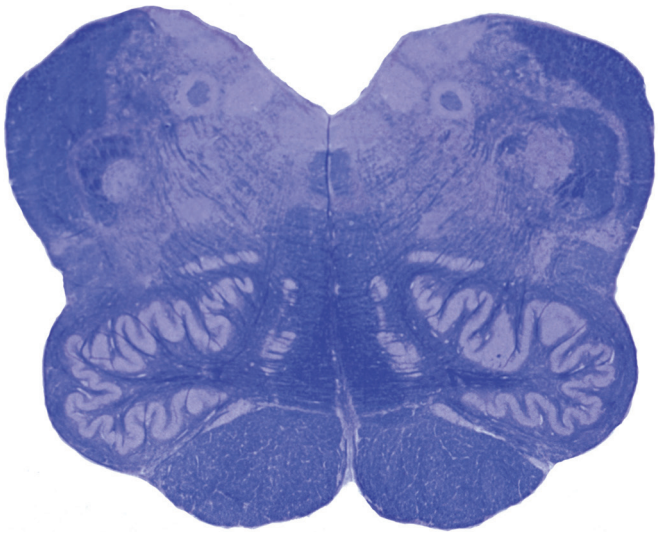


FIGURE A.9: Mid-Medulla: Cross-Section (schematic and histology)

FIGURE A.10—LOWER MEDULLA: CROSS-SECTION (SCHEMATIC AND HISTOLOGY)

The medulla seems significantly smaller at this level, approaching the size of the spinal cord below. The section is still easily recognized as medullary because of the presence of the pyramids anteriorly (the cortico-spinal tract) and the adjacent inferior olivary nucleus.

The tegmentum contains the cranial nerve nuclei, the reticular formation, and the other tracts. The nuclei of cranial nerve (CN) X and CN XII, as well as the descending nucleus and tract of CN V, are present as before (as in the mid-medullary section; see Appendix Figure A.9). The medial longitudinal fasciculus (MLF) and anterolateral fibers are also in the same position. The solitary tract and nucleus are still found in the same location. The internal arcuate fibers are present at this level; these are the fibers from the nuclei gracilis and cuneatus that cross (decussate) to form the medial lemniscus (see later). These fibers usually obscure visualization of the nucleus ambiguus. Finally, the reticular formation is still present.

The dorsal aspect of the medullary tegmentum is occupied by two large nuclei—the nucleus cuneatus (cuneate nucleus) laterally and the nucleus gracilis (gracile nucleus) more medially. These nuclei are found on the dorsal aspect of the medulla (see Figure 1.9 and Figure 6.11). These nuclei are the synaptic stations of the tracts of the same name that have ascended the spinal cord in the dorsal column (see Figure 5.2, Figure 6.10, and Appendix Figure A.11). The gracilis is mainly for the lower limb and lower body; the cuneatus carries information from the upper body and upper limb. The fibers relay in these nuclei and then move through the medulla anteriorly as the internal arcuate fibers, cross (decussate), and form the medial lemniscus on the opposite side (see Figure 6.11). At this level, the medial lemniscus is situated between the olivary nuclei and dorsal to the pyramids and is oriented anteroposteriorly.

Posteriorly, the 4th ventricle is tapering down in size, giving a "V-shaped" appearance to the dorsal aspect of the medulla (see Figure 3.1 and Figure 3.3). It is usual for the ventricle roof to be absent at this level. This is likely accounted for by the presence of the foramen of Magendie, through which the cerebrospinal fluid escapes from the ventricular system into the subarachnoid space (see the sagittal schematic accompanying this figure; also see Figure 3.2 and Figure 7.8). Posterior to this area is the cerebello-medullary cistern, otherwise known as the cisterna magna (see the T1 magnetic resonance scan in Figure 3.2, and also Figure 7.8).

One special nucleus is found in the "floor" of the ventricle at this level (see Figure 3.3 but not indicated in the illustration), the **area postrema**. This forms a little bulge that can be appreciated on some sections. The nucleus is part of the system that controls vomiting, and it is often referred to as the vomiting "center." This region lacks a blood-brain barrier, thus allowing this particular nucleus to be "exposed" directly to whatever is circulating in the bloodstream. It likely connects with the nuclei of the vagus nerve that are involved in the act of vomiting.

ADDITIONAL DETAIL

The accessory cuneate nucleus is found at this level, as well as at the mid-medullary level. This nucleus is a relay for some of the cerebellar afferents from the upper extremity (see Figure 5.15 and Figure 6.10). The fibers then go to the cerebellum via the inferior cerebellar peduncle. The inferior cerebellar peduncle has not yet been formed at this level.

Cross-sections through the lowermost part of the medulla may include the decussating cortico-spinal fibers (i.e., the pyramidal decussation; see Figure 6.11); this would therefore alter significantly the appearance of the structures in the actual section.

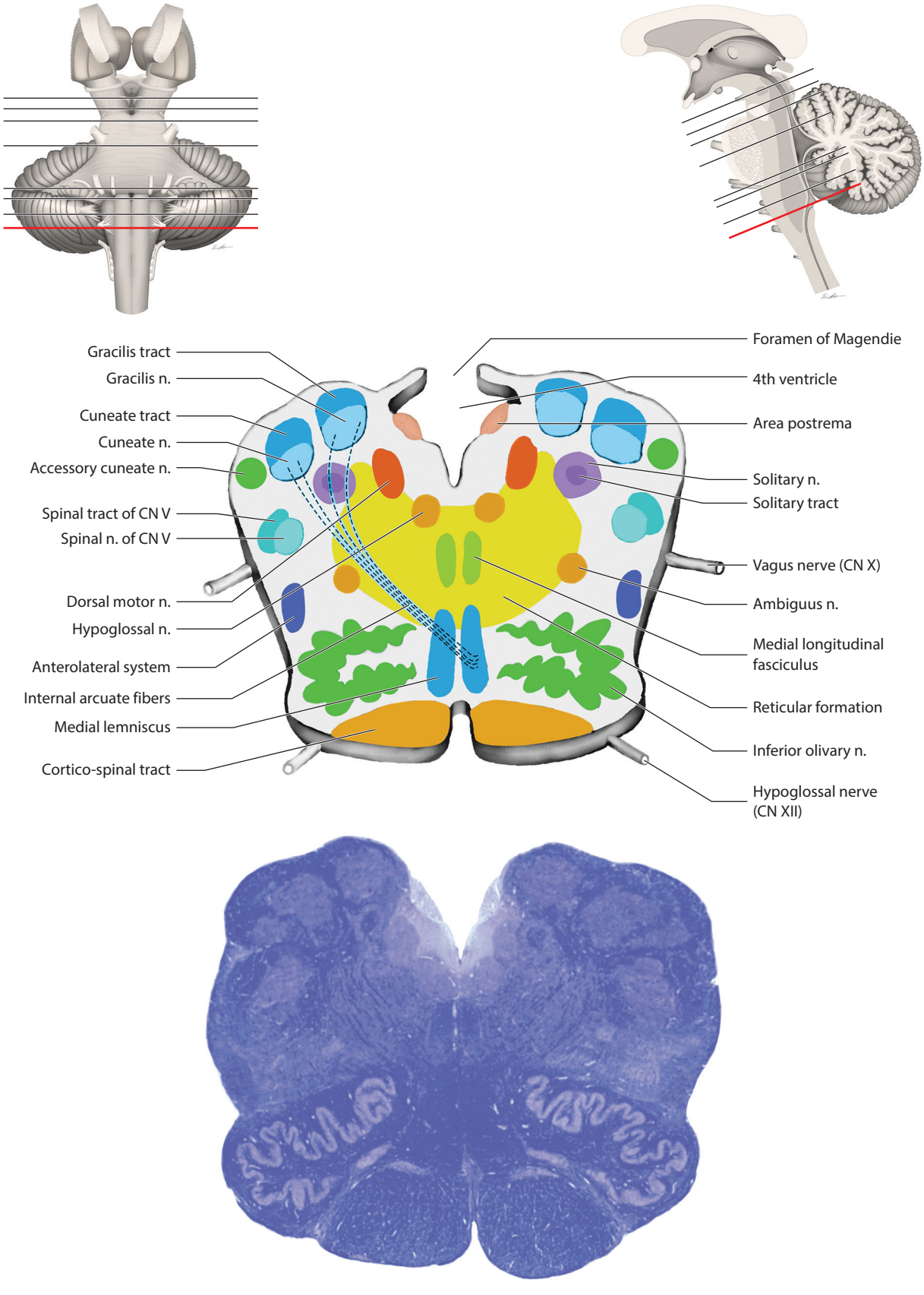


FIGURE A.10: Lower Medulla: Cross-Section (schematic and histology)