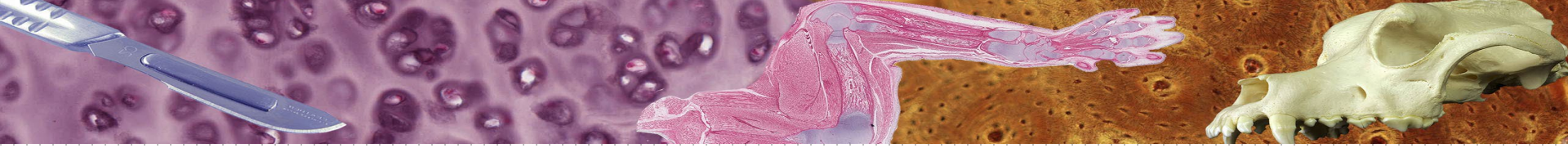
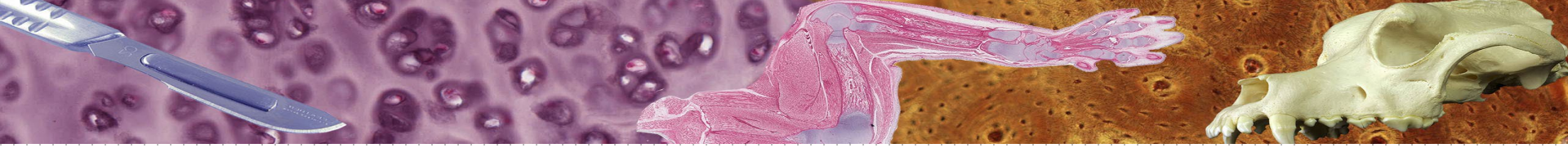


Animal Anatomy II

The Respiratory System



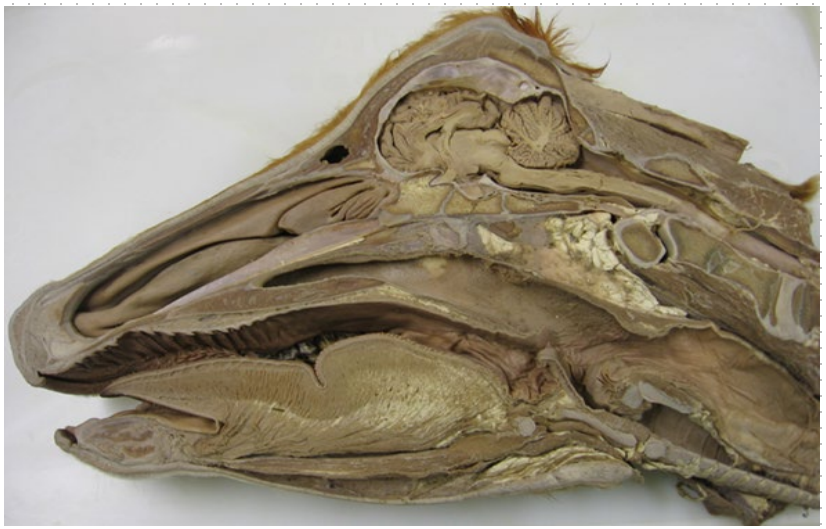
Respiratory System

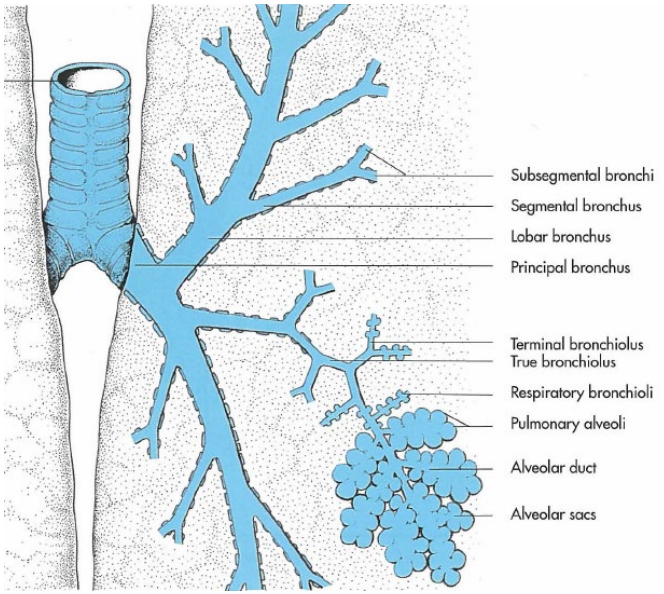
- The respiratory system is the body system that brings oxygen from the air into the body for delivery via the blood to the cells
- Respiration is the exchange of gases (oxygen and carbon dioxide) between the atmosphere and the body cells
- Ventilation means the bringing in of fresh air
  - Ventilation is also known as breathing

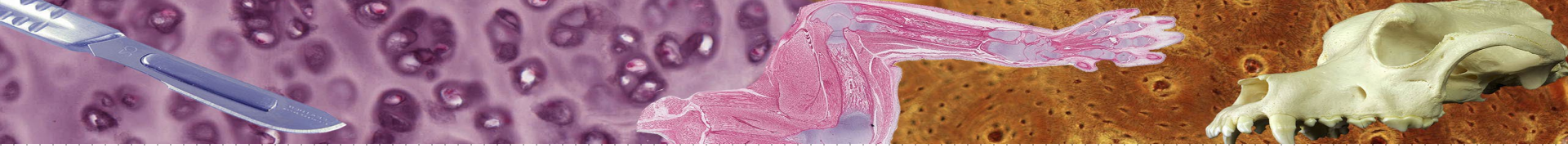
Respiratory System

Has 3 portions:

- **Upper Airways**: external nares, nasal cavity, nasopharynx, oropharynx, laryngopharynx, larynx.
- **Conducting Zone**: trachea, bronchi, bronchioles, terminal bronchioles.
- **Respiratory Zone**: bronchi, bronchioles , alveolar ducts, alveoli.







Respiratory System

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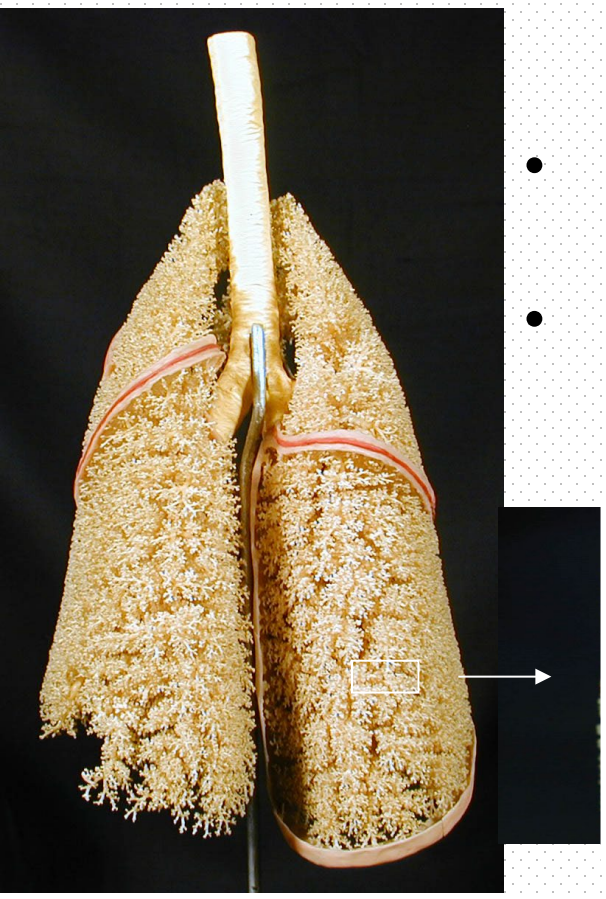
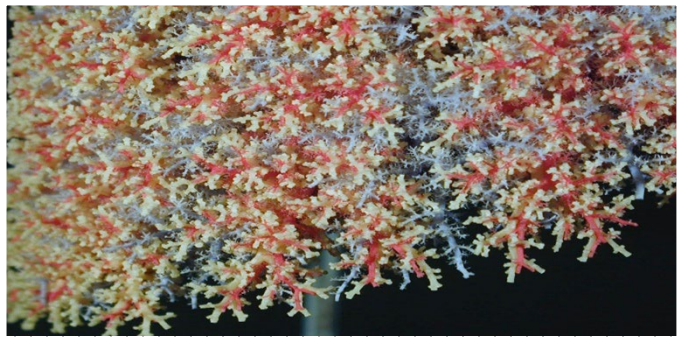
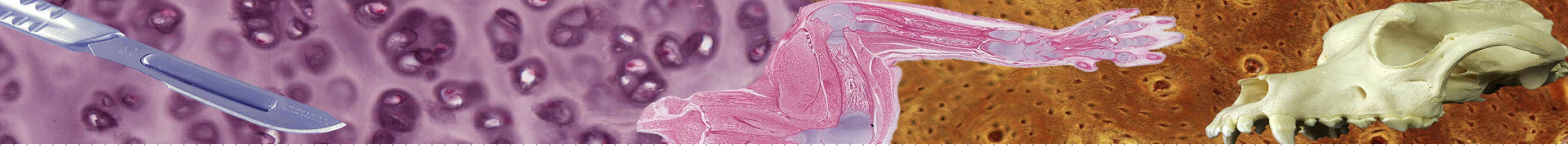
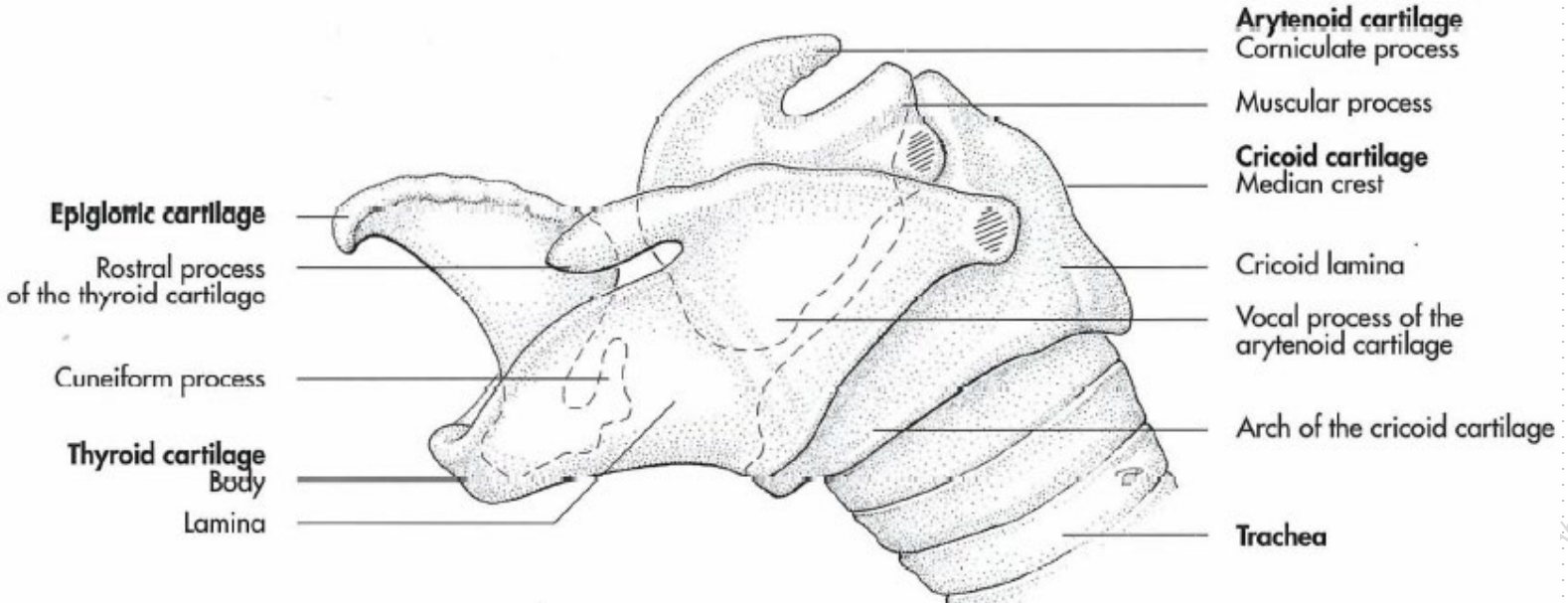






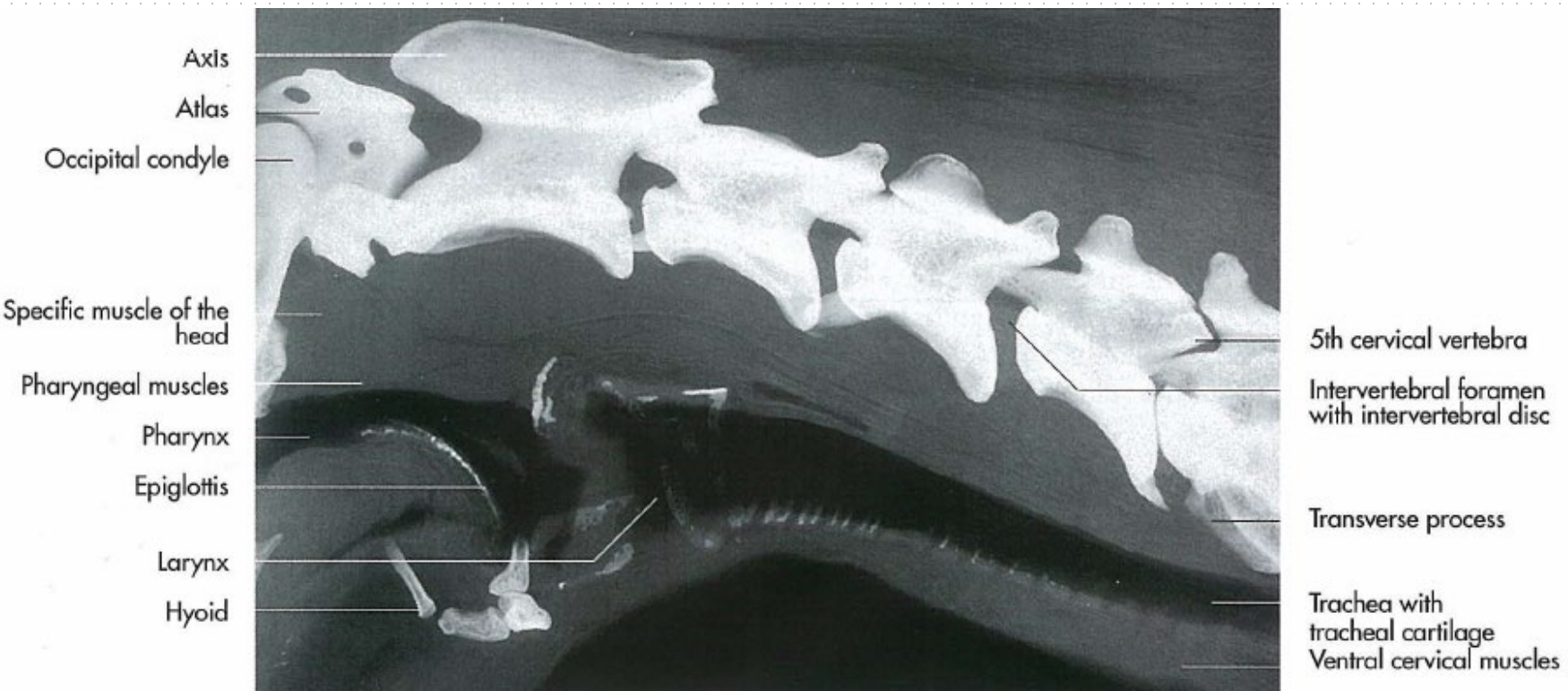
The Larynx

- A cartilaginous structure that surrounds and protects the glottis.
- Composed of four cartilages (thyroid cartilage, cricoid cartilage, arytenoid cartilage and epiglottis).
- The various cartilages are bound together by ligaments.
- Two pairs of folds: **vestibular folds** and **vocal folds** (air passing through the glottis vibrates the vocal folds, producing sound).



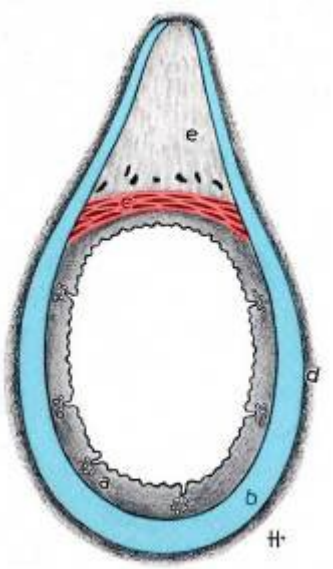
The Trachea

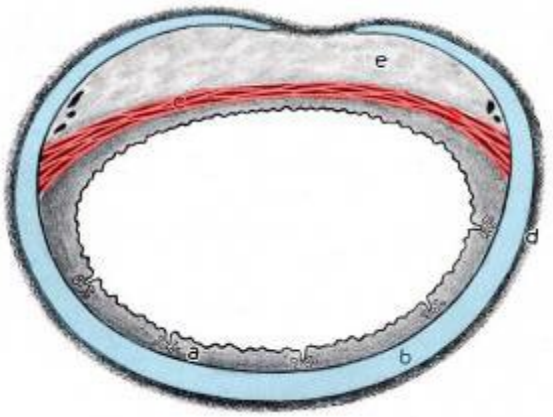
- Extends from the larynx to the primary bronchi.
- Lies ventral to the esophagus.
- Has incomplete C-shaped cartilages (except bird) to make its wall non-collapsible.



Trachea

Ox



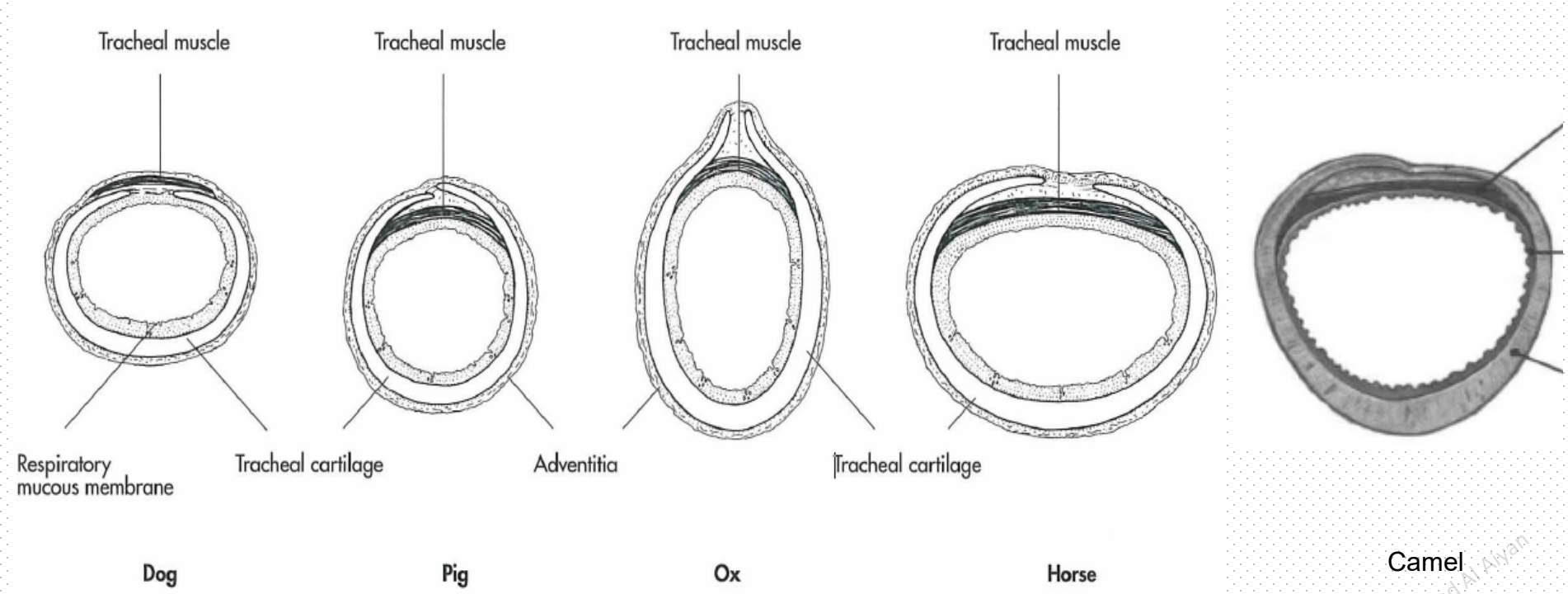


Horse

Note: The configuration of the tracheal rings, the tracheal mucosa and the trachealis muscle.

The Trachea

- The tracheal cartilages are open dorsally and have different shapes in the different domestic species.
- The space left by failure of these cartilages to meet dorsally is bridged by the transverse running tracheal muscle and connective tissue.



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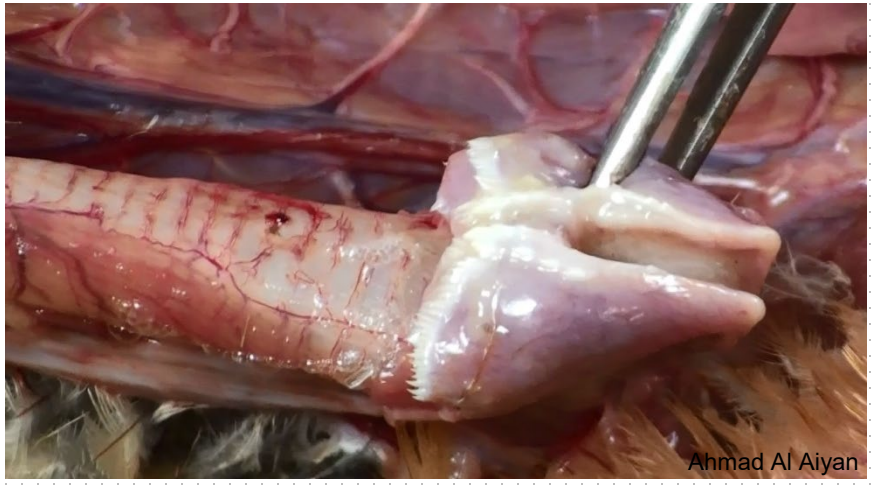
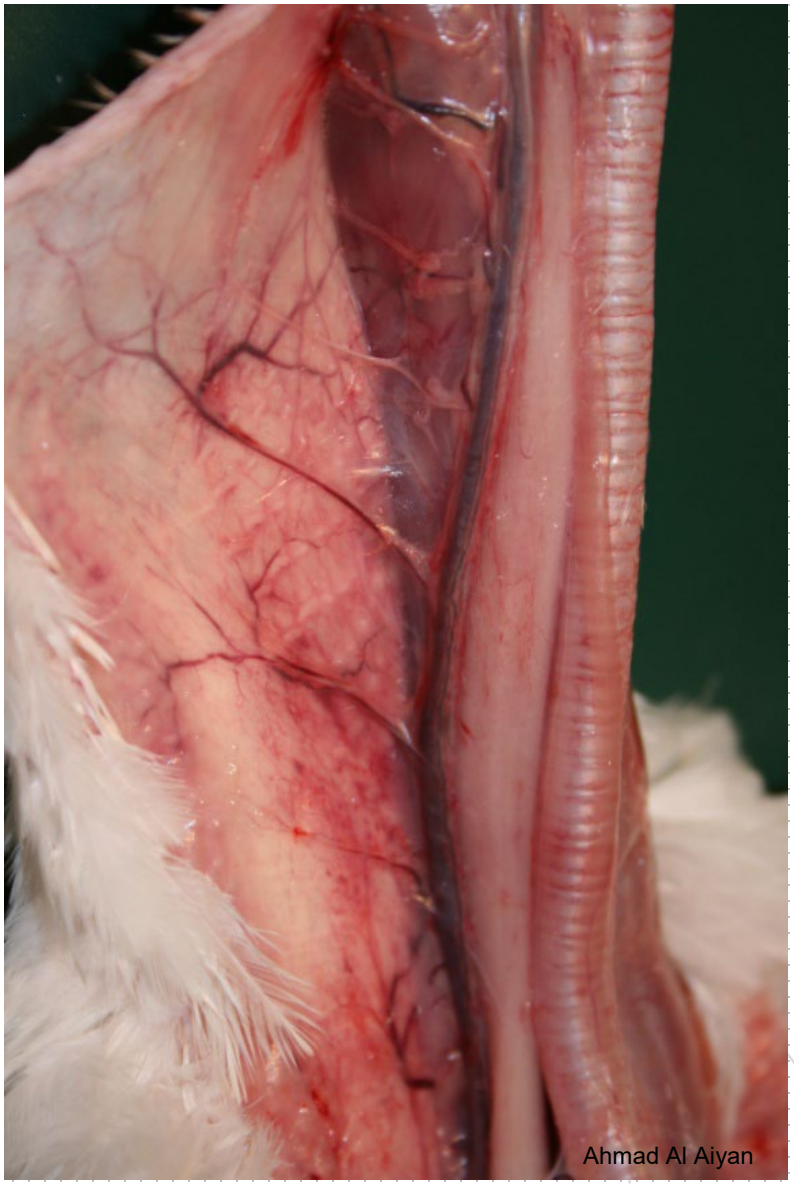
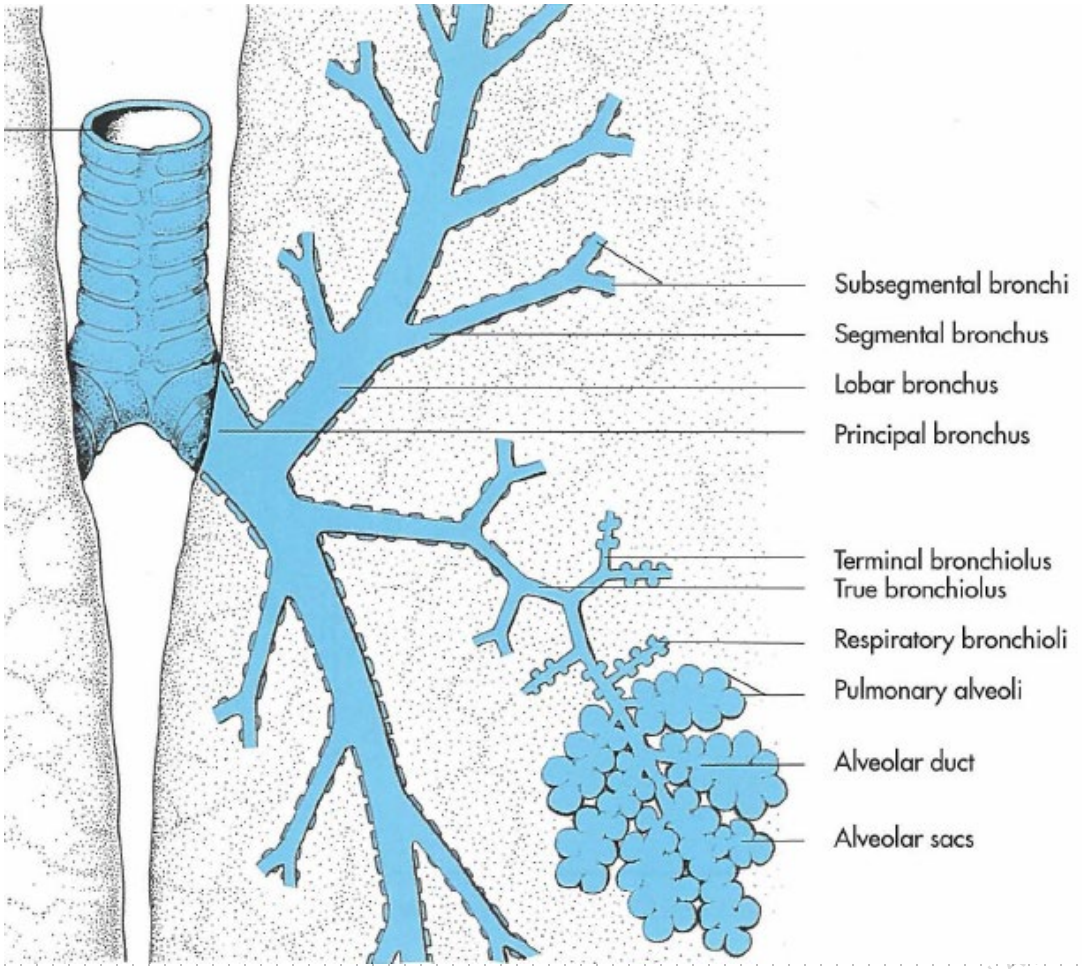


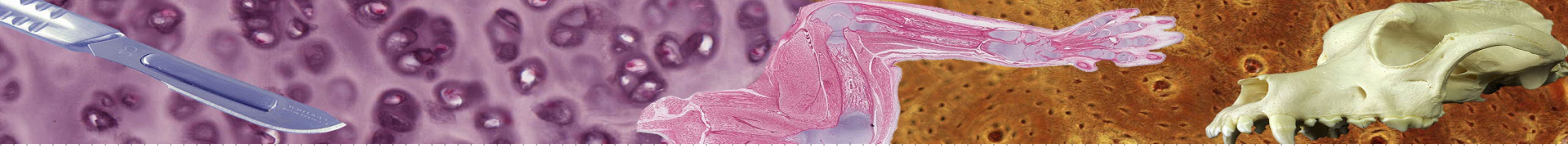


The Bronchial Tree

The lower end of the trachea divides into two primary bronchi.

Primary bronchus ⇨
secondary bronchus ⇨
tertiary bronchus ⇨
terminal bronchioles ⇨
respiratory bronchioles ⇨
alveolar ducts ⇨
alveoli.



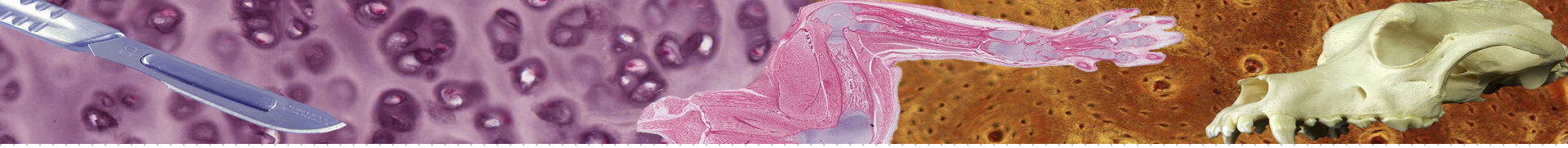


pleura

- A serous membrane lining the contents of the thoracic cavity.
- Consists of a single layer of flat epithelium and underlying propria.
- The thoracic cavity is lined by **parietal pleura.**
- Each lung is covered in **visceral pleura,** arranged as closed pleural sacs.
- The space between the right and left pleural sacs is the mediastinum
- The narrow space between the parietal and visceral pleura is the pleural cavity.

The Lung

- Elastic, air-filled organs with a soft, spongy texture.
- A thin fluid filled cleft is present between the viscera pleura (pleura pulmonalis) and the parietal pleural, which functions to reduce friction during respiration.
- They are fixed in place by their attachment to the trachea, blood vessels, the mediastinum and the pleura.



The Lung

- The **left lung** is divided into two lobes: cranial and caudal lobe.
- The **right lung** is divided into four lobes: cranial, middle, caudal and accessory lobe.

	Left lung	Right lung
Dog and Cat	Cranial lobe divided Caudal lobe	Cranial lobe Middle lobe Caudal lobe Accessory lobe
Pig	Cranial lobe divided Caudal lobe	Cranial lobe Middle lobe Caudal lobe Accessory lobe
Ox, Goat and Sheep	Cranial lobe divided Caudal lobe	Cranial lobe divided Middle lobe Caudal lobe Accessory lobe
Horse	Cranial lobe Caudal lobe	Cranial lobe Caudal lobe Accessory lobe

The Lung

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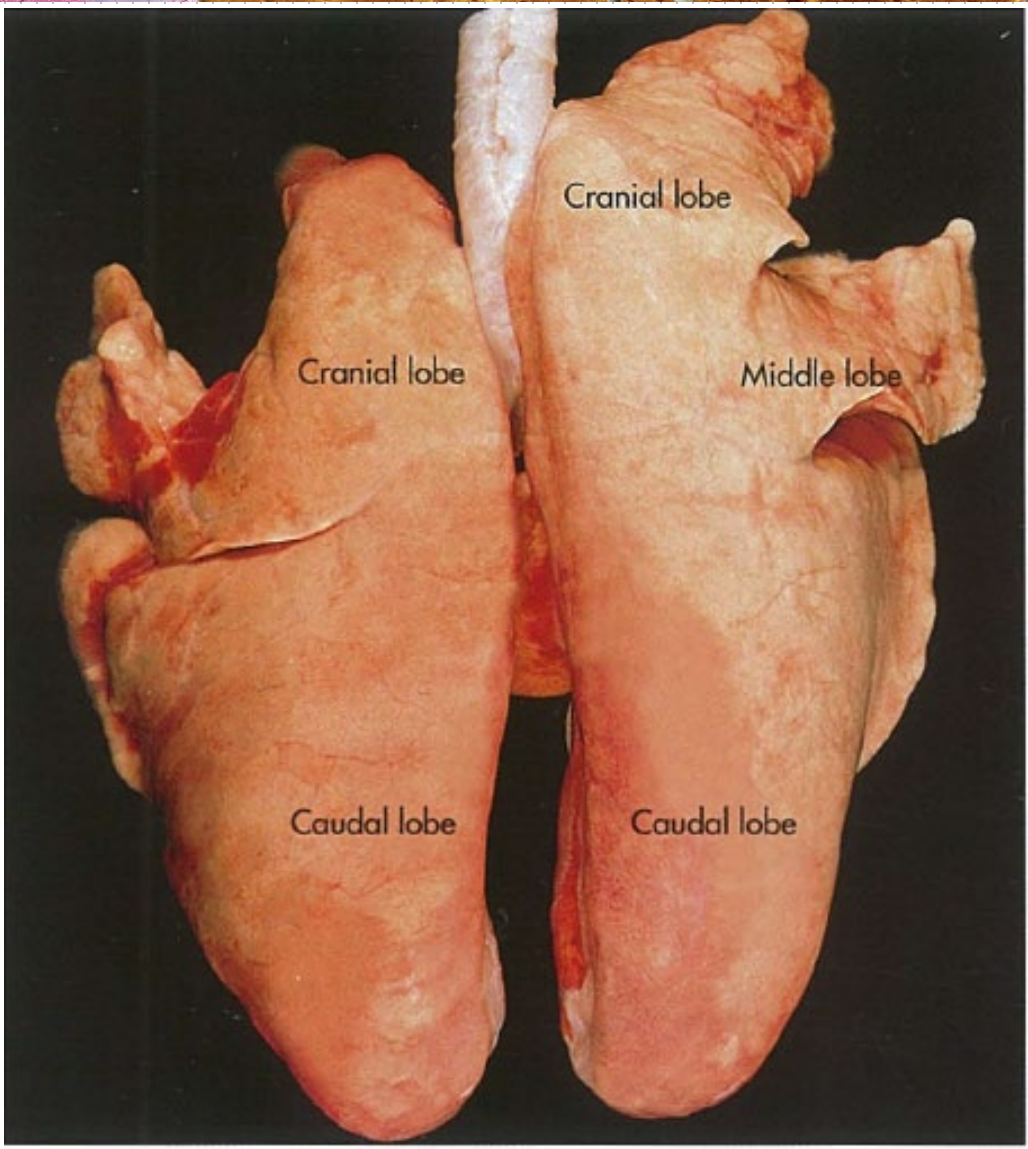
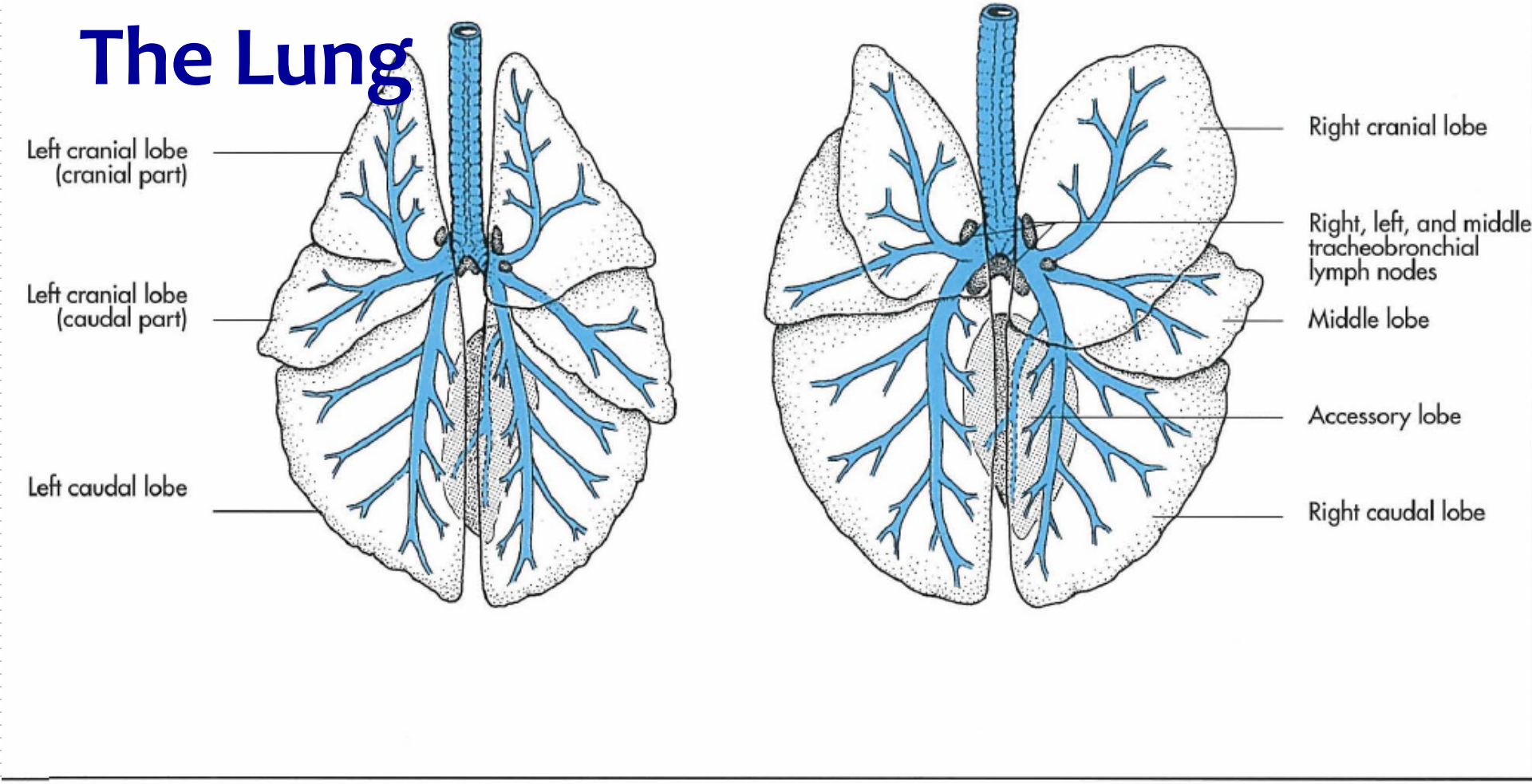


Fig. 8-31. Lungs of a pig, dorsal aspect (courtesy of PD Dr. J. Maierl, Munich).

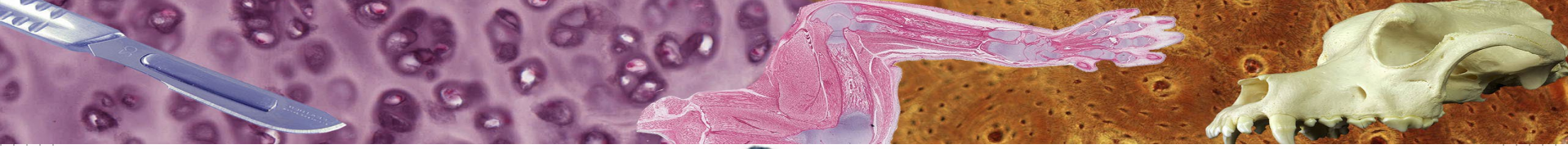
The Lung



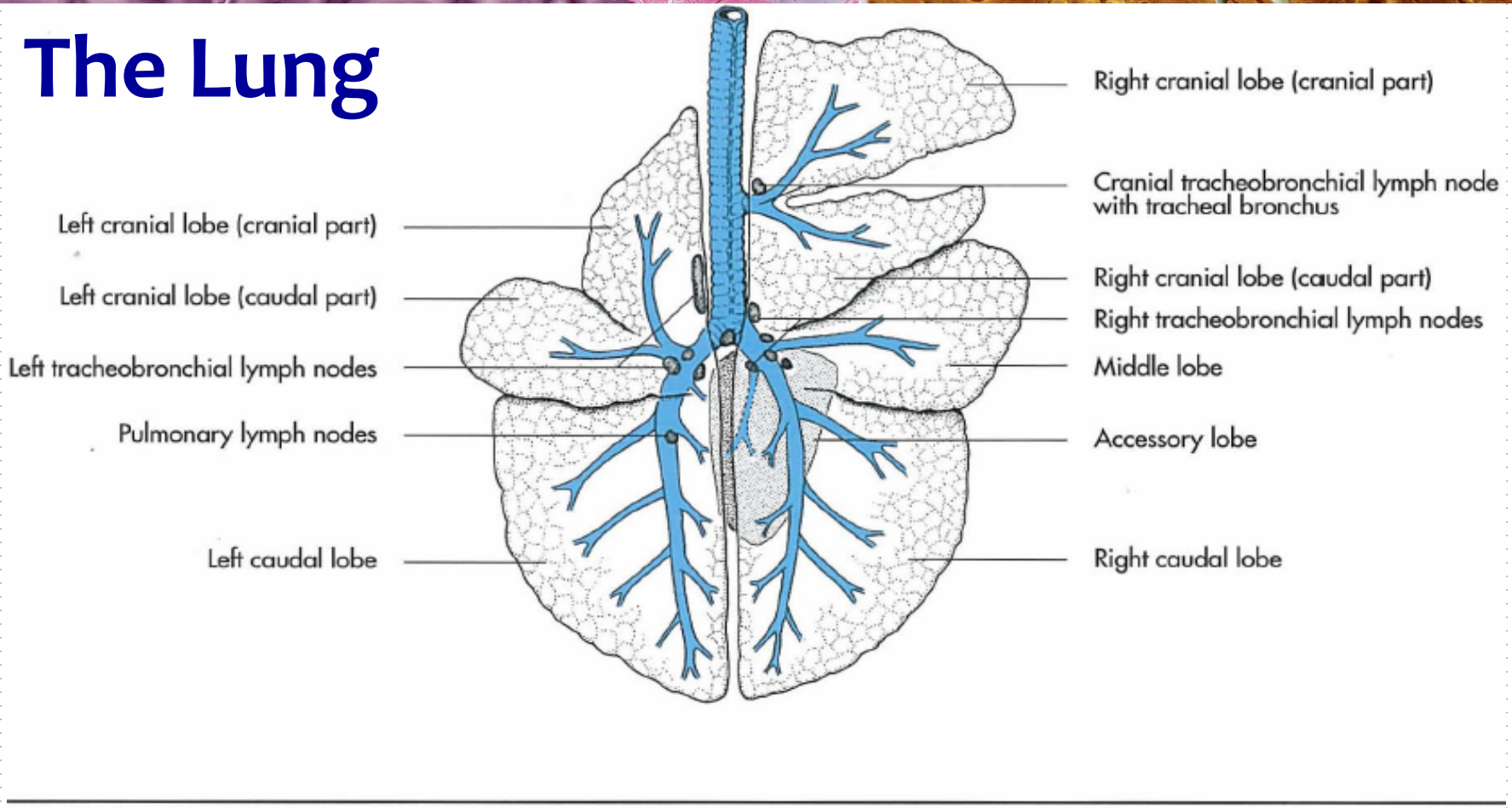
8-26. Lung lobes, bronchial tree and lymphnodes of the cat (left) and the dog (right), dorsal aspect, schematic (Ghetie, 1958).

Canine:

The right lung is larger and is divided into cranial, middle, caudal and accessory lobes. The left lung is divided into a cranial and caudal lobe.



The Lung



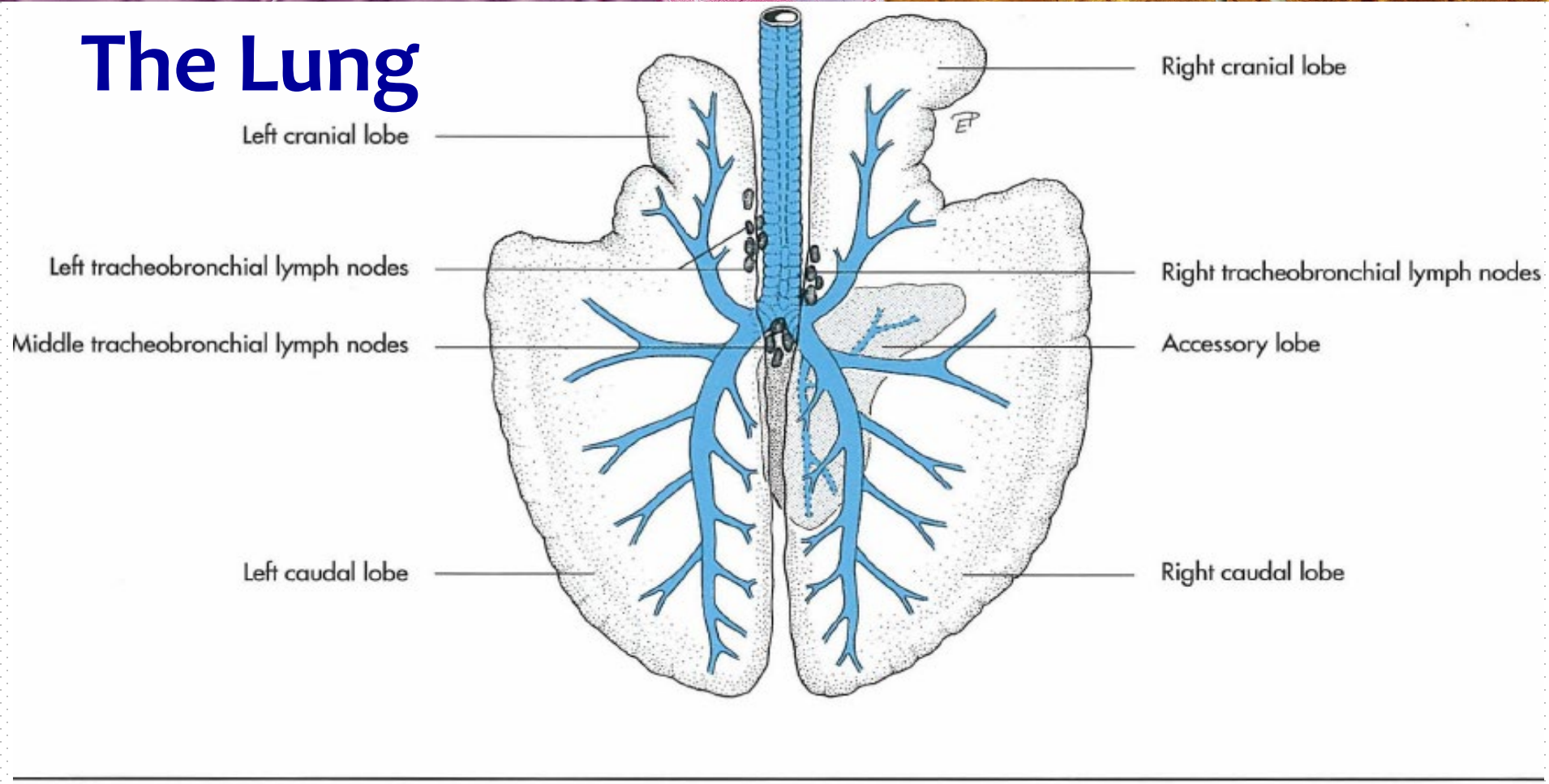
. Lung lobes, bronchial tree and lymphnodes of the ox, dorsal aspect, schematic (Ghetie, 1958).

Bovine:

The right lung is significantly larger than the left.

The left lung is divided into a cranial and caudal lobe, with the cranial further divided into two parts. The right lung is divided into cranial, middle, caudal and accessory lobes

The Lung



8-29. Lung lobes, bronchial tree and lymphnodes of the horse, dorsal aspect, schematic (Ghetie, 1958).

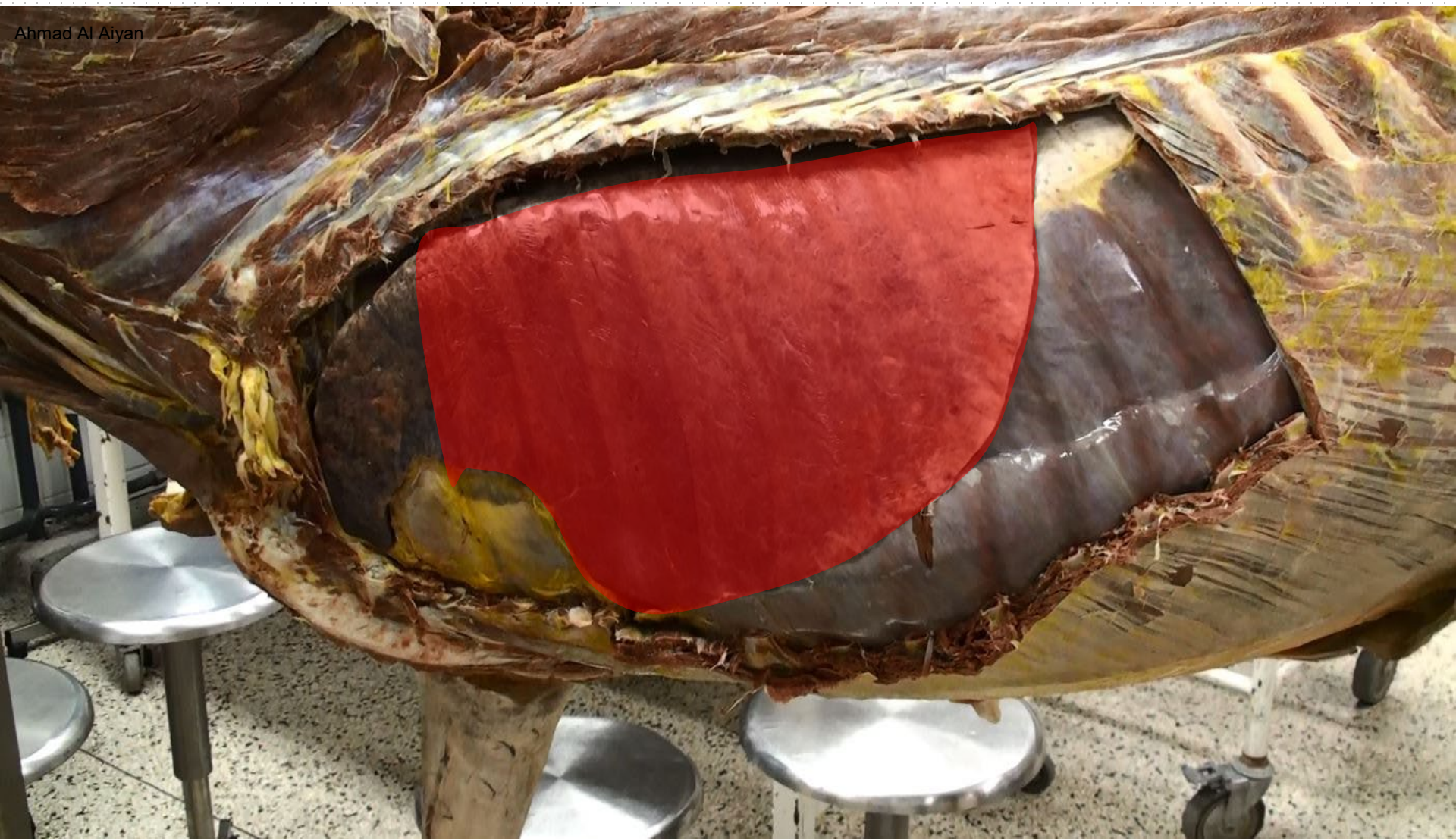
Equine:

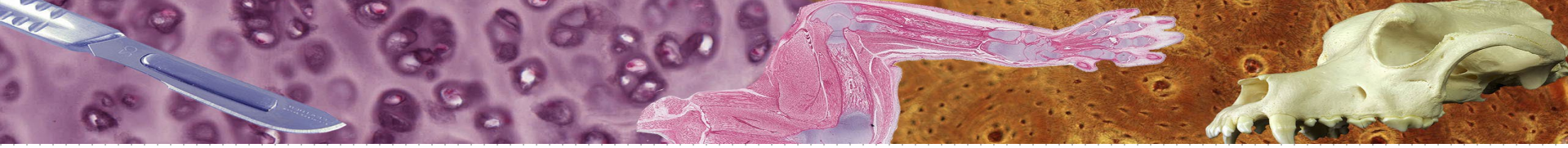
The lungs are more equal in size.

There is no external lobation other than the accessory lobe of the right lung.

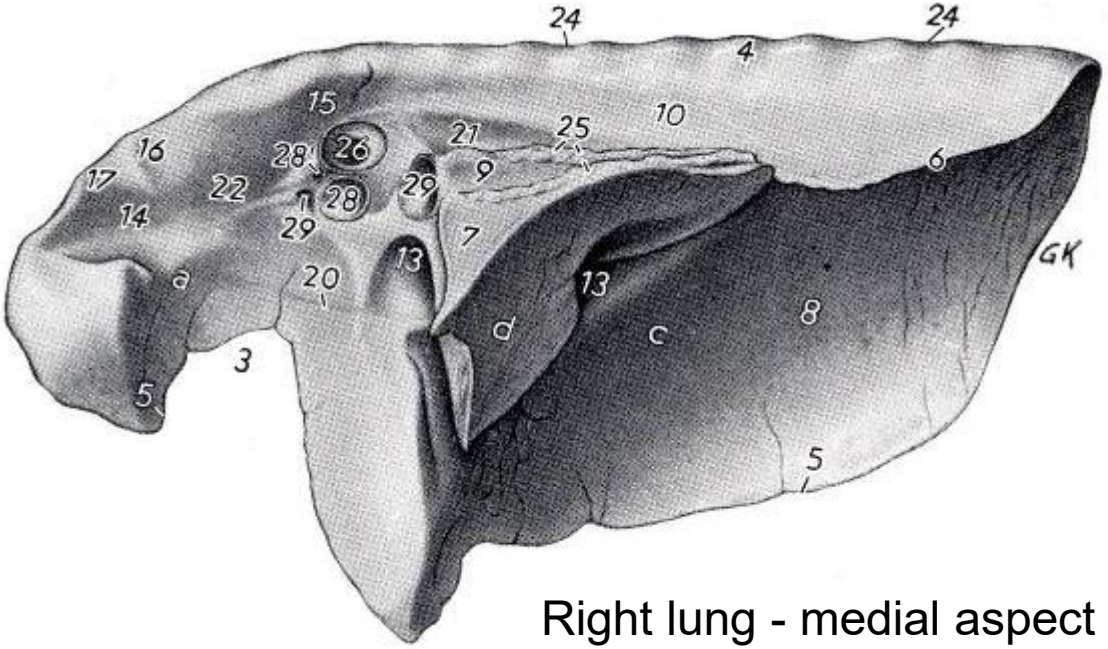
Lung, horse

Lung, horse

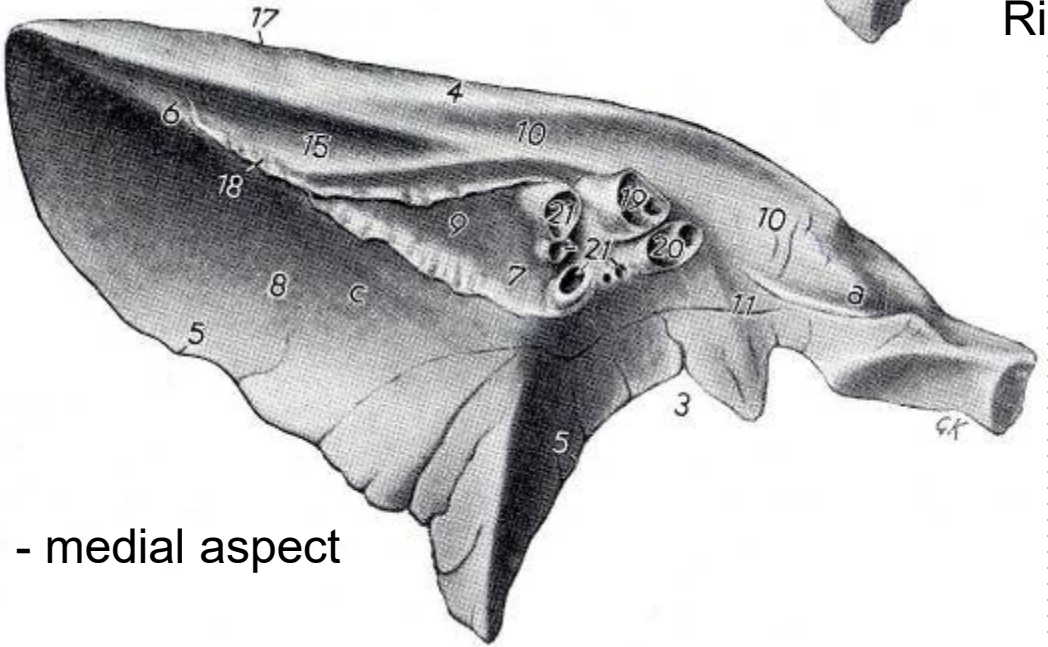




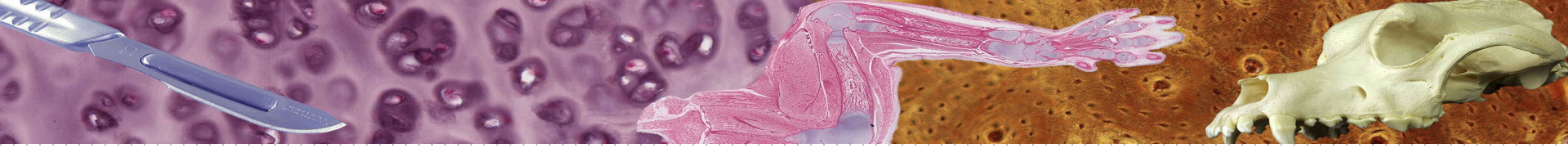
Lungs of the Horse



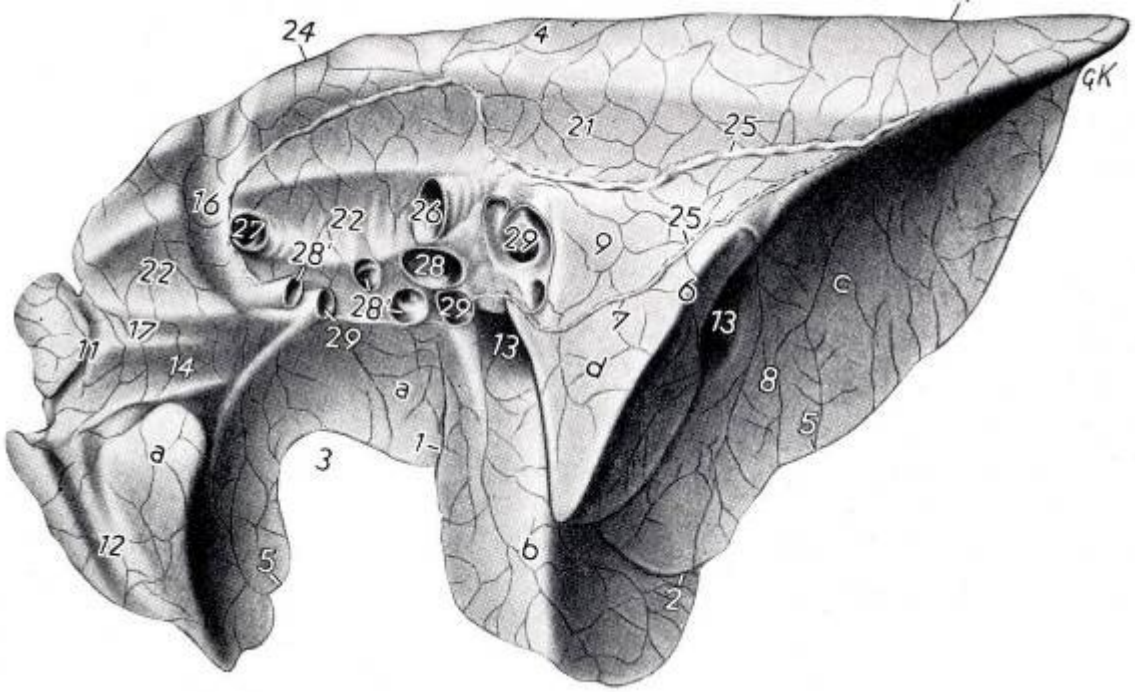
Right lung - medial aspect



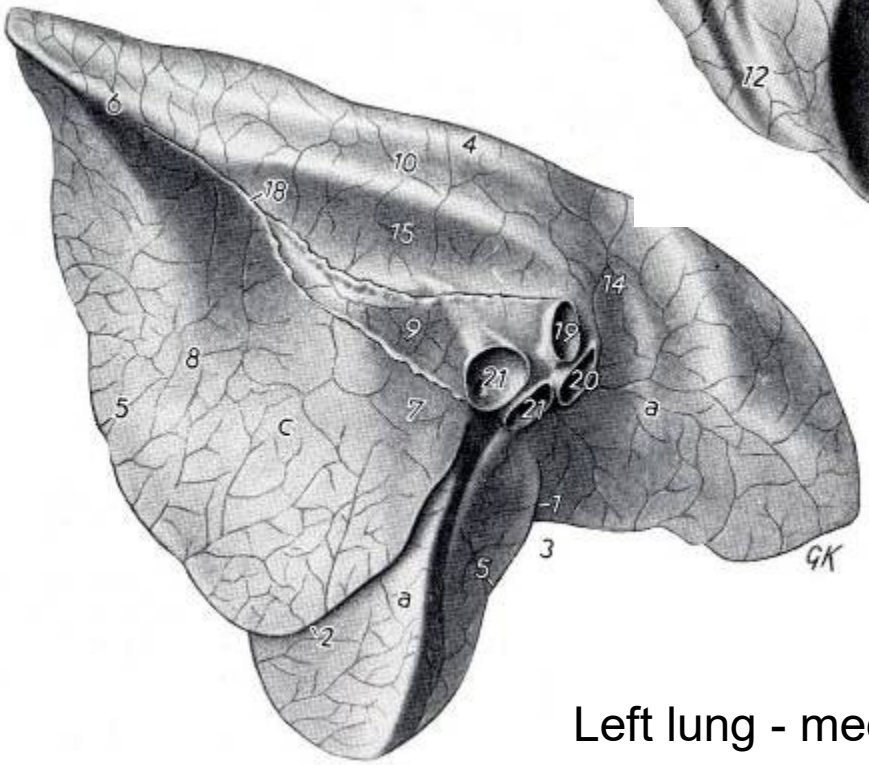
Left lung - medial aspect



Lungs of the Ox



Right lung - medial aspect



Left lung - medial aspect

The Lung

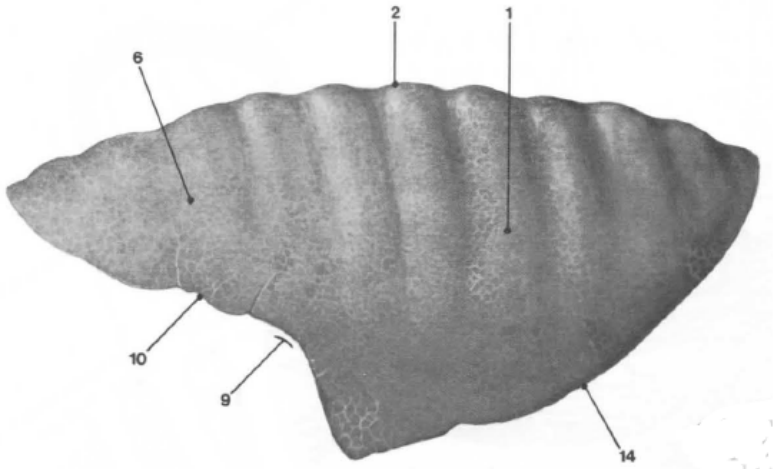


Fig. 4.38. Left lung, fixed *in situ*. Costal surface

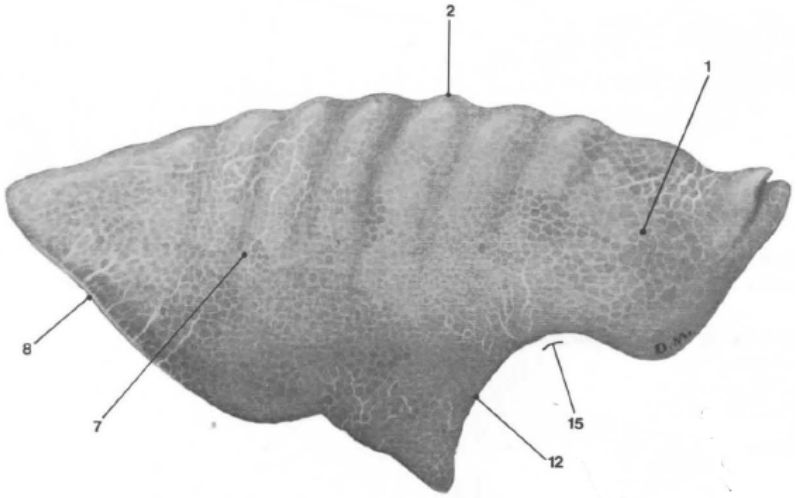


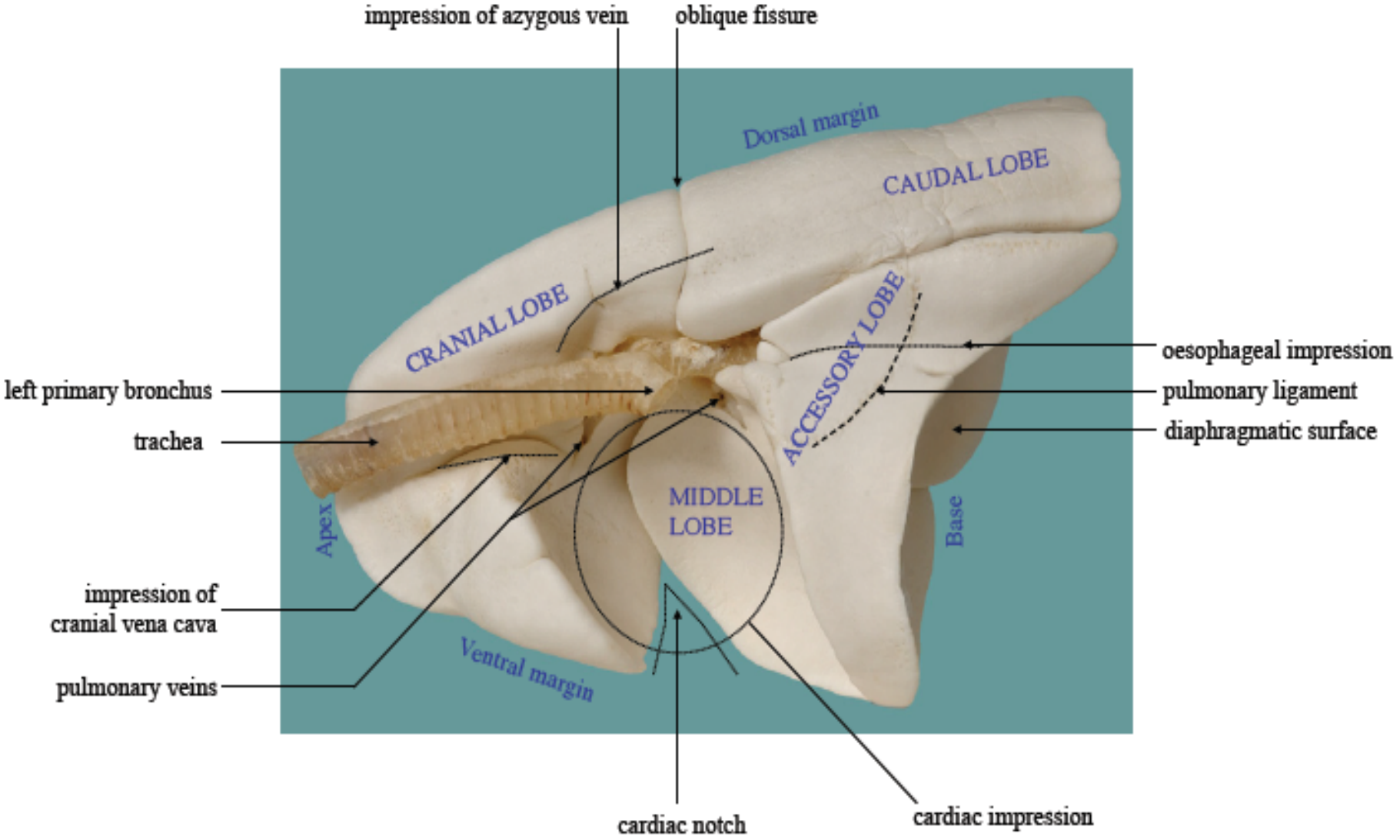
Fig. 4.40. Right lung, fixed *in situ*. Costal surface

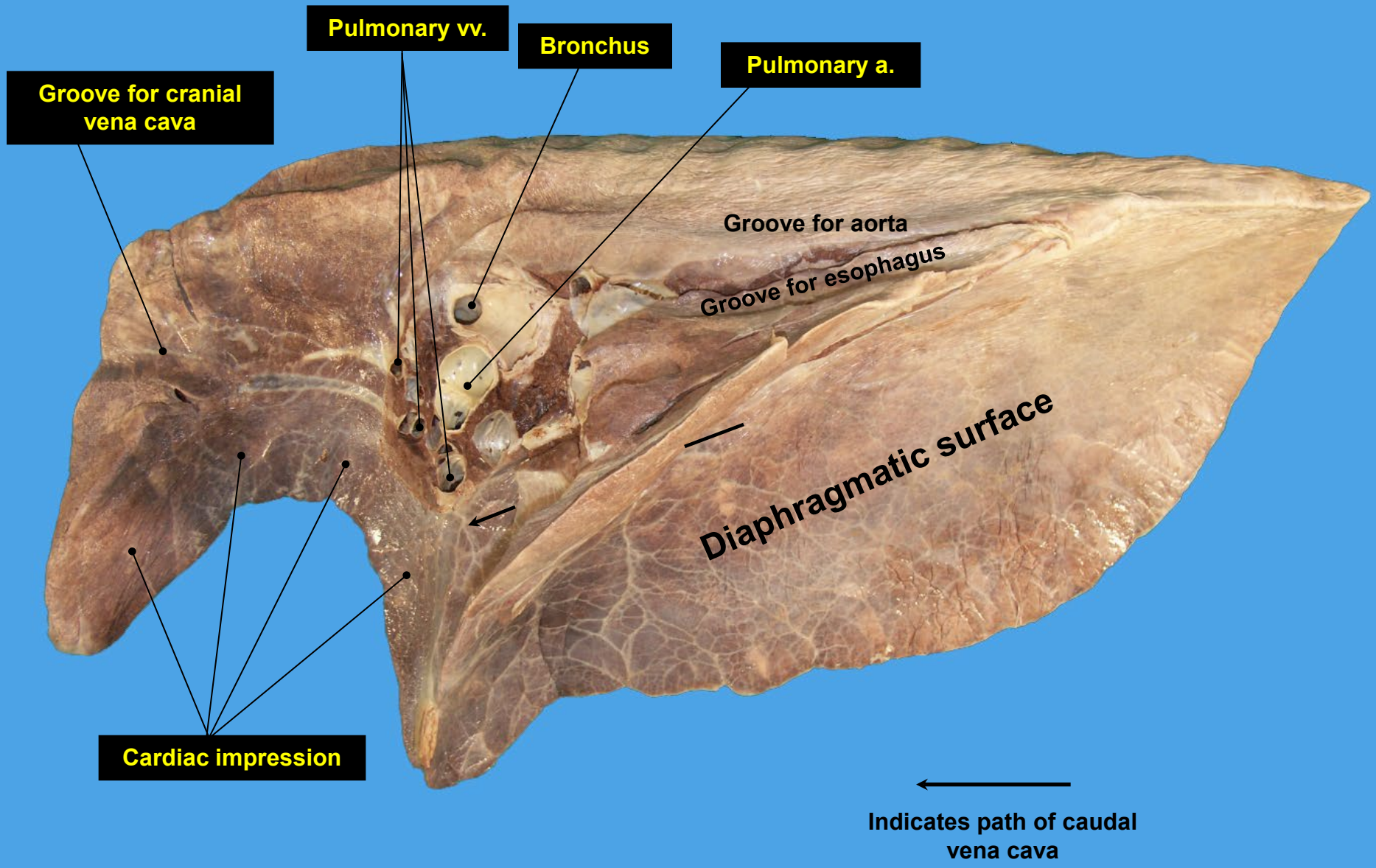
Camel:

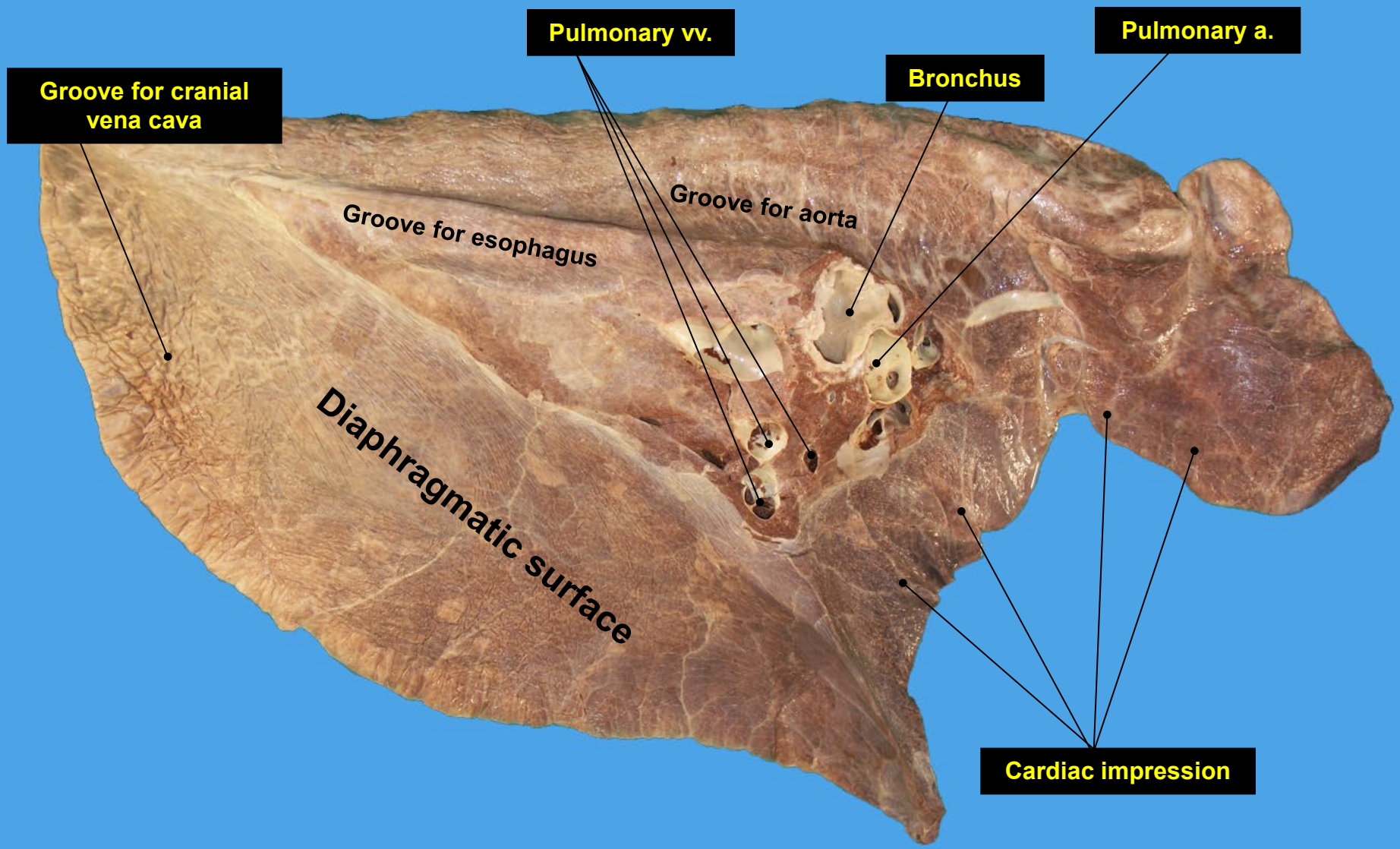
Each lung has a cranial and caudal lobe, and the right lung has an accessory lobe in addition.

The left end of the tracheal rings overlap the right ends.

Dog, right lung (air-dried)
Medial view




Pulmonary vv.
Bronchus
Pulmonary a.
Groove for cranial vena cava
Groove for aorta
Groove for esophagus
Diaphragmatic surface
Cardiac impression
Indicates path of caudal vena cava


Groove for cranial vena cava
Pulmonary vv.
Bronchus
Pulmonary a.
Groove for esophagus
Groove for aorta
Diaphragmatic surface
Cardiac impression

The Lung

- Shortly before this bifurcation the tracheal bronchus leaves the trachea to the right in the pig and ruminants.

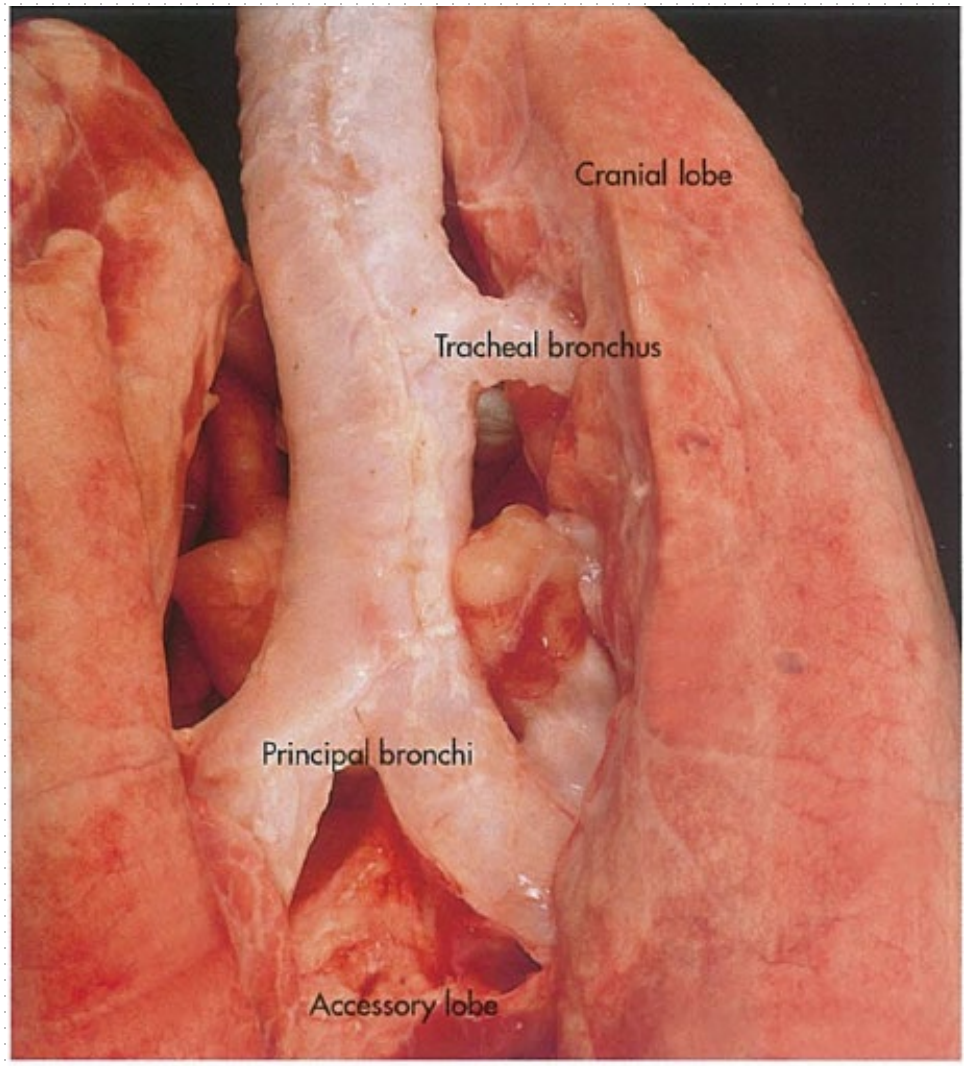
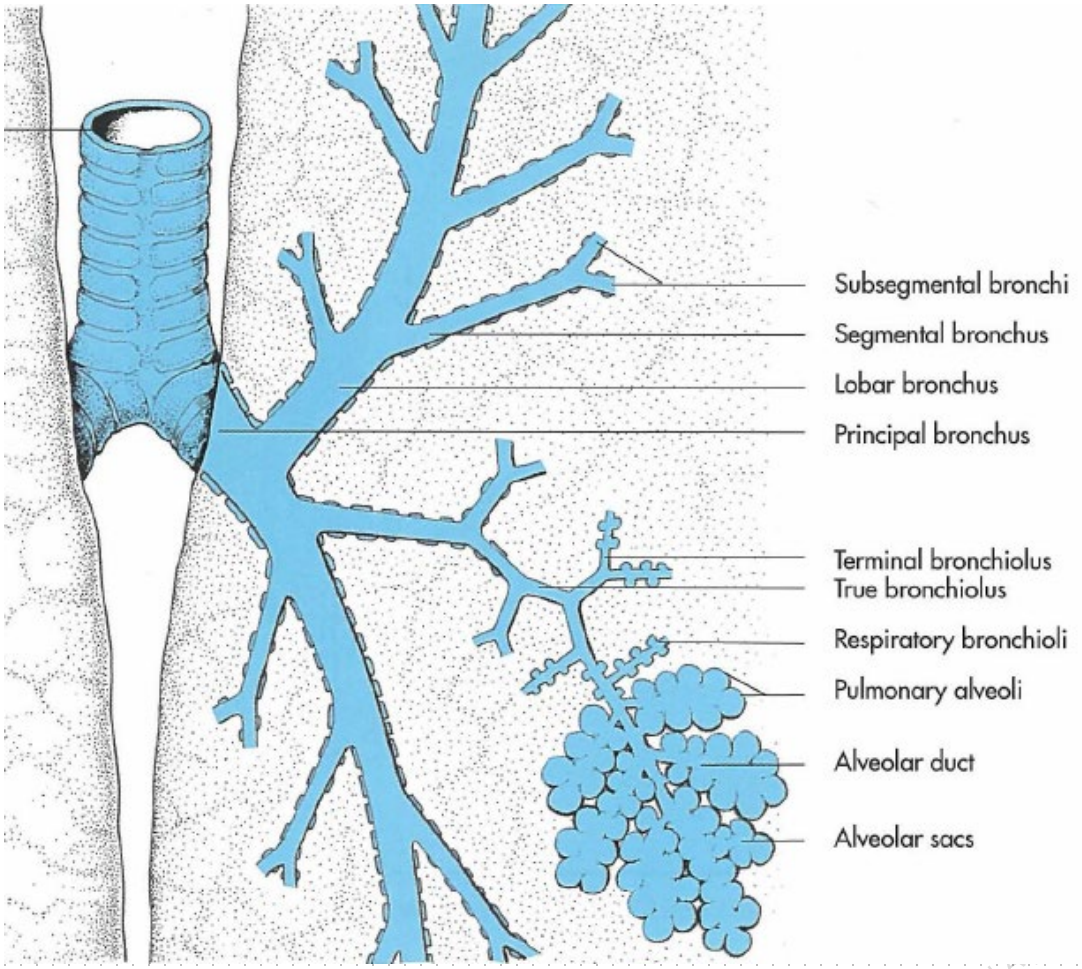


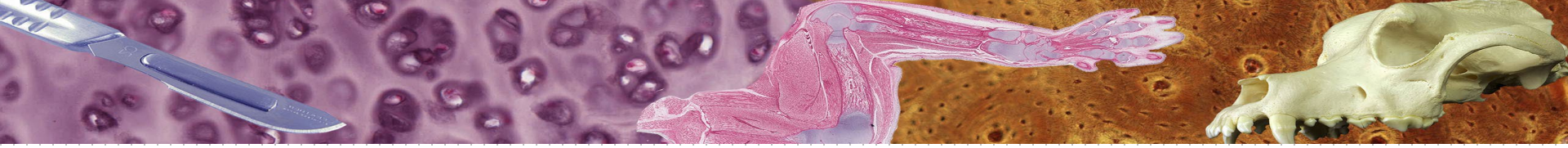
Fig. 8-32. Lungs of a pig, demonstrating the tracheal bronchus, dorsal aspect (courtesy of PD Dr. J. Maierl, Munich).

The Bronchial Tree

The lower end of the trachea divides into two primary bronchi.

Primary bronchus ⇨
secondary bronchus ⇨
tertiary bronchus ⇨
terminal bronchioles ⇨
respiratory bronchioles ⇨
alveolar ducts ⇨
alveoli.





Respiratory System

Respiratory Bronchiole:

- Has a few alveolar scattered along its wall
- Lined by typical bronchiolar epithelium, but changes to simple squamous at alveolus entrance
- The alveoli entrance is guarded by bronchial smooth muscle

Alveolar duct:

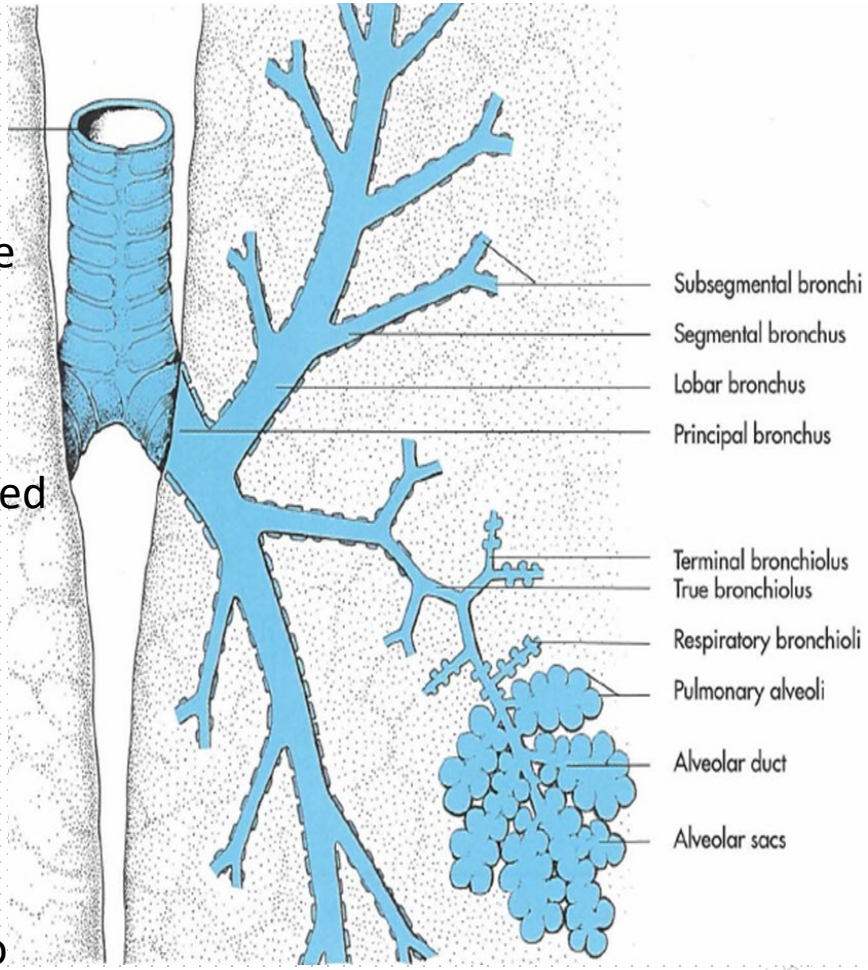
- Have alveoli on its walls with the openings guarded by smooth muscle

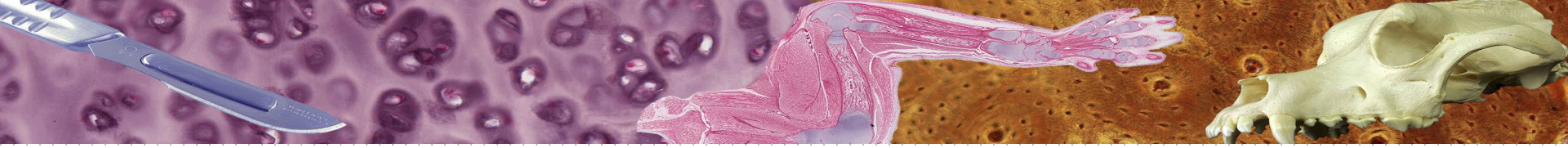
Alveolar sac:

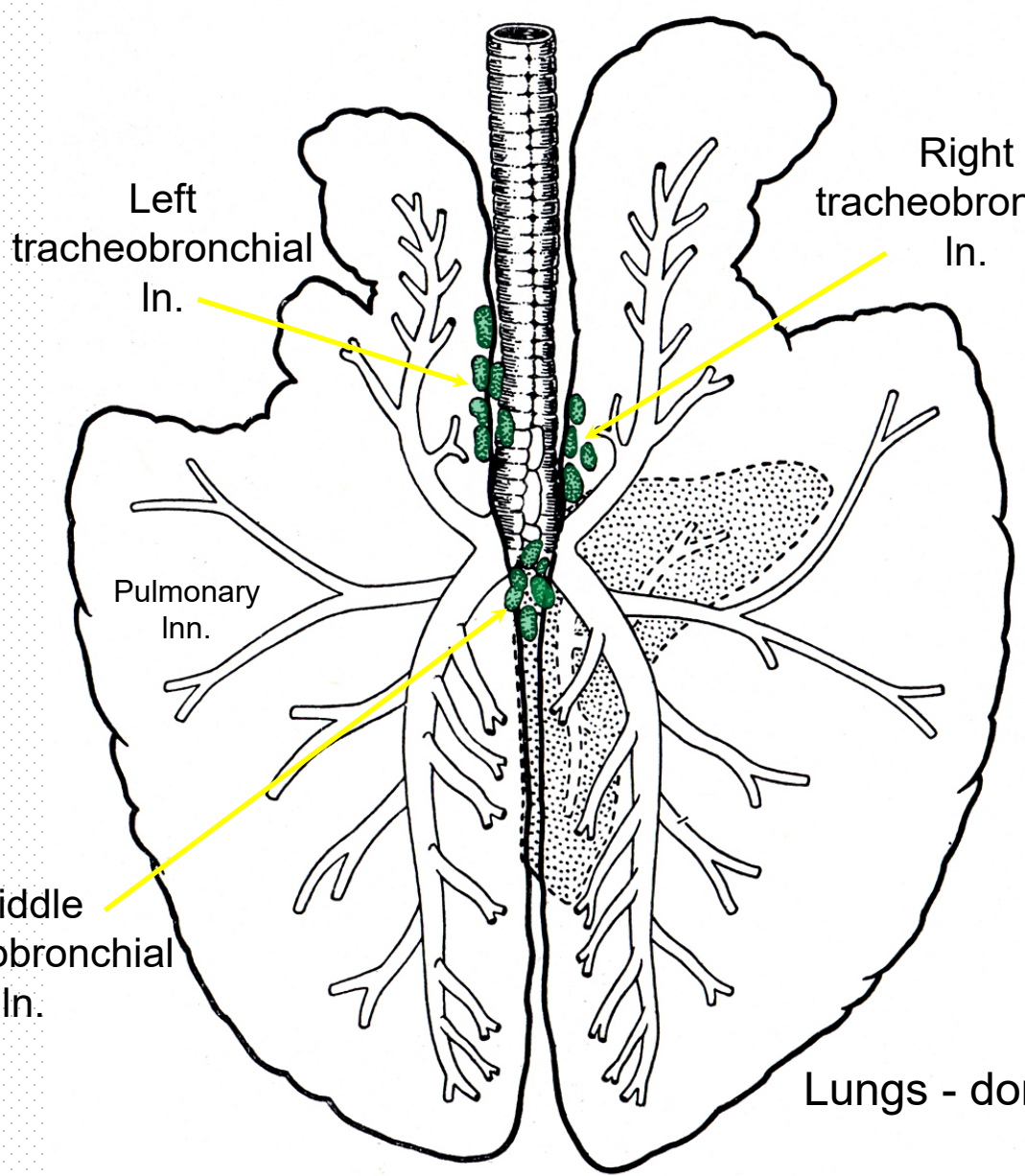
- Usually there are clusters of alveolar sacs on the end of the alveolar duct

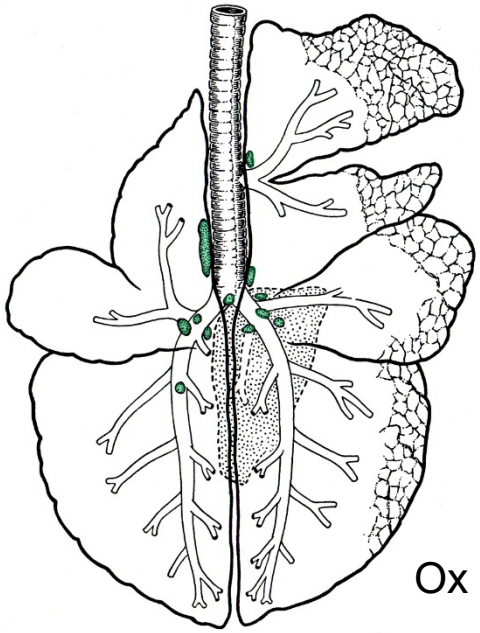
Alveolus:

- Minute polygonal chambers whose diameter changes with breathing
- The wall is a thin irregular sandwich with the two outer surfaces formed by epithelial cells and an inner network of capillaries

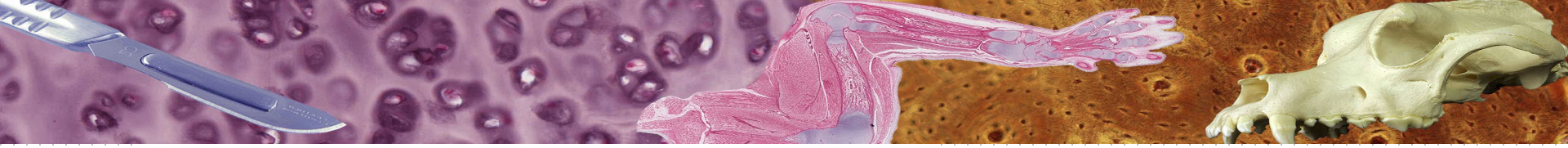








Lungs - dorsal aspect - Horse



Note: The distinct tracheal bronchus and extensive interlobular connective tissue

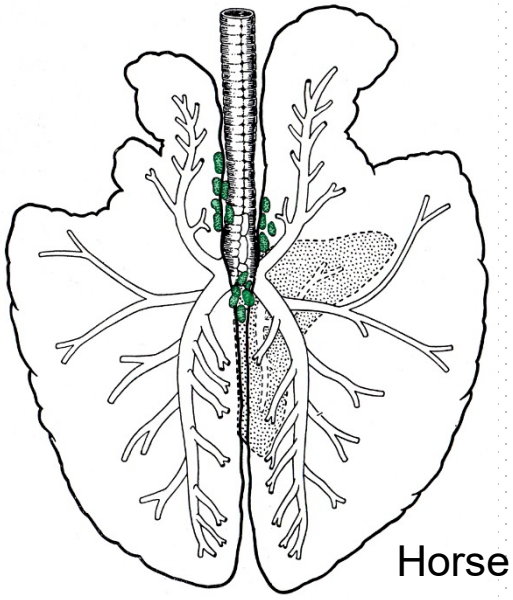
Cranial tracheobronchial ln.

Left tracheobronchial ln.

Pulmonary lnn.

Right tracheobronchial ln.

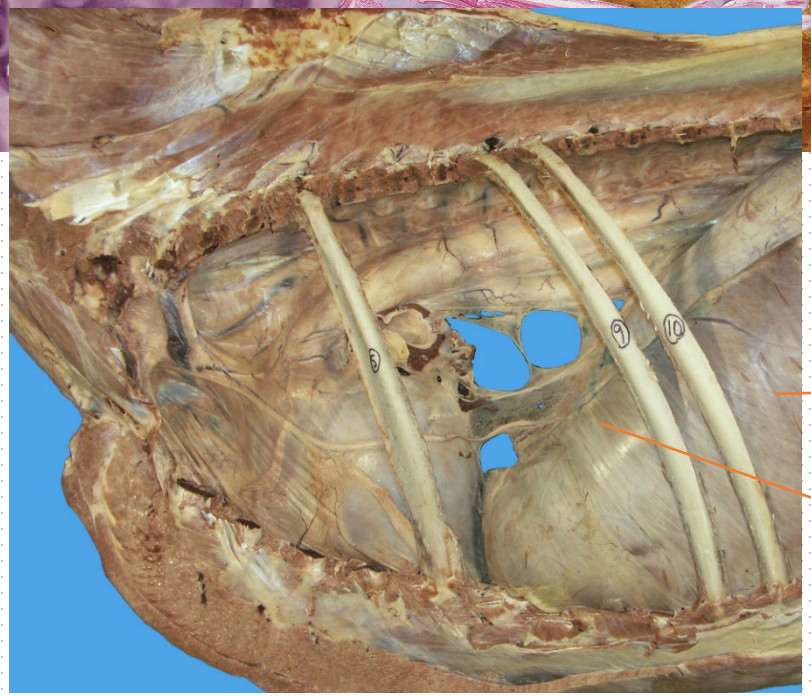
Middle tracheobronchial ln.



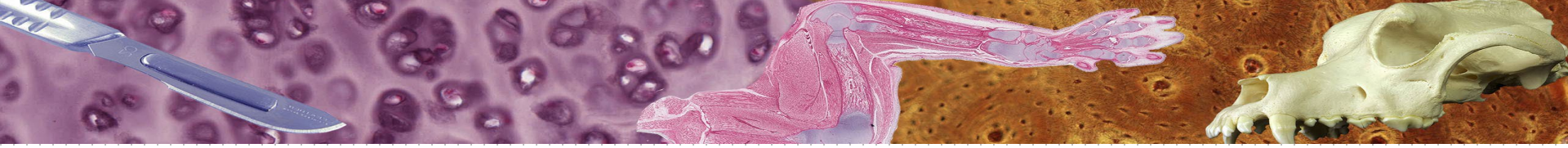
Horse

Lungs - dorsal aspect - Ox

Diaphragm

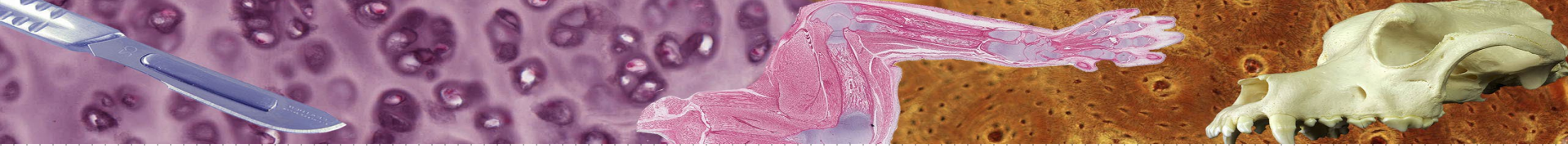


- A dome shaped structure separating the thoracic and abdominal cavities.
- Convex on its cranial surface.
- Has a muscular peripheral part and a tendinous central area.
- Muscular part has sections arising from the xiphoid process of sternum, vertebral column and caudal ribs.
- Supplied by the phrenic nerve
- During inspiration, the diaphragm contracts to increase the volume of the thoracic cavity, thus decreasing its pressure to draw air in.
- Vice versa occurs for expiration with the diaphragm relaxing.



The diaphragm

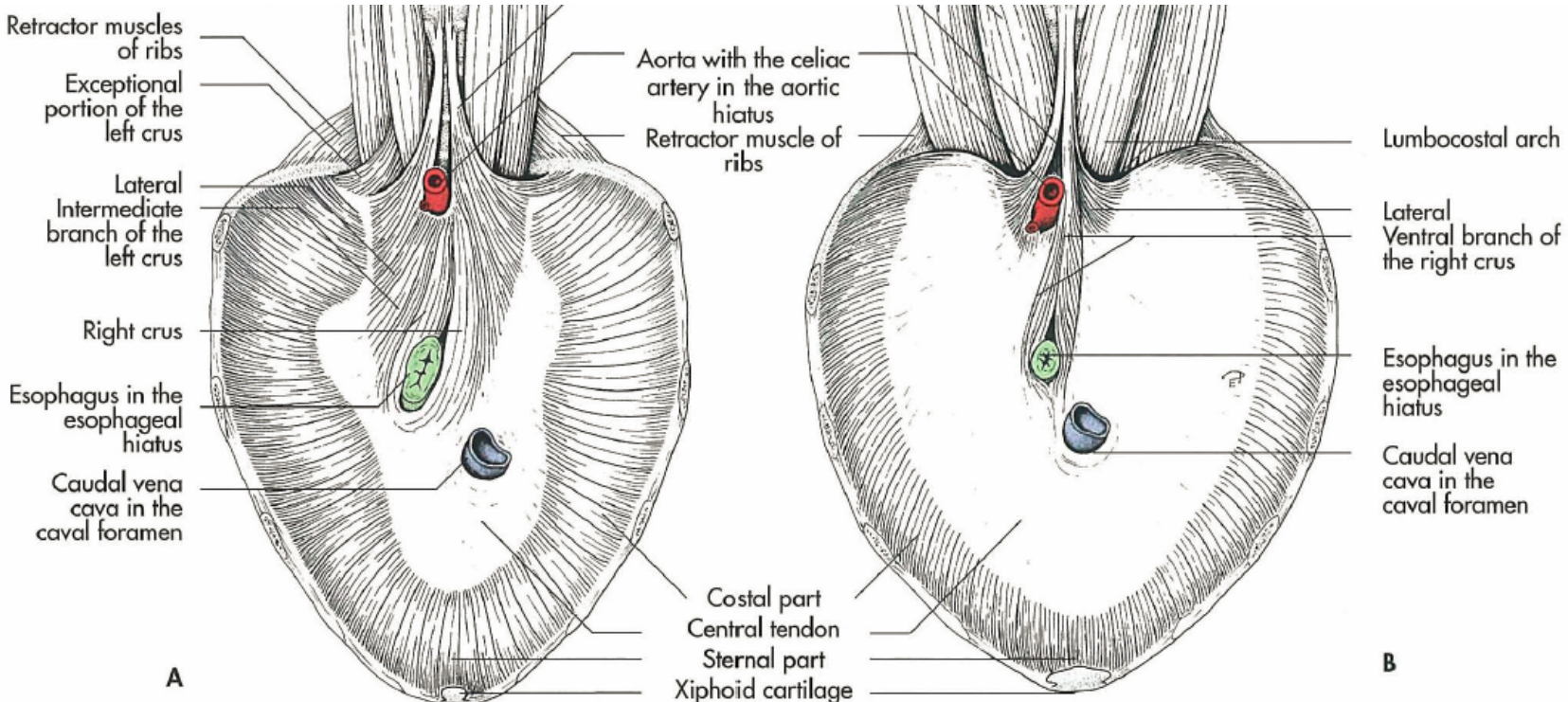
- On the thoracic side the diaphragm is covered by the endothoracic fascia (fascia endothoracica) and the pleura.
- On the abdominal side by the transversal fascia (fascia transversalis) and the peritoneum.



The diaphragm

There are three openings in the diaphragm:

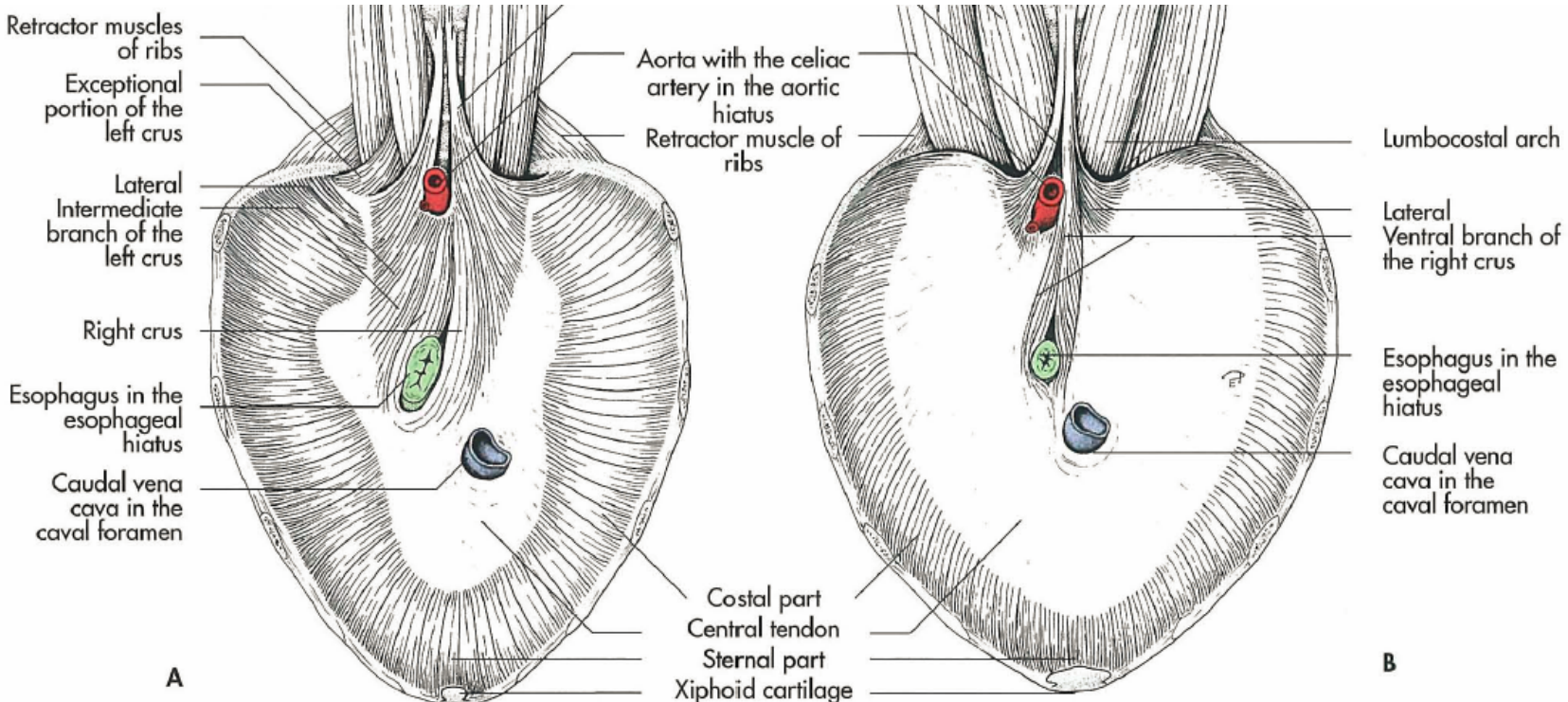
1. The aorta, the azygos vein (v. azygos), the thoracic duct.
2. The esophageal hiatus (hiatus esophageus).
3. Caval foramen (foramen venae cavae)



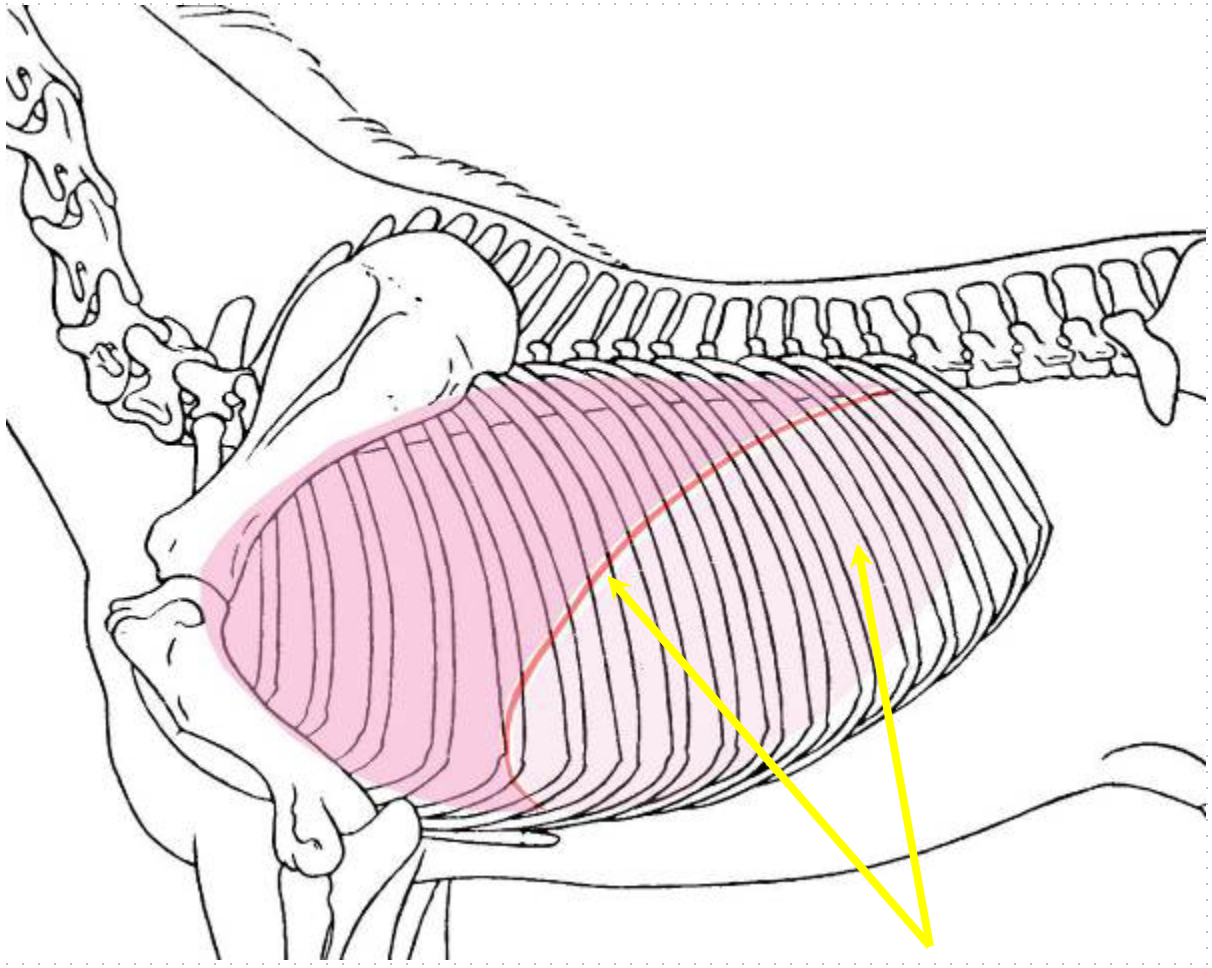
The diaphragm

The muscular part can be subdivided into:

- Lumbar part (pars lumbalis).
- Costal part (pars costalis).
- Sternal part (pars sternalis).



The diaphragm

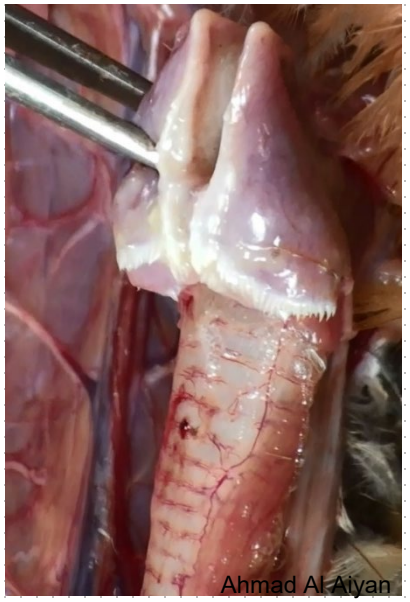


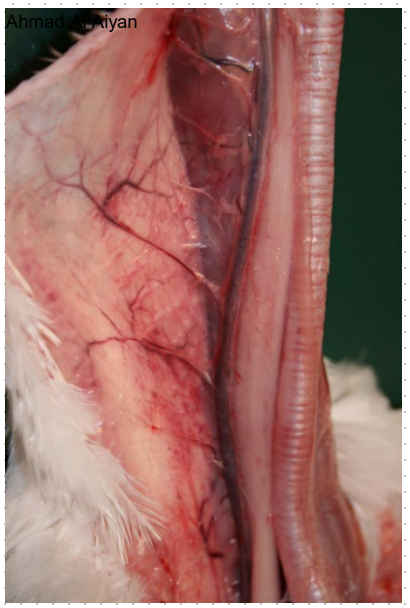
shadow of the diaphragm

Avian Respiratory Tract

The avian tract differs in the following ways:

- A choana (opening) connecting the nasal and oral cavity.
- The larynx does not have an epiglottis, so muscles constrict, closing the glottis, to allow passage of food.
- The trachea is longer and wider than in mammals, and consists of interlocking rigid cartilages.



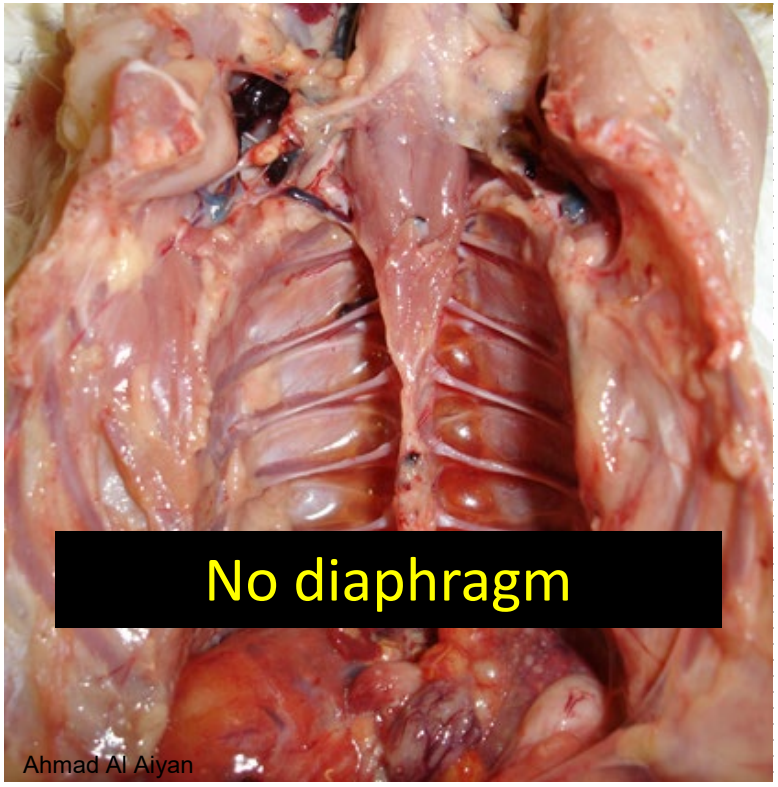


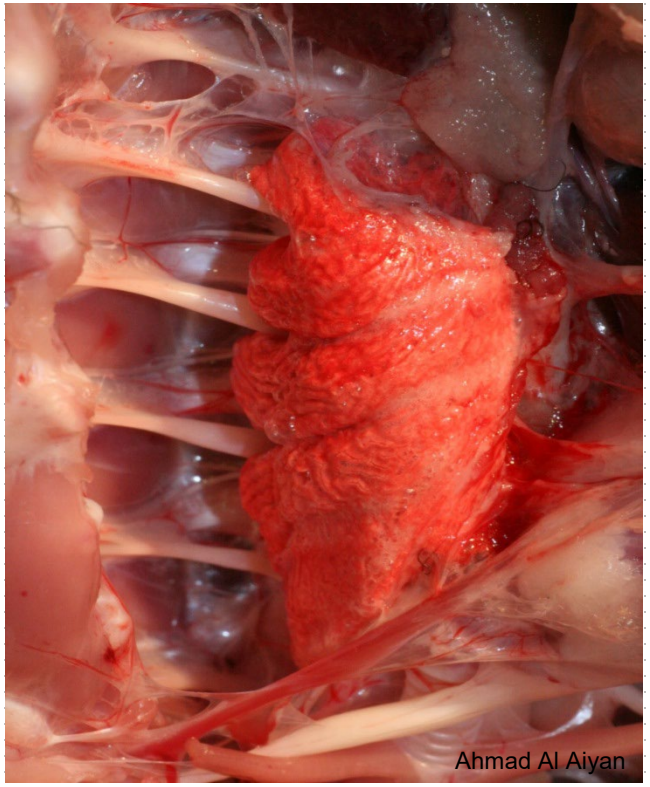
Avian Respiratory Tract

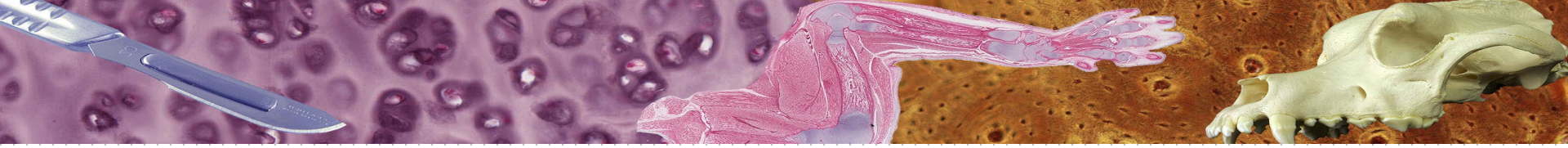
- A syrinx is located at the trachea bifurcation and is responsible for sound production.

Avian Respiratory Tract

- The lungs are stiffer and do not expand like mammalian lungs.

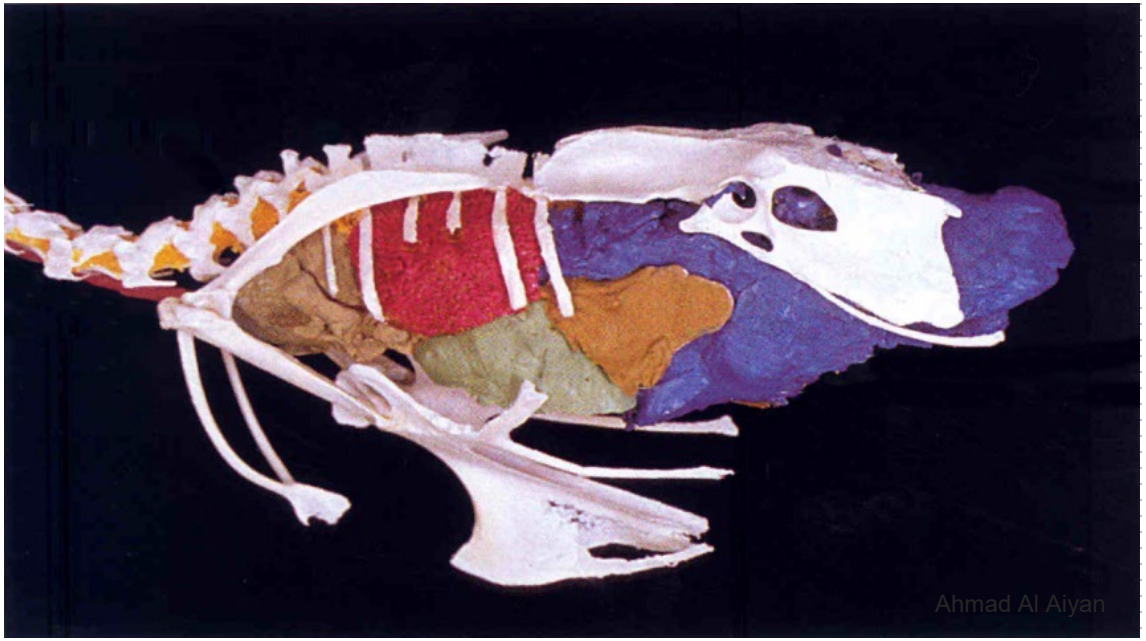


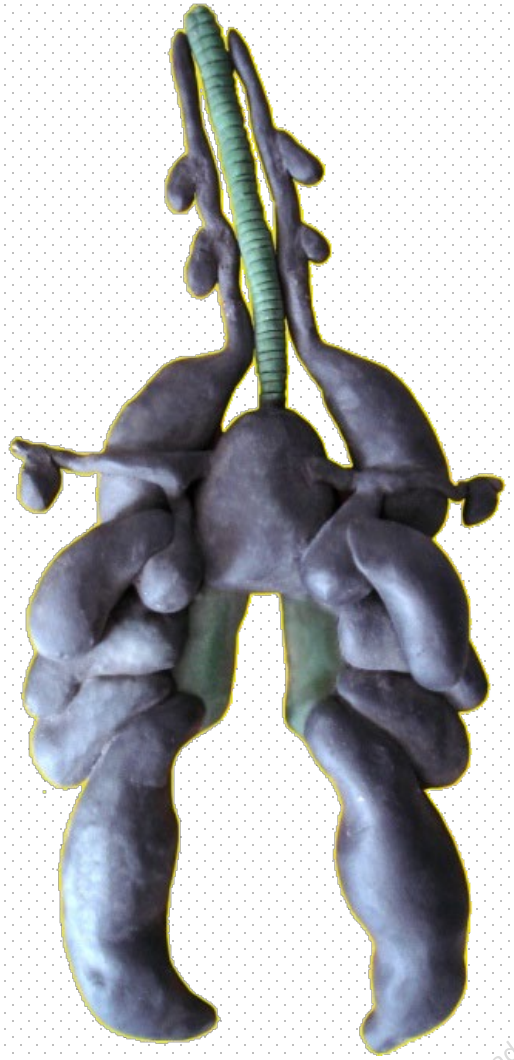




Avian Respiratory Tract

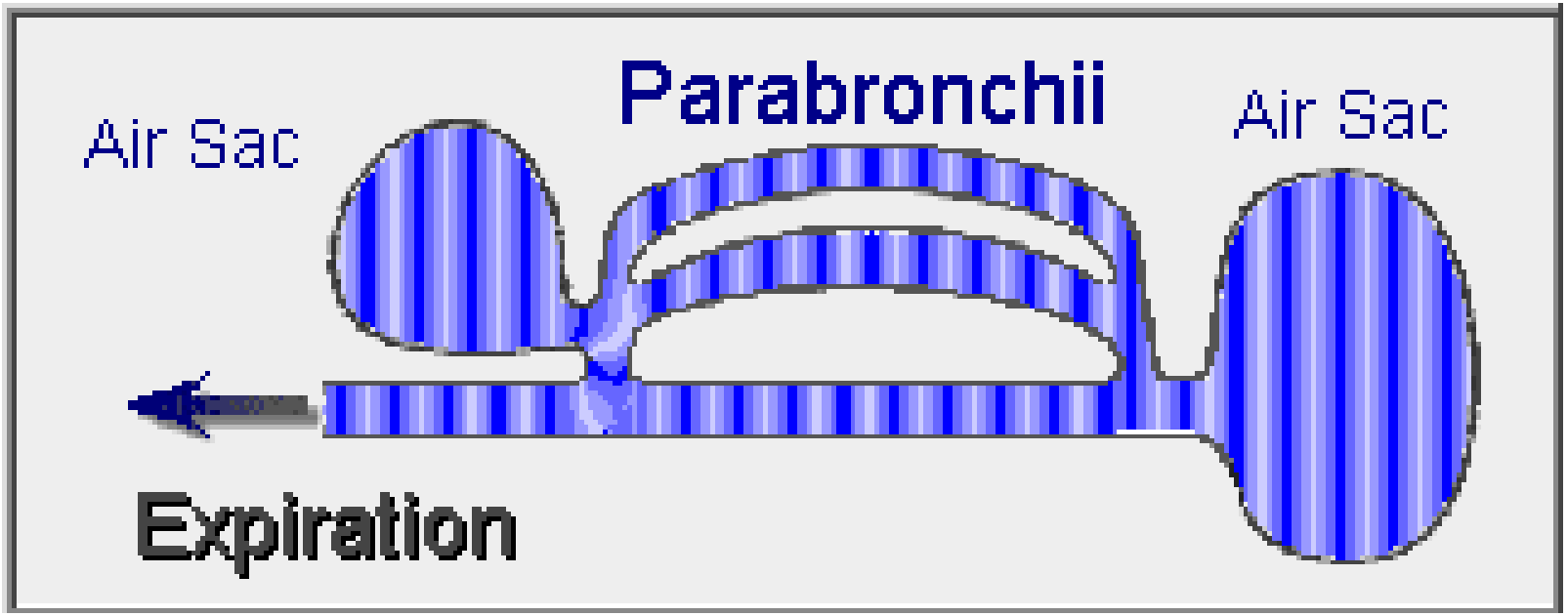
- Air sacs, acting as bellows, may store air during respiration, allowing the lungs to be constantly supplied by fresh air.

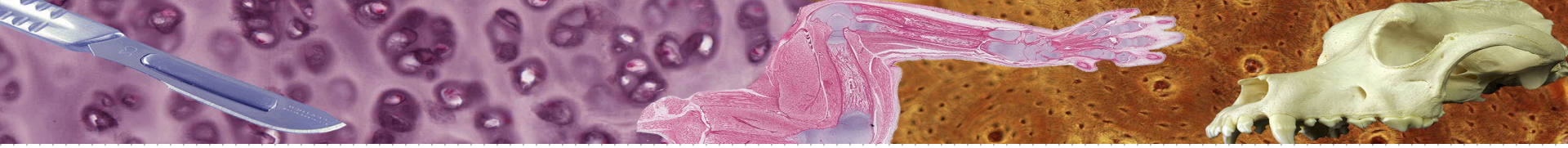




Avian Respiratory Tract

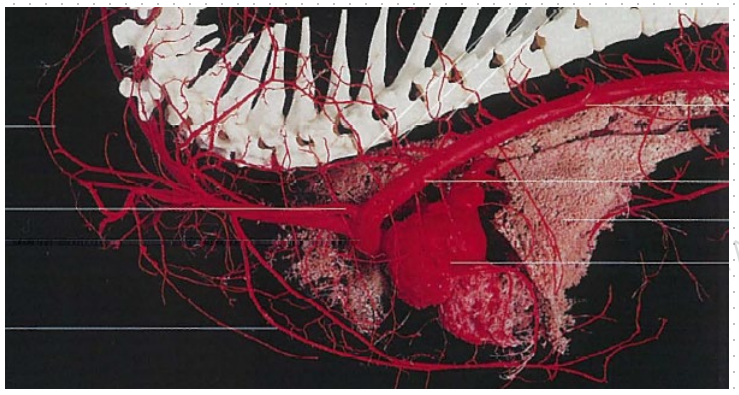
- There is a counter current exchange in the lungs of the bird, allowing for efficient exchange.
- Birds experience a continuous unidirectional air flow through the lungs.





The Blood Supply to the Lung

- The lung receives blood from arteries of the pulmonary circuit.
- The pulmonary arteries enter the lungs at the hilus and branch with the bronchi as they approach the lobules.
- Each lobule receives an arteriole and a venule, and a network of capillaries surrounds each alveolus as part of the respiratory membrane.
- The oxygenated blood from the alveolar capillaries passes through the pulmonary venules and then enters the pulmonary veins, which deliver it to the left atrium.

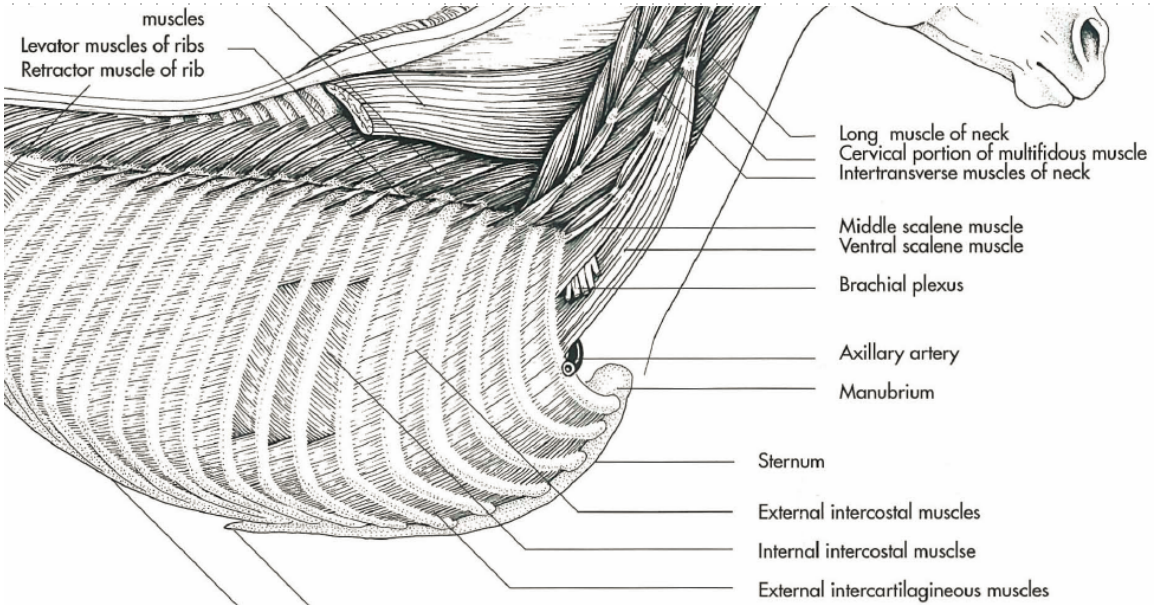


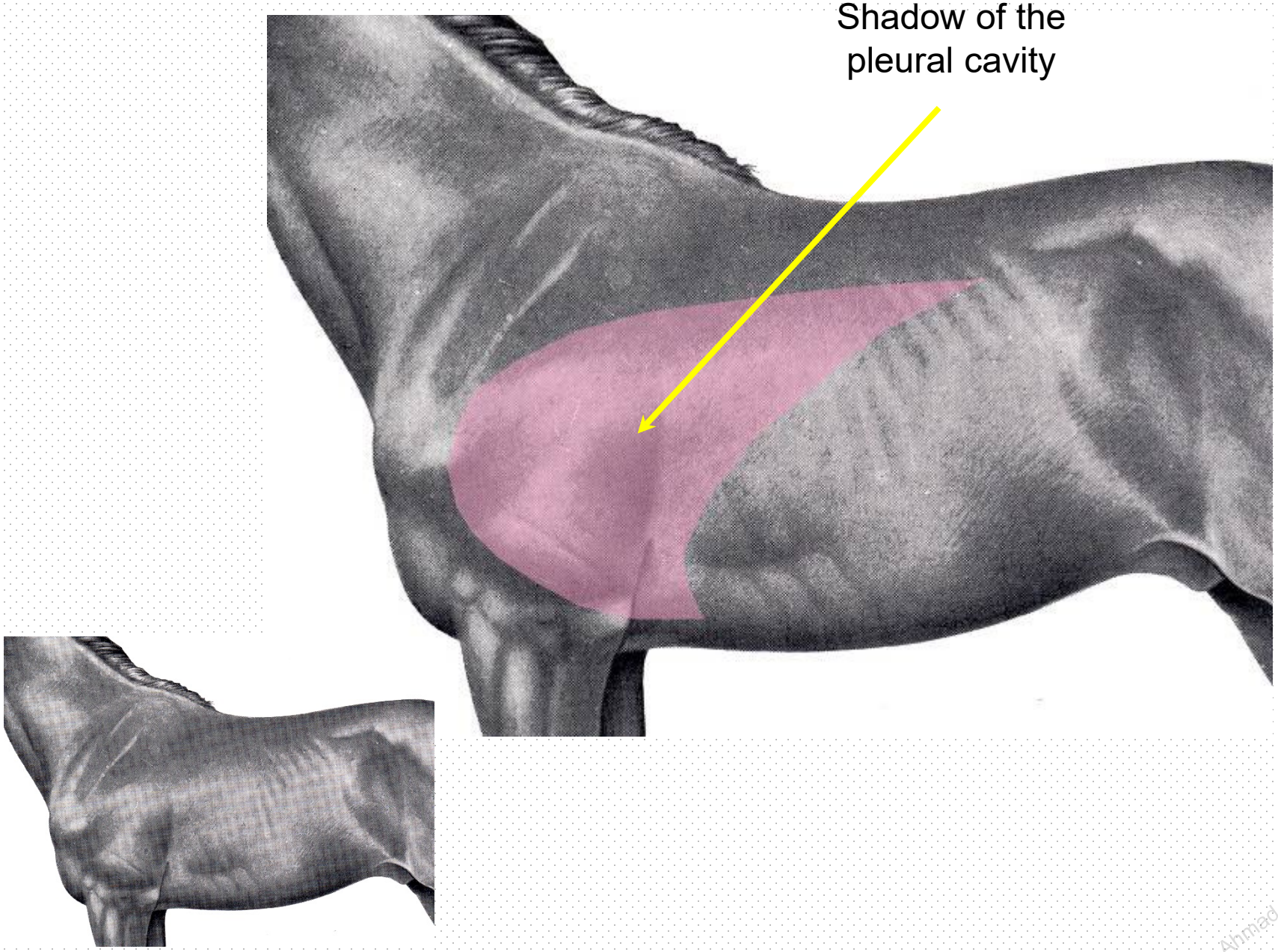
Manny Thanks for your Attention

Thoracic cavity and pleura

Intercostal muscles:

- External – run in a caudoventral direction and are responsible for inspiration
- Internal – run in a caudodorsal direction and consists of 2 components: the interosseus, responsible for expiration, and interchondral, responsible for inspiration.





Thoracic cavity

-dorsally – bodies of thoracic vertebrae

-ventrally – sternebrae

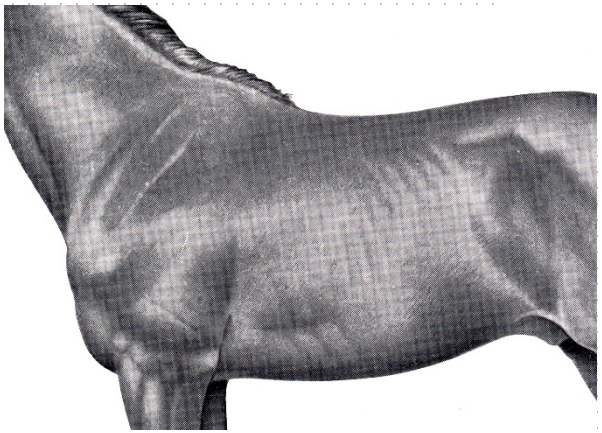
-laterally – ribs

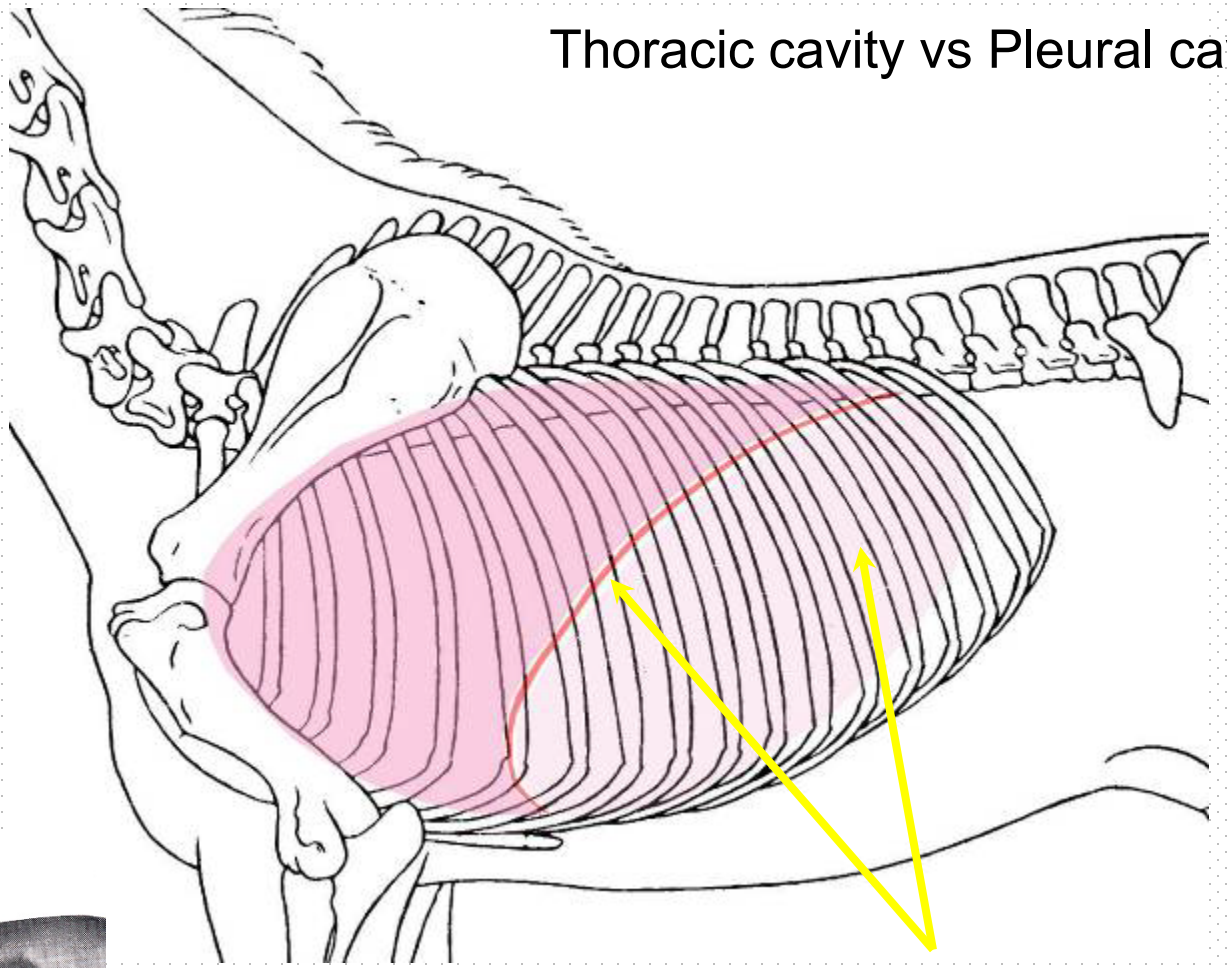
-cranially – thoracic inlet

-caudally – muscular diaphragm

Pleural cavity

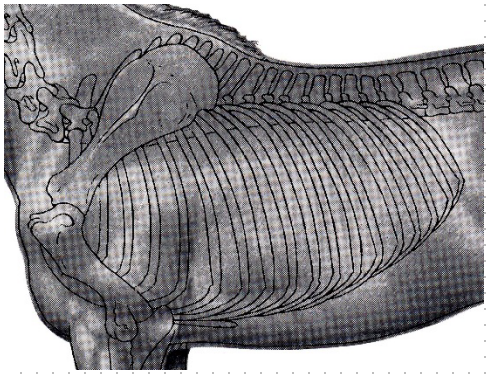
-two, closed pleural sacs that create a mediastinal space between them



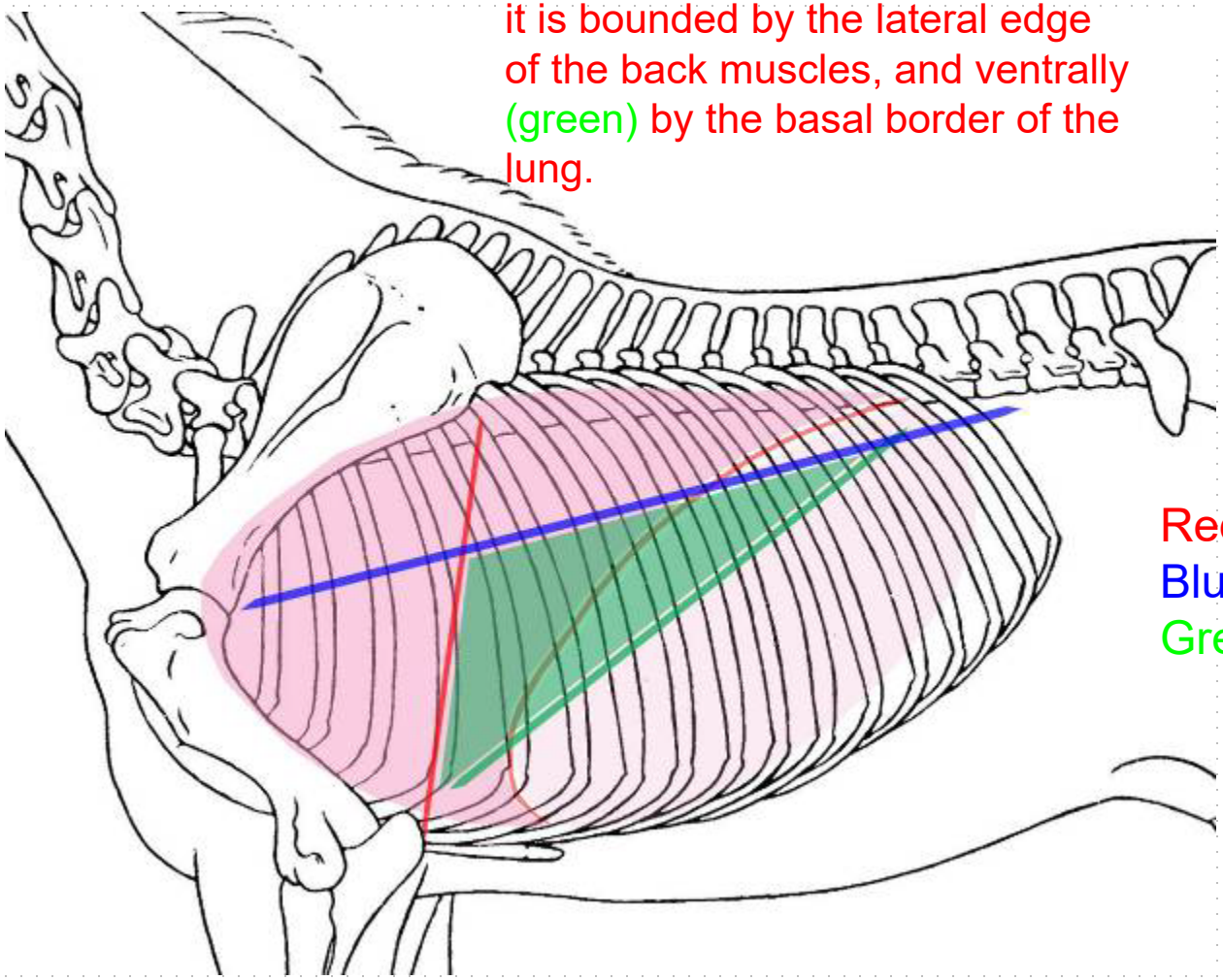


Thoracic cavity vs Pleural cavity

shadow of the diaphragm

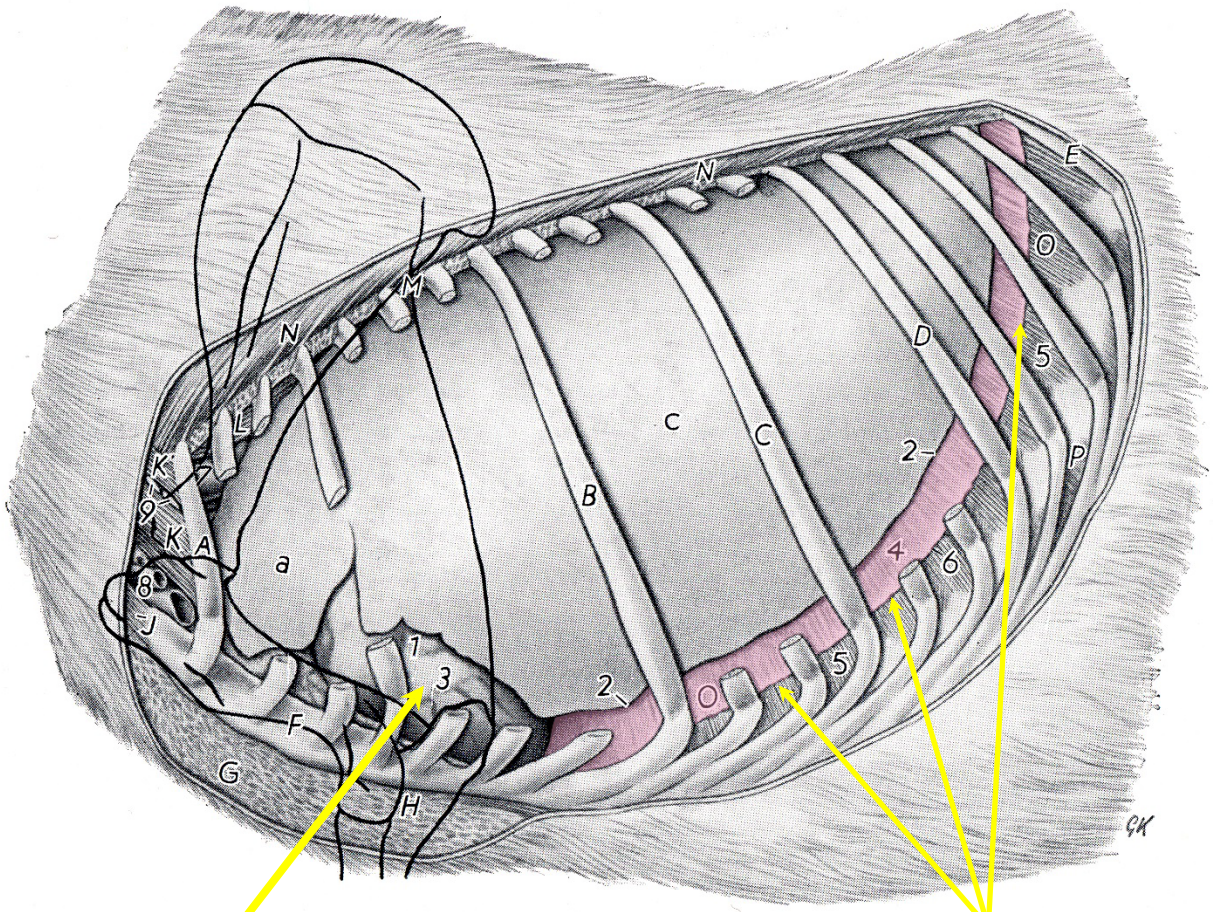


Audible lung field - (transparent green) - roughly triangular, the projection's cranial limit (red) is the triceps muscle, dorsally (blue) it is bounded by the lateral edge of the back muscles, and ventrally (green) by the basal border of the lung.



Red line = cranial limit
Blue line = dorsal limit
Green line = ventral limit

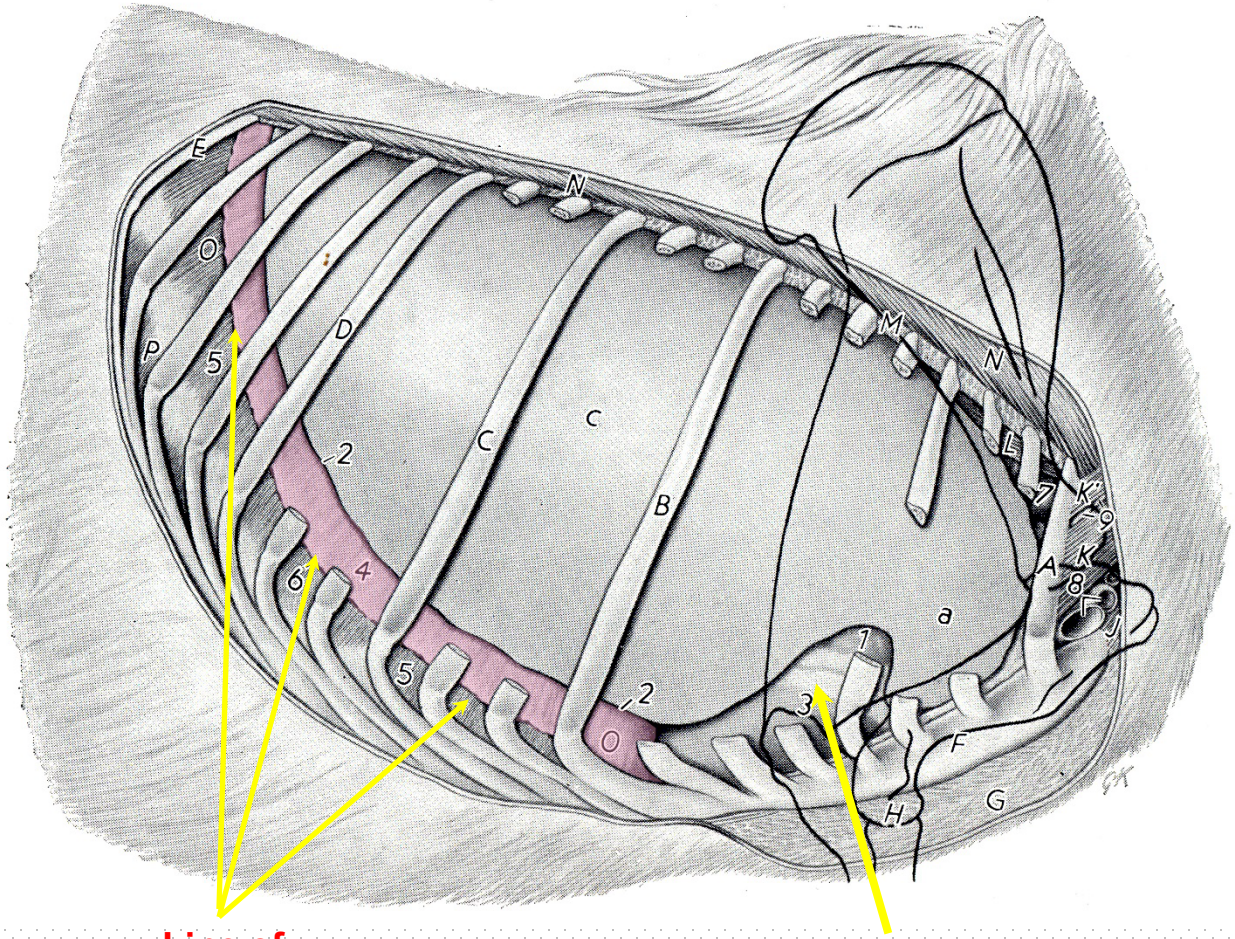
Left lateral aspect



Cardiac notch of the left lung = 3 to 6 intercostal spaces

Line of pleural reflection

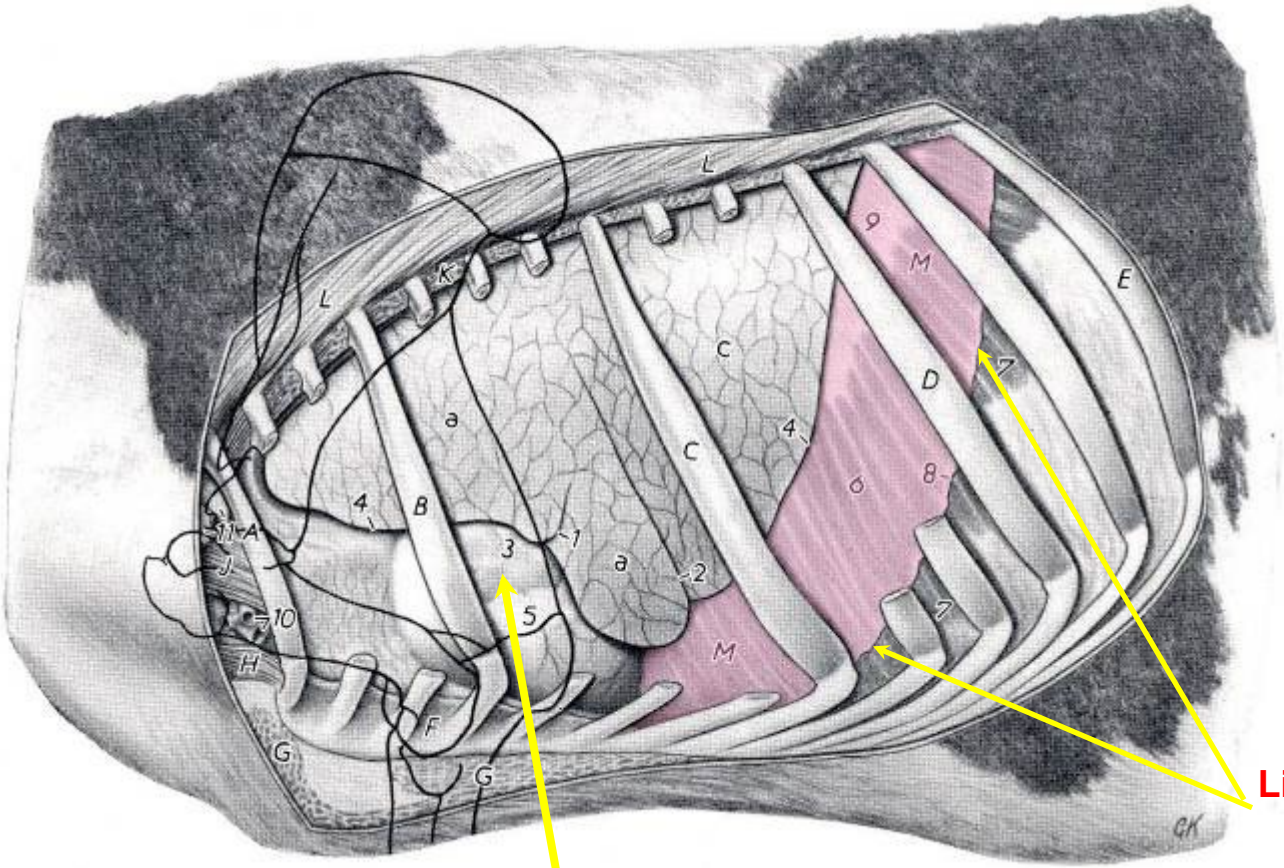
Right lateral aspect



Line of pleural reflection

Cardiac notch of the right lung
= 3 to 4 intercostal spaces

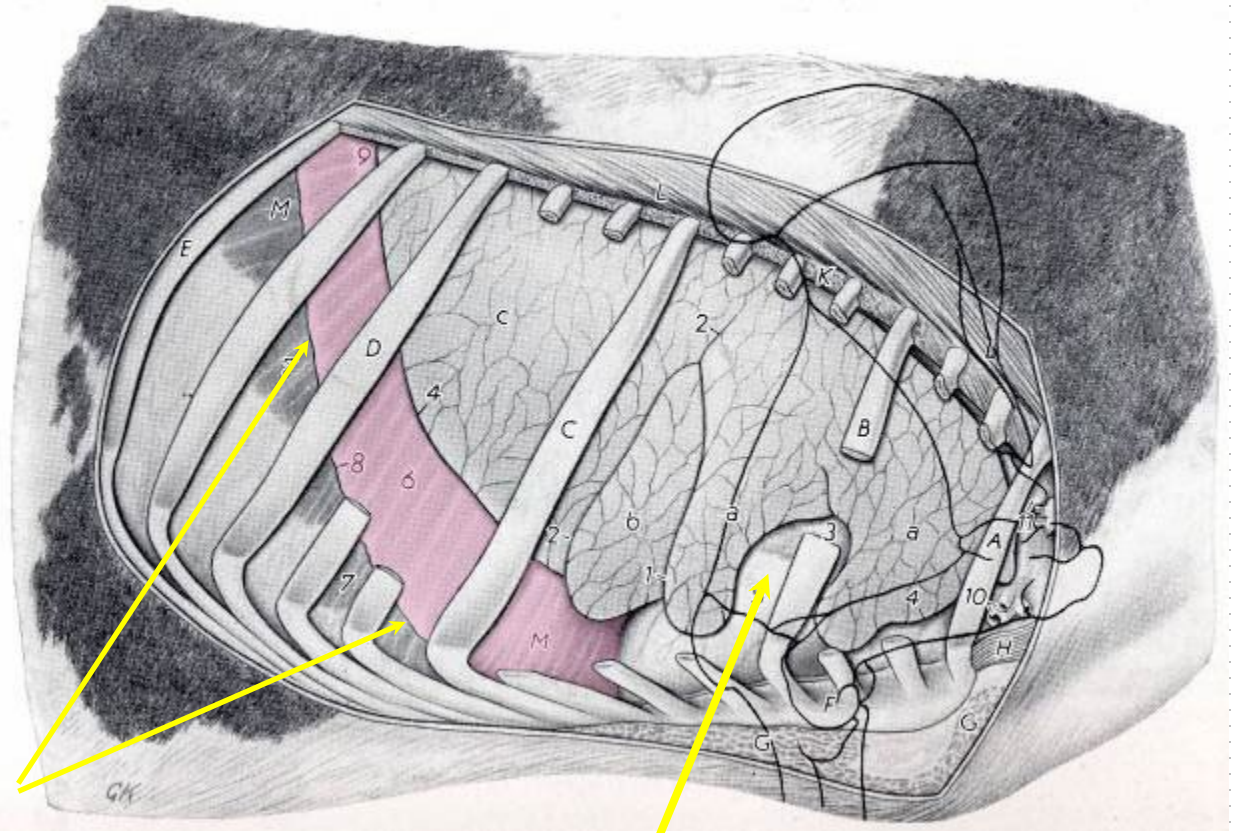
Left lateral aspect



Line of pleural reflection

Cardiac notch - left side - ventral one-third of the 3rd and 4th I.C. spp.

Right lateral aspect



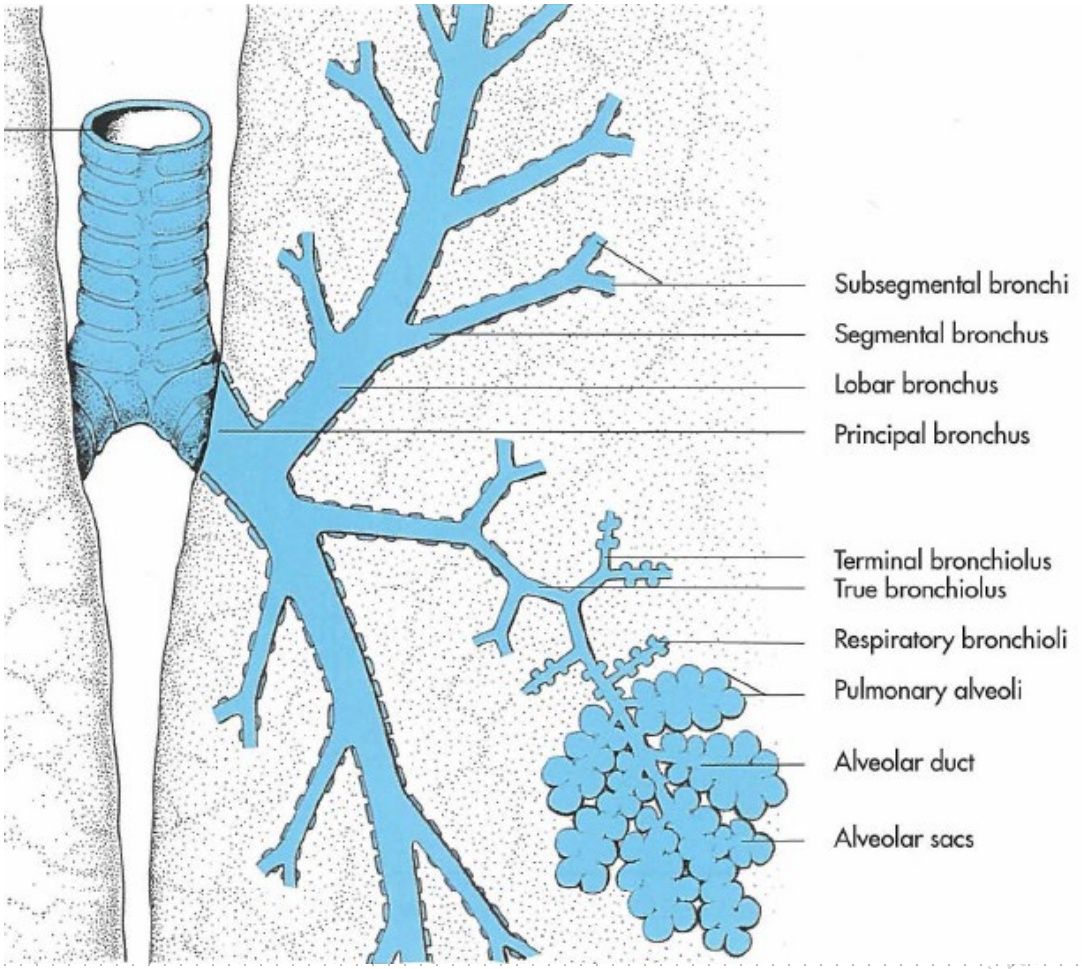
Line of pleural reflection

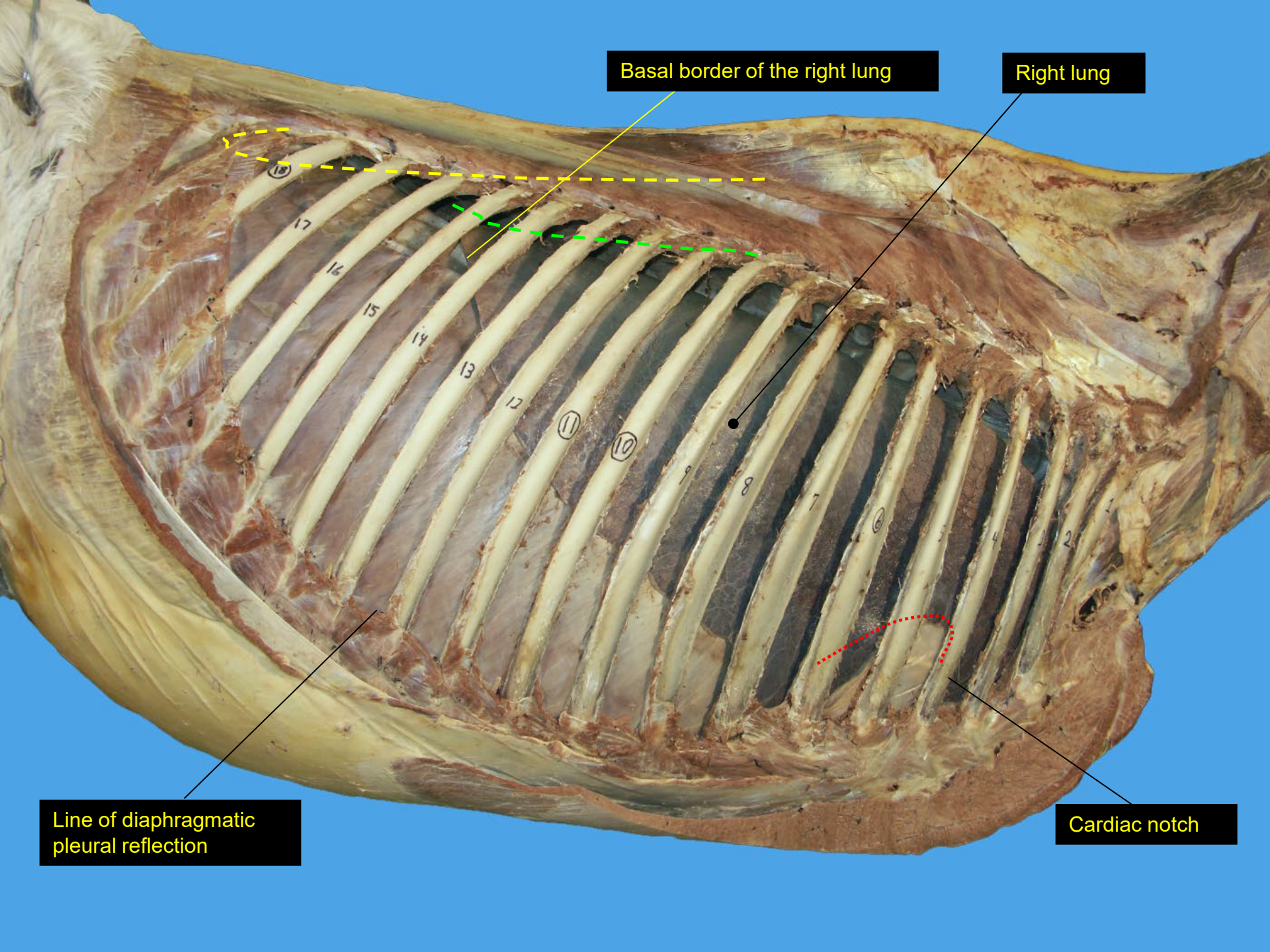
Cardiac notch - rt side - ventral one-quarter of the 3rd and 4th I.C. spp.

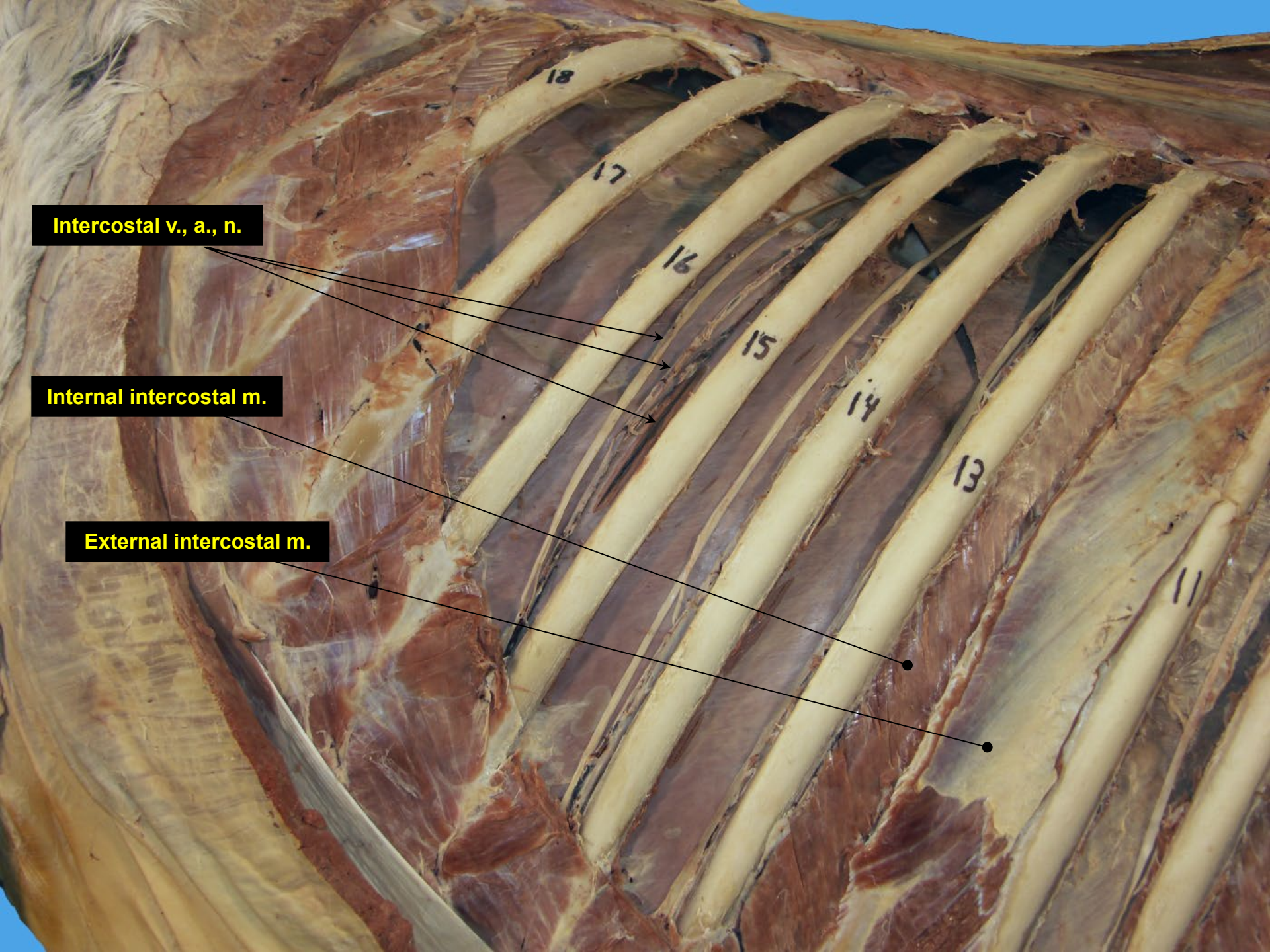
The Bronchial Tree

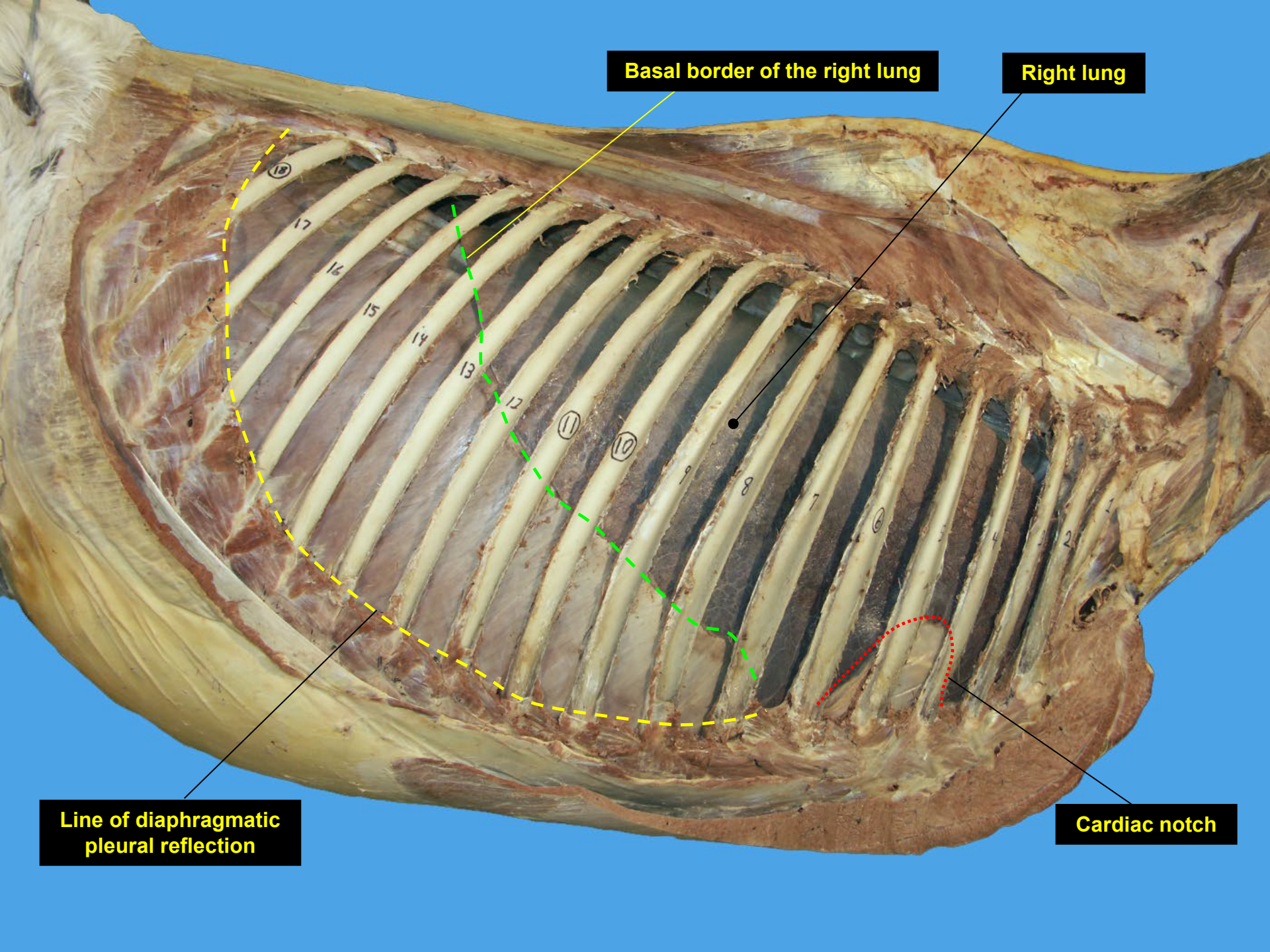
The lower end of the trachea divides into two primary bronchi.

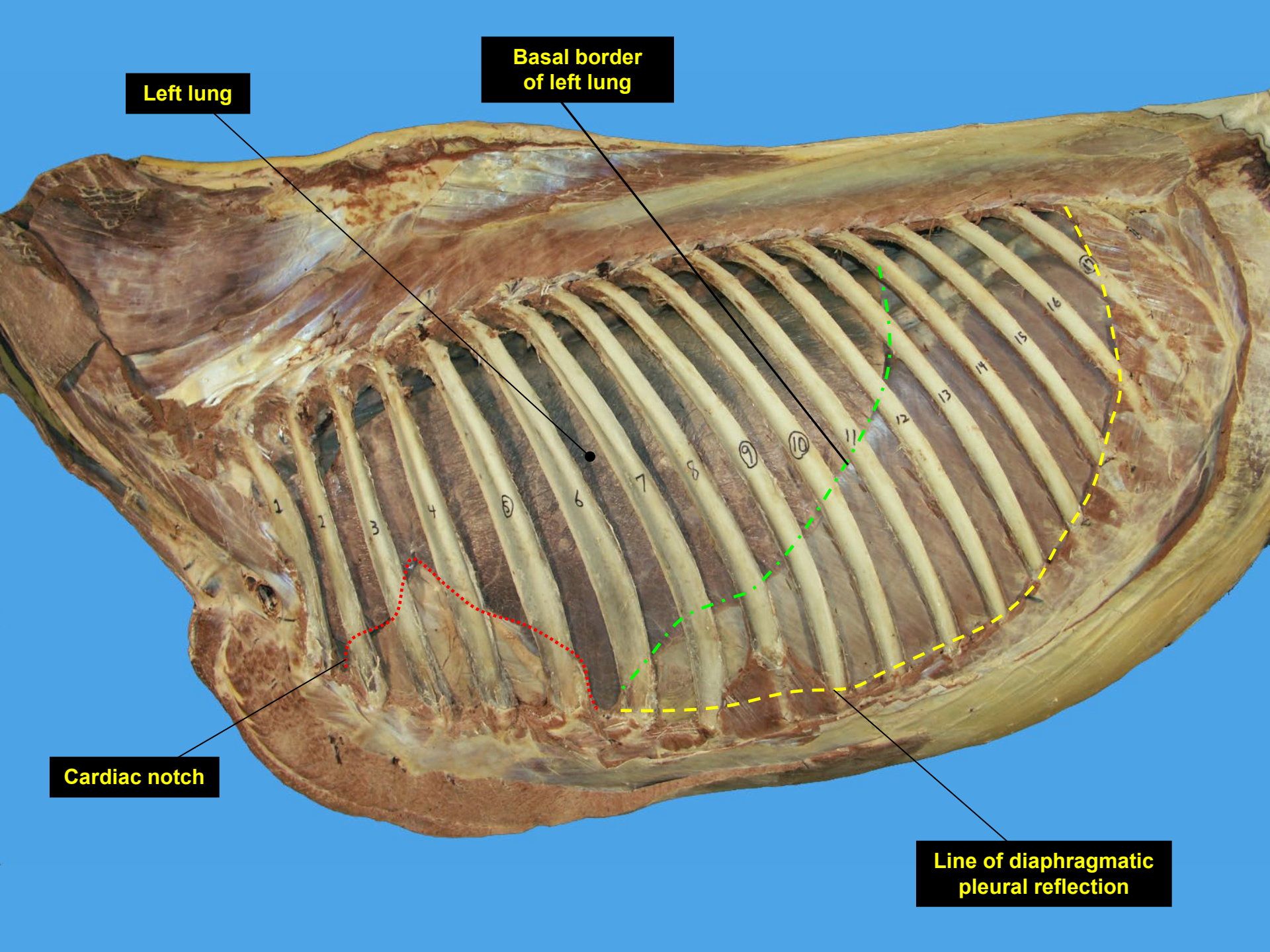
Primary bronchus ⇨
secondary bronchus ⇨
tertiary bronchus ⇨
terminal bronchioles ⇨
respiratory bronchioles ⇨
alveolar ducts ⇨
alveoli.




Basal border of the right lung
Right lung
Line of diaphragmatic pleural reflection
Cardiac notch

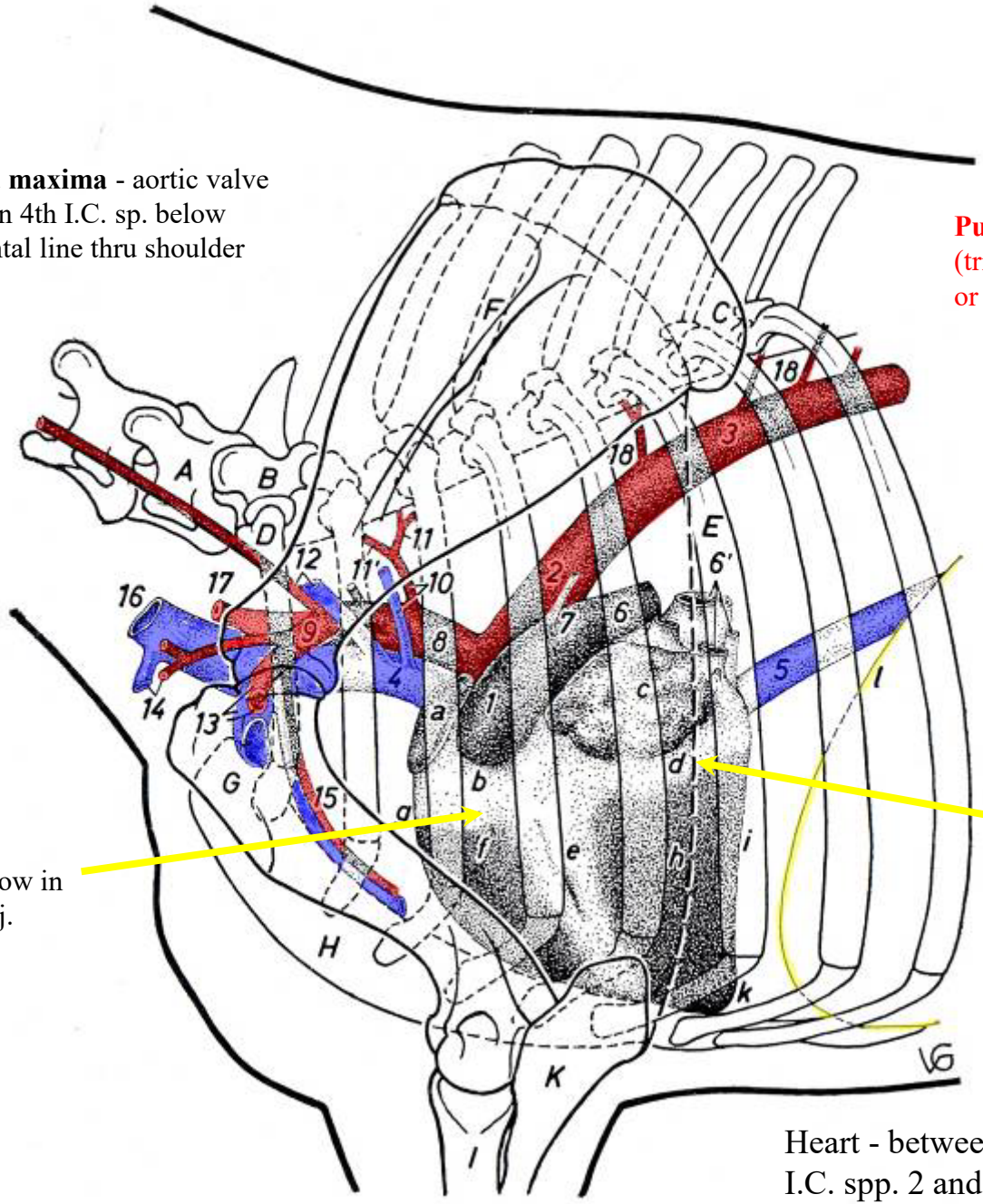

Intercostal v., a., n.
Internal intercostal m.
External intercostal m.
18
17
16
15
14
13
11


Basal border of the right lung
Right lung
Line of diaphragmatic pleural reflection
Cardiac notch


Left lung
Basal border of left lung
Cardiac notch
Line of diaphragmatic pleural reflection

Puncta maxima - aortic valve - high in 4th I.C. sp. below horizontal line thru shoulder joint.

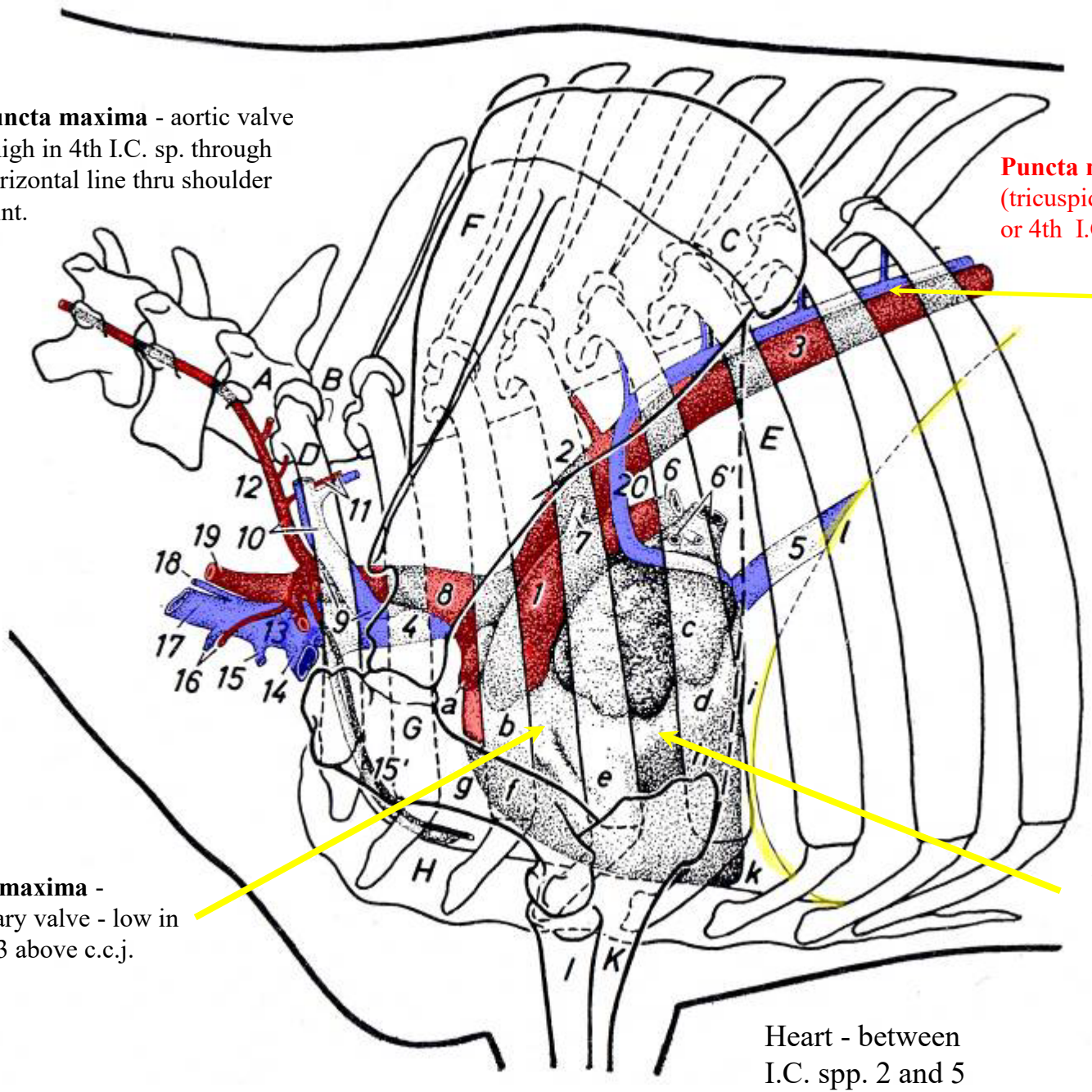
Puncta maxima - right AV valve - (tricuspid) - right side, low in 3rd or 4th I.C. sp.



Puncta maxima - pulmonary valve - low in I.C. sp. 3 above c.c.j.

Puncta maxima - left AV valve - (bicuspid) - low in 5th I.C. sp. caudodorsal to olecranon.

Heart - between I.C. spp. 2 and 6


Puncta maxima - aortic valve - high in 4th I.C. sp. through horizontal line thru shoulder joint.
Puncta maxima - right AV valve - (tricuspid) - right side, low in 3rd or 4th I.C. sp.
Note: The left azygos vein
Puncta maxima - pulmonary valve - low in I.C. sp. 3 above c.c.j.
Puncta maxima - left AV valve - (bicuspid) - low in 4th I.C. sp. dorsal to olecranon.
Heart - between I.C. spp. 2 and 5

Horse - Superficial and Deep Cervical Fascia and Muscles of the Neck & Thorax

Ox - Superficial and Deep Cervical Fascia and Muscles of the Neck & Thorax

Viborg's Triangle - area for safe entry into the retromandibular space. (Actual Dissection)

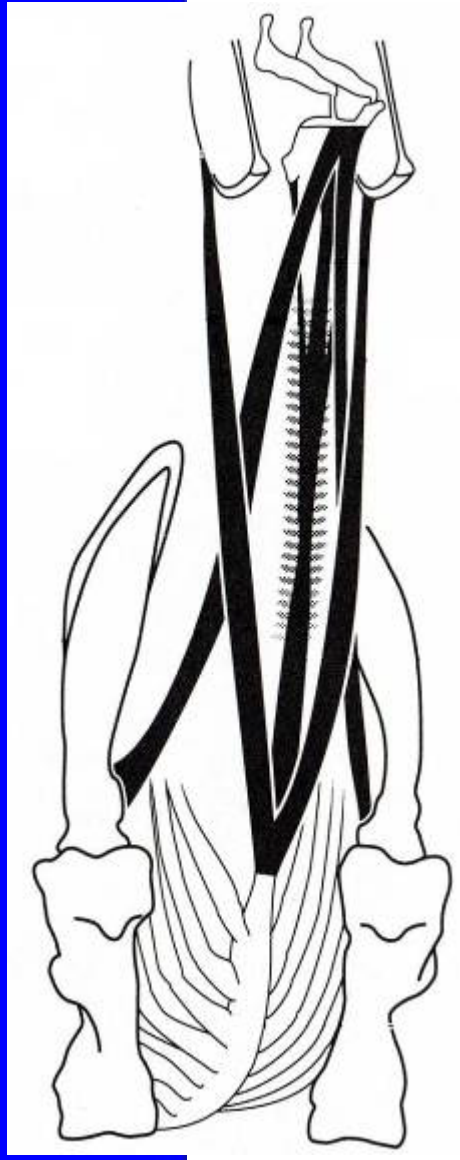
omohyoideus

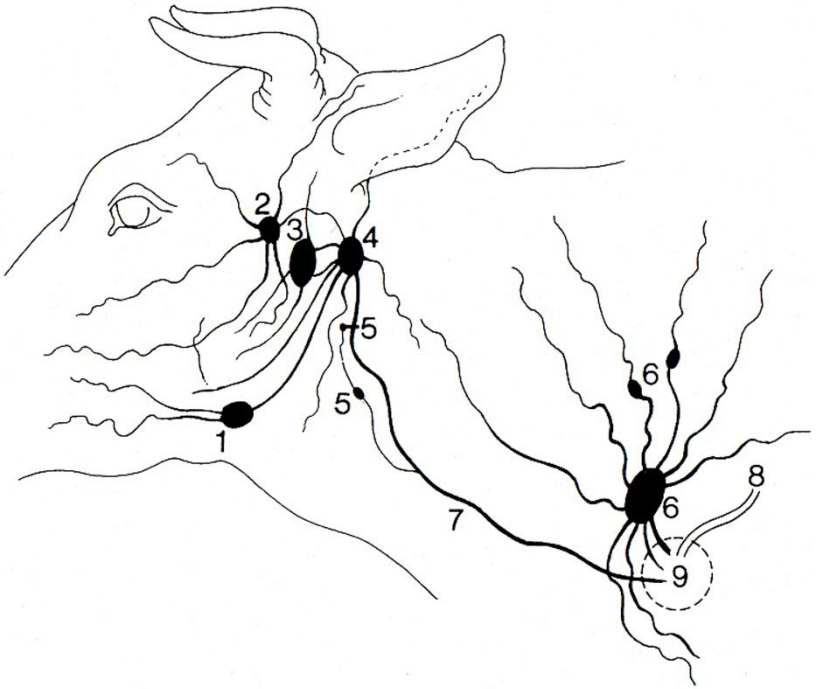
sternomandibularis

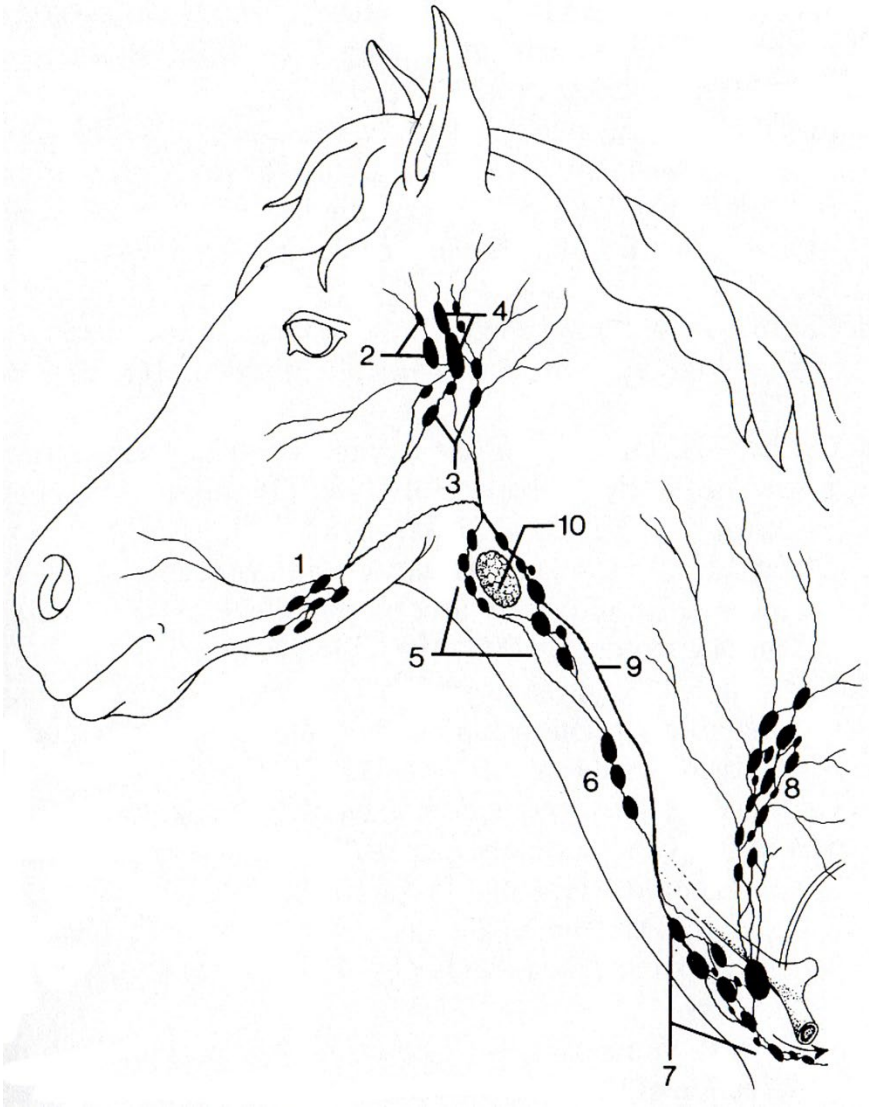
sternohyoideus

sternothyroideus

sternothyrohyoideus







Lymph Nodes of the Head and Neck

and There Respective Drainage

Lymphatic Structures of the Head and Neck

Ox

Lymph Nodes:

1 - mandibular

2 - parotid

3 - medial retropharyngeal

4 - lateral retropharyngeal

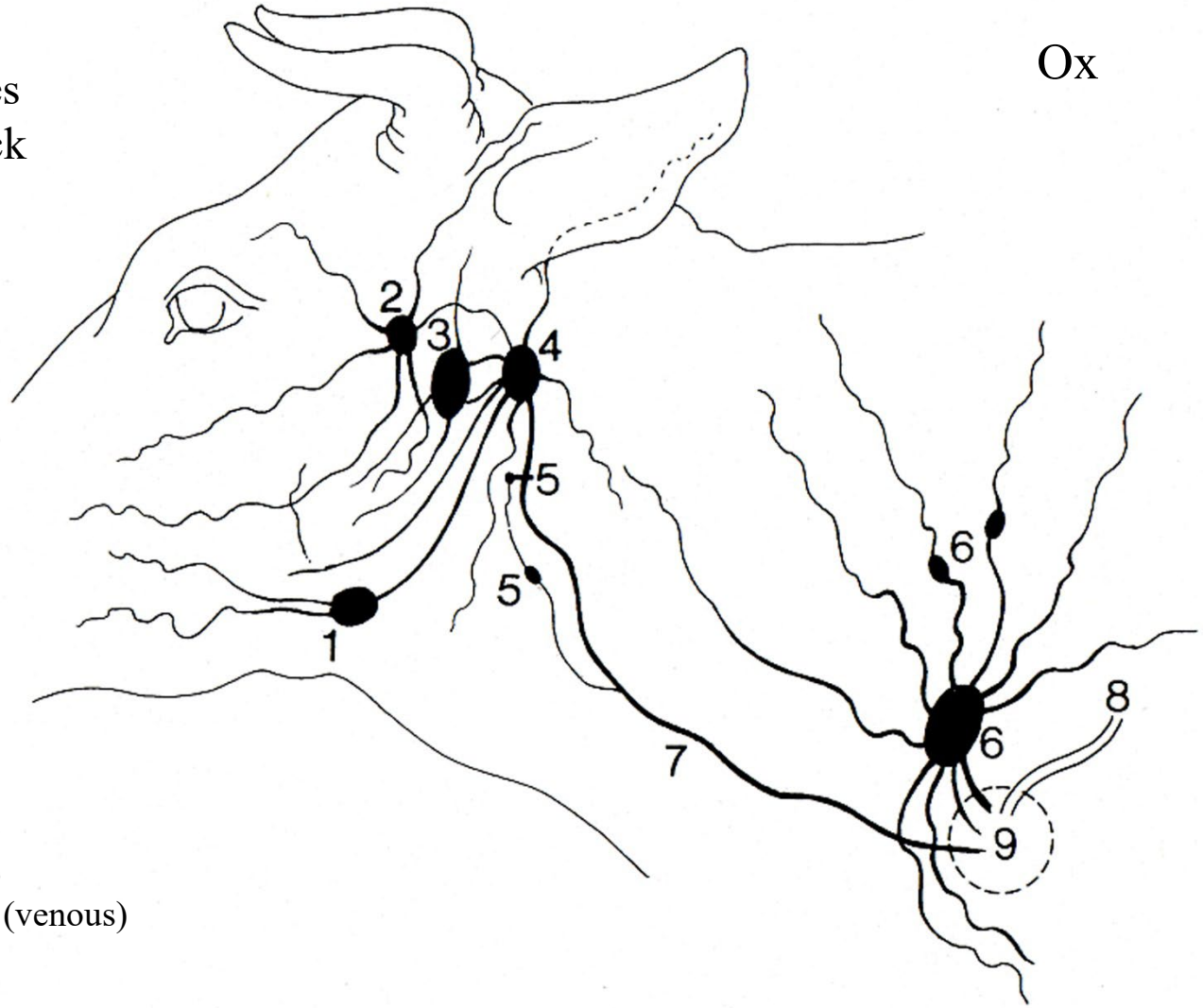
5 - deep cervical

6 - superficial cervical

7 - tracheal duct

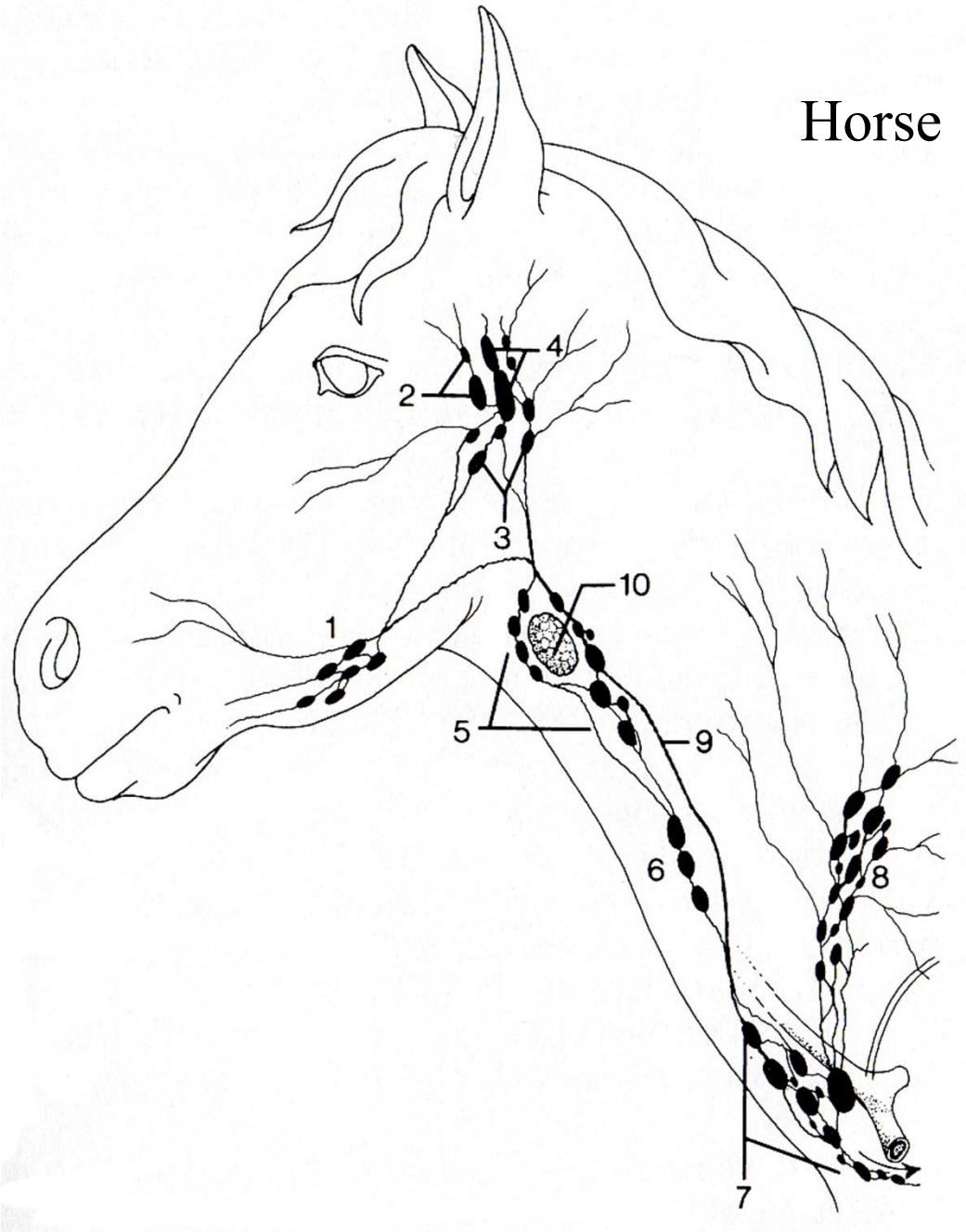
8 - thoracic duct

9 - brachiojugular junction (venous)



Lymphatic Structures of the Head and Neck

Horse



Lymph Nodes:

1 - mandibular

2 - parotid

3 - medial retropharyngeal

4 - lateral retropharyngeal

5 - cranial deep cervical

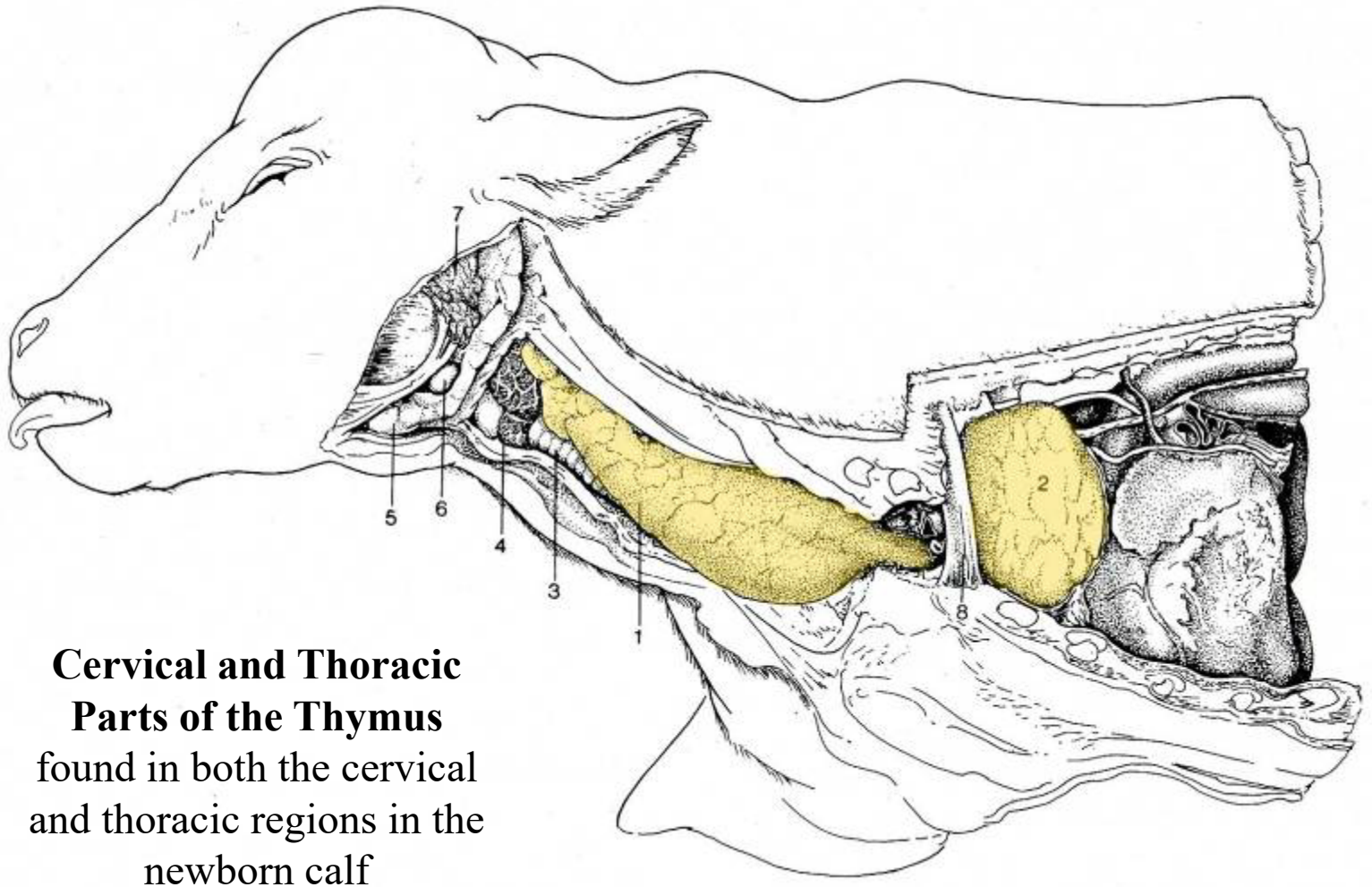
6 - middle deep cervical

7 - caudal deep cervical

8 - superficial cervical

9 - tracheal duct

10 - thyroid gland



Cervical and Thoracic Parts of the Thymus
found in both the cervical and thoracic regions in the newborn calf