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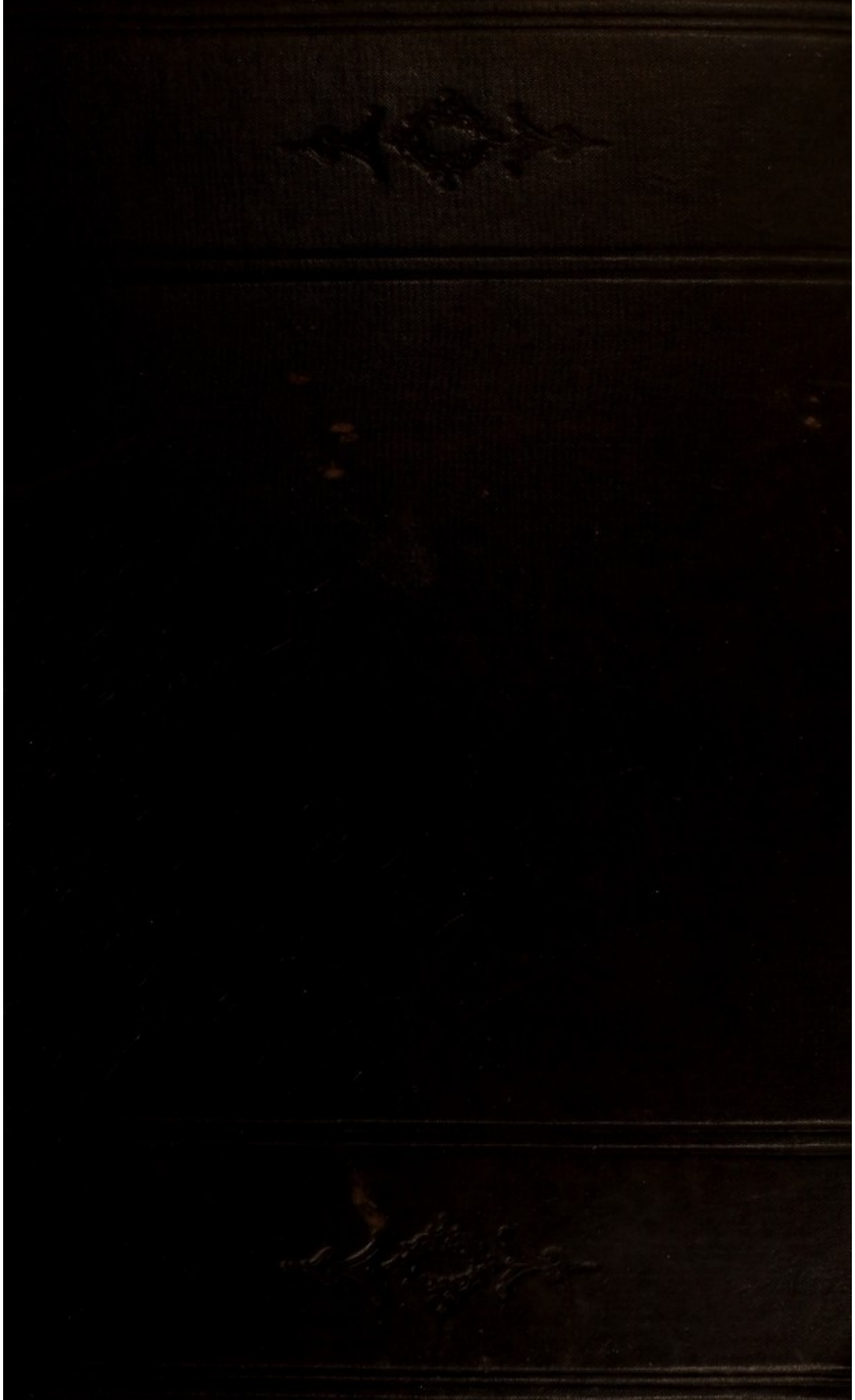

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F. G. Peachey

ANATOMY

DESCRIPTIVE AND TOPOGRAPHICAL

IN 625 ILLUSTRATIONS.

BY

CARL HEITZMANN M. D.

ENGLISH EDITION BY

LOUIS HEITZMANN M. D.

BONES. ARTICULATIONS. LIGAMENTS. — MUSCLES. FASCIAE. TOPOGRAPHY. — ORGANS OF SENSE. — VISCERA. TOPOGRAPHY. — NERVOUS SYSTEM. — VASCULAR SYSTEM. TOPOGRAPHY.

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PREFACE.

Sixteen years ago, „Heitzmann's Anatomischer Atlas" was first published. Since that time the work has been one of the principal works on anatomy in use in German and Austrian universities, and more than 30.000 copies of it have been sold.

As the work is now offered to the English reading medical public, it is by no means an exact translation from the German, and, especially in the second part, the text was often materially altered, in order to bring it more in unison with the leading English works, such as Gray and Quain. It will be noticed that a good many Latin words were allowed to remain in the figures, even where such words are not in general use in the English text books; wherever this was done, the corresponding English word was almost invariably added to the text, so that, even for those not well versed in Latin, there would be no difficulty in understanding them.

With the exception only of those figures especially so mentioned, the illustrations were all drawn on wood by the author, either from nature, or from preparations in the anatomical museum at Vienna.

In its present, slightly altered form, it is hoped that the work will serve both as an aid to the medical student, and as a work of reference to the physician.

Vienna, October 1886.

Louis Heitzmann.

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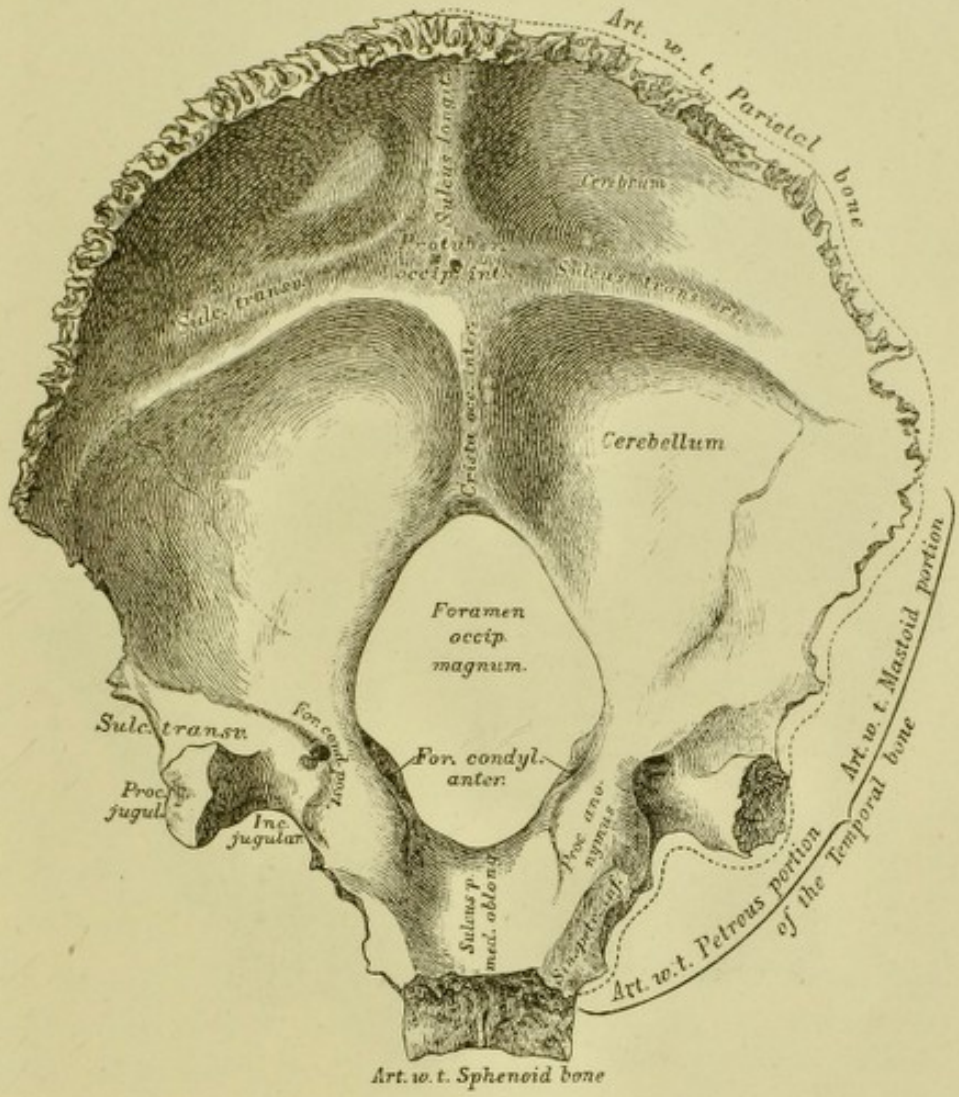
PART FIRST.

I.

BONES. ARTICULATIONS.

LIGAMENTS.

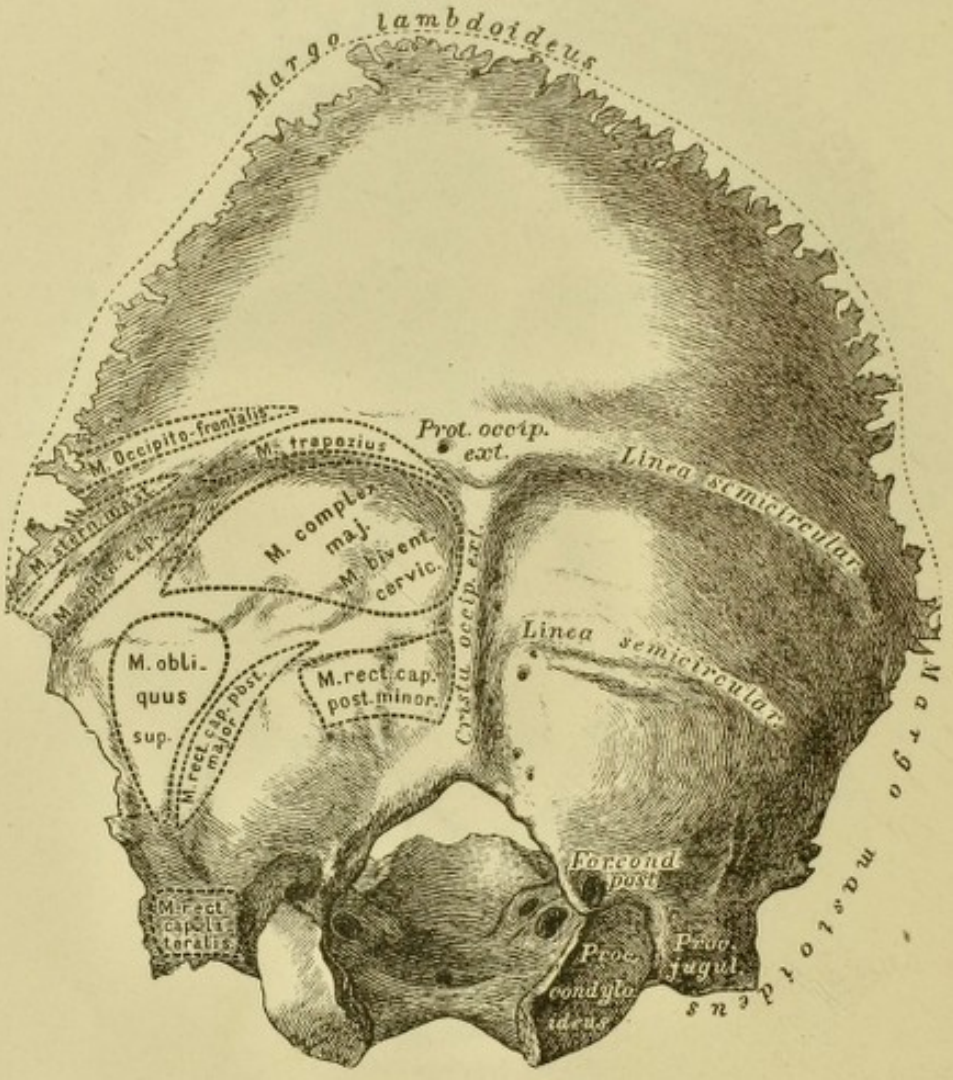


1. Occipital Bone, *Os occipitis,* from before.

The occipital bone is divided into 4 portions: 1. basilar portion; 2. occipital portion; 3. and 4. two condyloid portions.

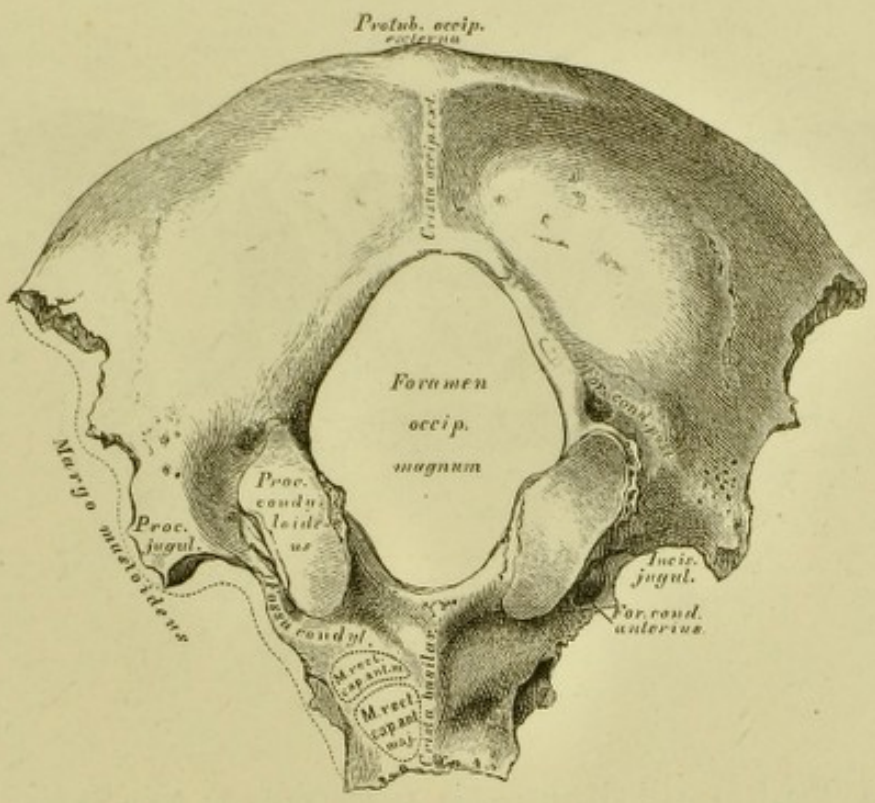
1. Basilar portion. The upper surface presents a sulcus for the *Medulla oblongata.* The anterior surface borders on the body of the sphenoid bone; the lateral surfaces articulate with the petrous portions of the temporal bones.

2. Occipital portion. In the middle of the anterior surface is the internal occipital protuberance, *Protuberantia occipitalis interna,* which is in the center of the *Eminentia cruciata interna;* the lower half of the perpendicular crus is called the internal occipital crest, *Crista occipitalis interna* (for the *Sinus occipitalis* and the *Falx cerebelli);* the upper half forms the longitudinal sulcus (for the longitudinal sinus); the two transverse crura contain the transverse sulcus (for the lateral sinus and attachment of the *Tentorium cerebelli*). In both upper fossae lie the occipital lobes of the cerebrum; in the lower the 2 hemispheres of the cerebellum.



2. Occipital Bone, *Os occipitis,* from behind.

2. Occipital portion with the external occipital protuberance, *Protuberantia occipitalis externa,* from which runs the external occipital crest, *Crista occipitalis externa,* to the *Foramen magnum;* transversely run both *Lineae semicirculares externae,* i. e. the superior and inferior curved lines (for the insertion of muscles and ligaments). The borders are the superior, *Margo lambdoideus,* for articulation with both parietal bones, and the inferior, *Margo mastoideus,* for articulation with the mastoid portion of the temporal bone.

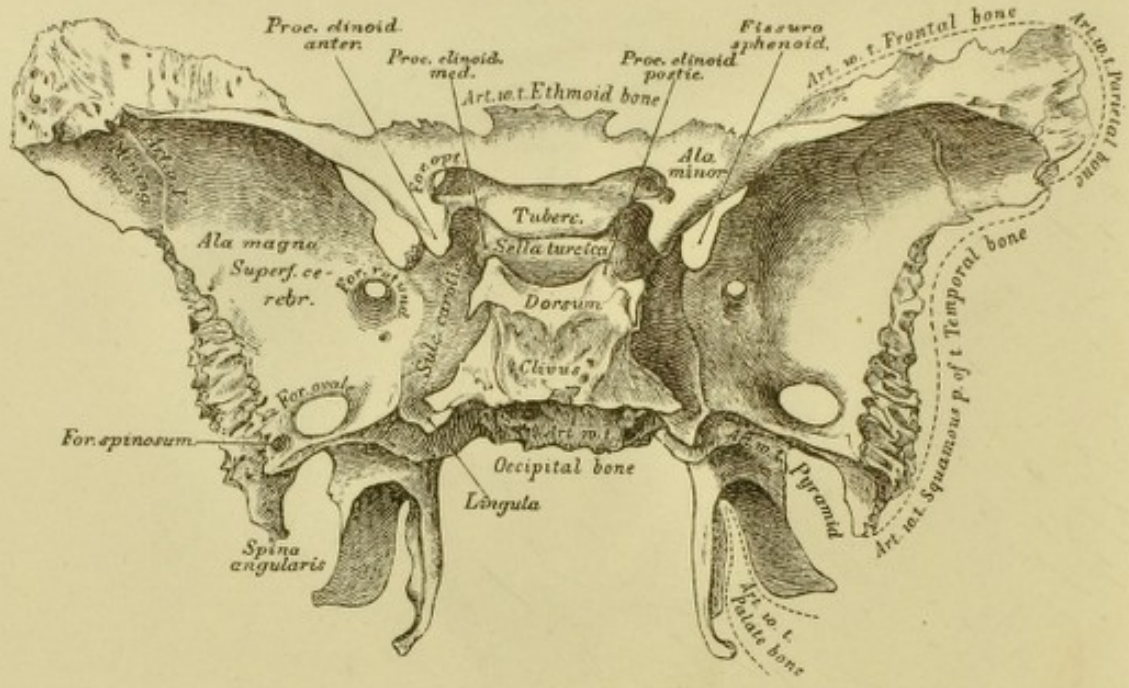


3. Occipital Bone, *Os occipitis,* from below.

3. and 4. Condyloid portions. On the upper surface (Fig. 1) the *Processus anonymus;* on the lower surface both condyloid processes for articulation with the atlas; behind these the flat condyloid fossae. In front of the condyloid process lies the anterior condyloid foramen (a short canal for the XII. pair of cranial nerves). The posterior condyloid foramen is not always present (for an *Emissarium Santorini*).

The inner border of the condyloid portions forms the lateral border of the *Foramen magnum;* the outer border shows the jugular notch, *Incisura jugularis,* and at its posterior end the jugular process. The upper surface of the process presents a groove (for the lateral sinus of the *Dura mater*).

The occipital bone articulates with 6 bones: with the 2 parietal bones, the 2 temporal bones, with the sphenoid bone and with the first cervical vertebra (atlas).



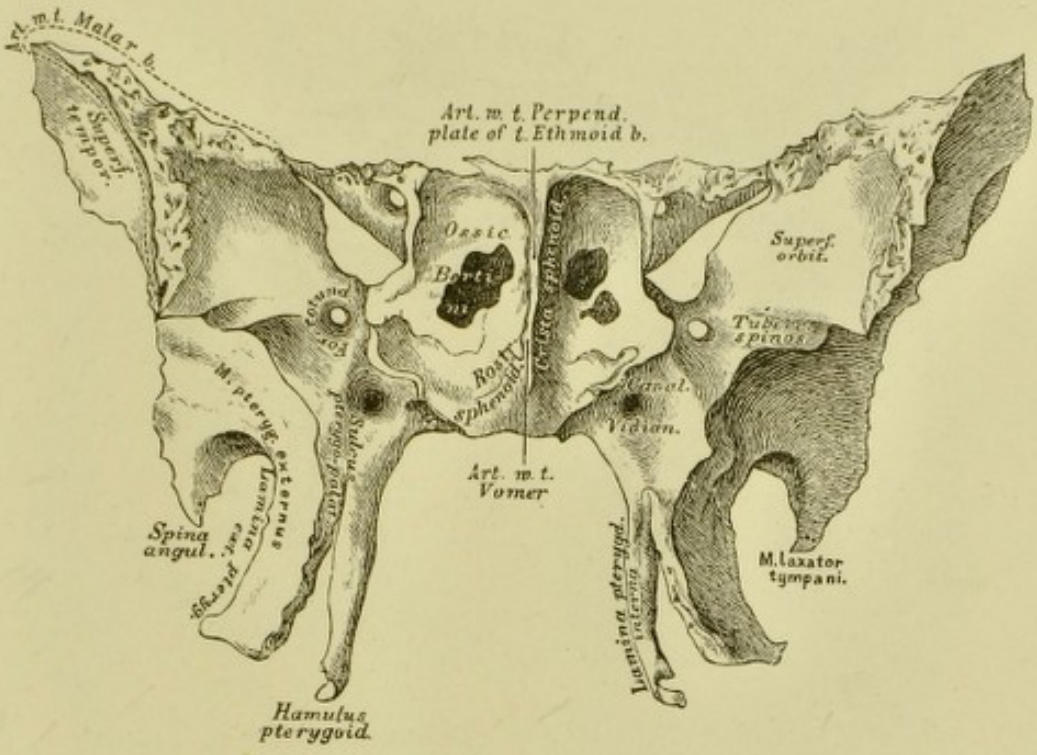
4. Sphenoid Bone, *Os sphenoideum,* from above.

The sphenoid bone is divided into: 1. the body, 2. the wings; the latter form 3 pairs: a) the lesser wings, *Alae minores;* b) the greater wings, *Alae magnae,* and c) the wing like or pterygoid processes, *Processus pterygoidei.*

Body. On the upper surface the pituitary fossa or *Sella turcica* (for the *Hypophysis cerebri*); its posterior wall, the *Dorsum sellae* or *ephippii,* with the posterior clinoid processes, *Processus clinoidei postici.* The posterior surface of the *Dorsum sellae* is continuous with the basilar groove of the occipital bone-*Clivus.* In front of the pituitary fossa the *Tuberculum ephippii;* on both sides of this the middle clinoid processes. On the lateral surfaces of the body the cavernous groove, *Sulcus caroticus* (for the *Carotis*) with the *Lingula.*

Lesser wings; each arises from the body by 2 roots, between which is the optic foramen; the ends looking toward the *Dorsum sellae* form the anterior clinoid processes, *Processus clinoidei anteriores.*

Greater wings each with three surfaces and three borders. The cerebral surface, *Superficies cerebralis,* with the furrow for the middle meningeal artery and vein. The inner segment of the upper border forms with the lower surface of the lesser wing the sphenoidal fissure, *Fissura sphenoidalis (Fiss. orbitalis superior).* The posterior border is prolonged into the spinous process, *Spina angularis.* The *Foramen rotundum* (for the 2nd division of the V. pair of cranial nerves); the *Foramen ovale* (for the 3rd division of the V. pair); the *Foramen spinosum* (for the middle meningeal artery).

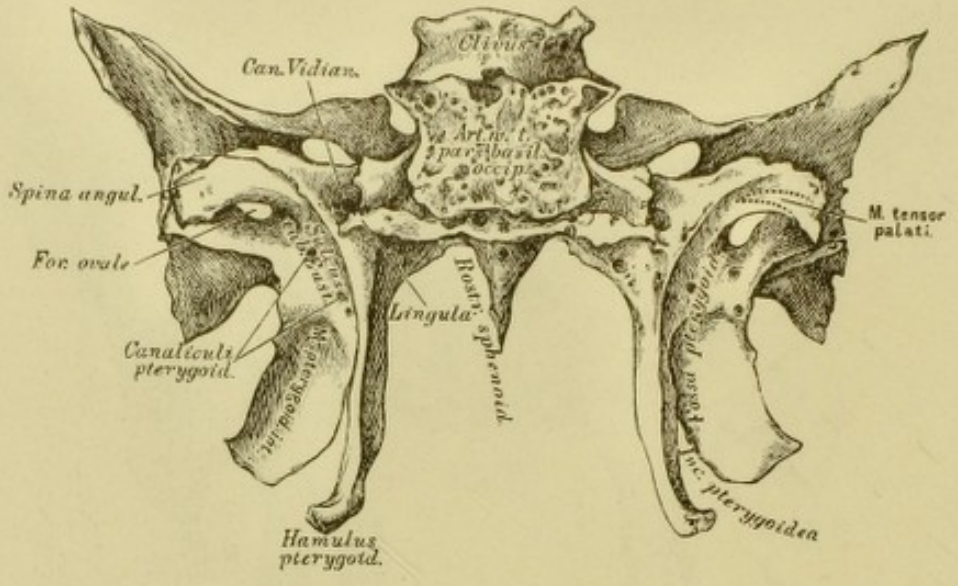


5. Sphenoid Bone, *Os sphenoideum,* from before.

Body. On the anterior surface are two irregular openings, which lead into the sphenoidal sinuses, and are separated from each other by the *Crista sphenoidalis;* this becomes elongated in front, forming the *Rostrum sphenoidale.*

The pterygoid processes are formed of two plates, the external and internal pterygoid plates, *Lamina pterygoidea externa et interna,* separated behind by an intervening notch, the *Fossa pterygoidea*; the inner plate ends in the hamular process, *Hamulus pterygoideus.* Between both plates is the *Incisura pterygoidea* (Fig. 6). At the base of the pterygoid process is the Vidian canal, running in a horizontal direction, and from whose anterior opening the pterygo-palatine groove, *Sulcus pterygo-palatinus,* passes in a downward course.

The *Ossicula Bertini* or sphenoidal turbinated bones are triangular bones, partially covering the openings of the sphenoidal sinuses, which latter are situated on the anterior wall of the body of the sphenoid bone.

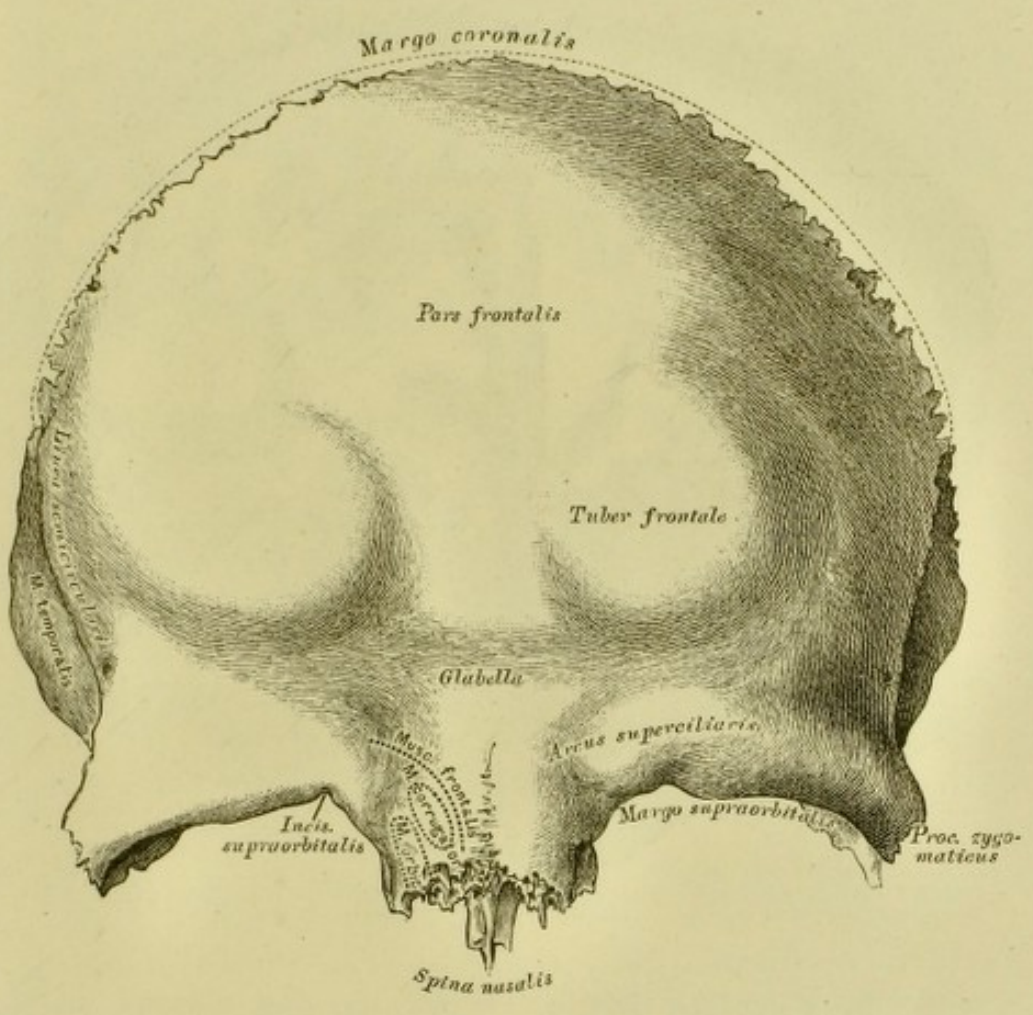


6. Sphenoid Bone, *Os sphenoideum* from behind.

Body. The posterior surface articulates with the basilar portion of the occipital bone.

Pterygoid processes: at the upper half of the posterior border of the inner plate is the sulcus for the Eustachian tube, *Sulcus tubae Eustachianae;* between this and the *Foramen ovale* are the *Canaliculi pterygoidei;* the outer of which has its orifice on the cerebral surface of the great wing between the *Lingula* and *Foramen rotundum* (Fig. 4), the inner in the Vidian canal.

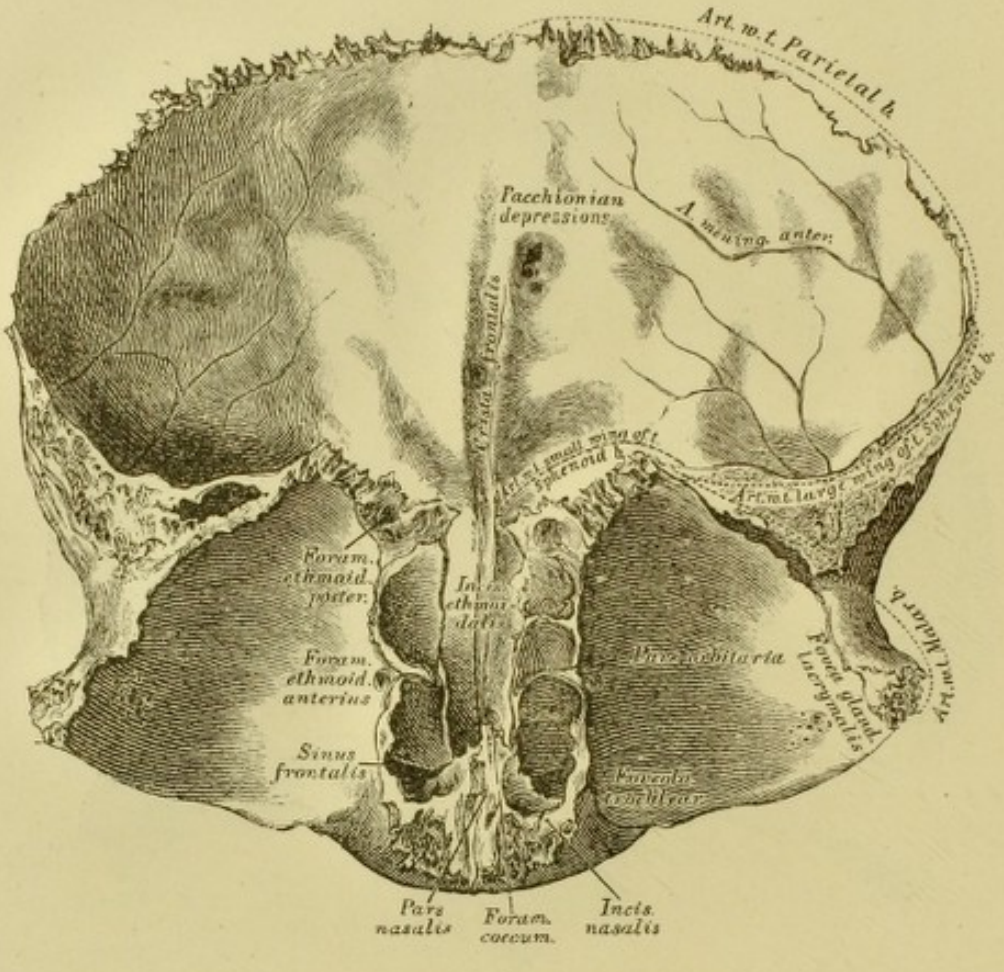
The sphenoid bone articulates with all the cranial bones and 5 bones of the face, namely with the 2 malar bones, the 2 palate bones and the vomer.



7. Frontal Bone, *Os frontis,* from before.

The frontal bone is divided into: 1 frontal portion, *Pars frontalis*, 2 orbital portions, *Partes orbitales*, and 1 nasal portion, *Pars nasalis.*

On the frontal portion are the two supra-orbital arches, *Margines supraorbitales*, at the inner third of which is the supra-orbital notch or foramen, *Incisura supraorbitalis (Foramen supraorbitale);* externally the external angular or zygomatic process, *Processus zygomaticus.* On the outer surface of the frontal portion the superciliary ridges, *Arcus superciliares;* above them the frontal eminences, *Tubera frontalia*, between which latter is the *Glabella.* Running upward from the zygomatic process is the temporal ridge or *Linea semicircularis.* At the nasal portion the superior nasal spine, *Spina nasalis superior,* runs forward, above this is the deep-dented *Incisura nasalis.*

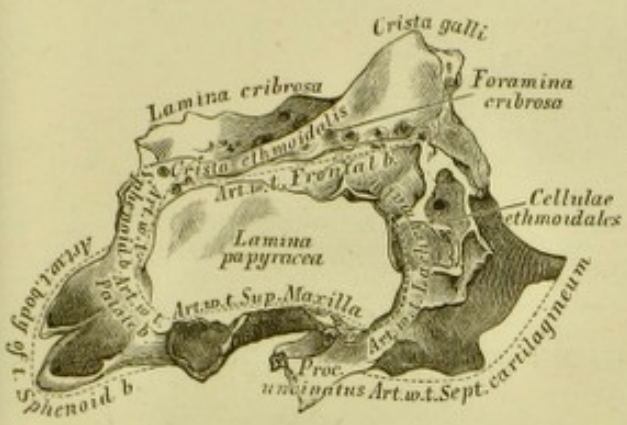


8. Frontal Bone, *Os frontis,* from behind.

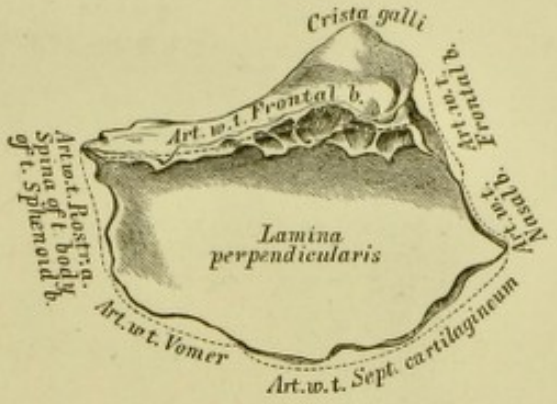
Frontal portion. The inner surface is divided by the frontal crest, *Crista frontalis*, into 2 halves; on both sides are Pacchionian depressions. The border of the frontal portion, *Margo coronalis*, commences behind the zygomatic process with a triangular, serrated surface.

The two orbital portions are separated from each other by the ethmoidal notch, *Incisura ethmoidalis;* on the inferior surface close to the zygomatic process is the lachrymal fossa, *Fovea glandulae lacrymalis;* toward the nasal portion a depression, *Foveola trochlearis*, sometimes the *Hamulus trochlearis* (for the pulley of the superior oblique muscle of the eye). The inner border is broad and cellular, the compartments leading to the frontal sinuses, *Sinus frontales;* between the outer edge of the inner border and the contiguous *Lamina papyracea* of the ethmoid bone are the anterior and posterior ethmoidal foramina, *Foramen ethmoidale anterius et For. ethm. posterius;* the latter sometimes formed only by the frontal bone. On the nasal portion behind the superior nasal spine is the *Foramen coecum* (for a vein); above it the *Incisura nasalis.*

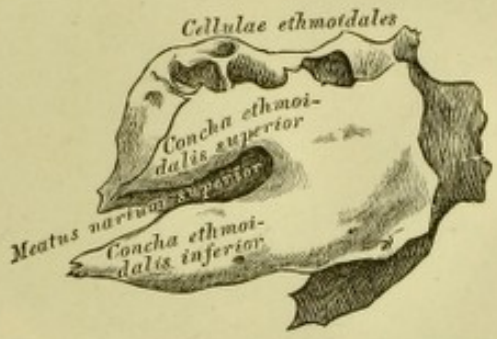
The frontal bone articulates with 12 bones; with the 2 parietal, the sphenoid, the ethmoid bones; with the 2 nasal, the 2 superior maxillary, the 2 lachrymal and the 2 malar bones.



9. Ethmoid Bone, *Os ethmoideum*, from the outside.



10. Ethmoid Bone; perpendicular plate.



11. Ethmoid Bone; inner surface of the labyrinth.

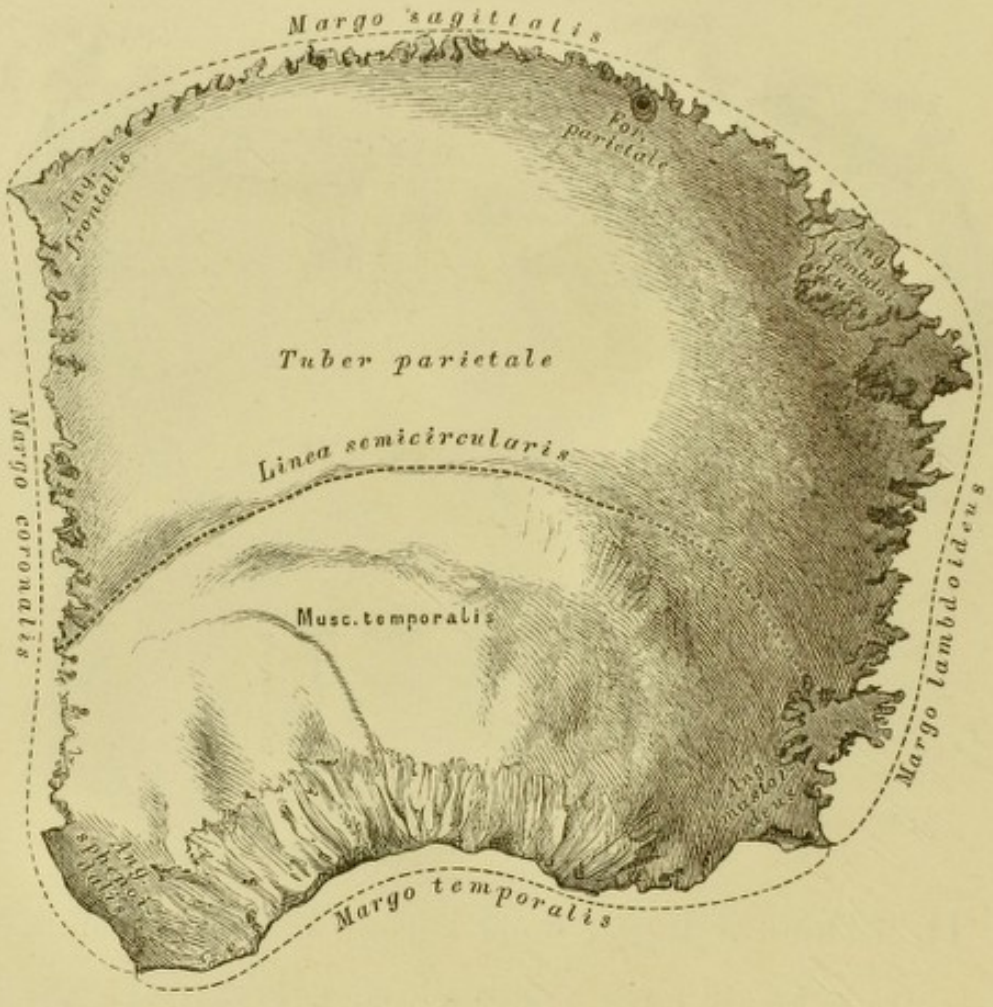
The ethmoid bone is divided into: 1. cribriform plate, *Lamina cribrosa;* 2. perpendicular plate, *Lamina perpendicularis;* 3. and 4. the cellular lateral masses, the ethmoidal labyrinths.

The cribriform plate is divided into 2 halves by the *Crista ethmoidalis*, which, projecting upward, forms the *Crista galli*. The cribriform plate is perforated by the *Foramina cribrosa*. From its under surface the perpendicular plate (Fig. 10), which forms the upper part of the bony *Septum narium*, decends.

The labyrinth (Fig. 11) is divided into the ethmoidal cells, *Cellulae ethmoidales* (anterior, middle and posterior), which are closed externally by the *Lamina papyracea (Os planum);* internally they are limited by the superior and inferior ethmoidal turbinated bones, *Concha ethmoidalis superior et inferior*, between which lies the superior meatus of the nose, *Meatus narium superior.*

From the anterior end of the inferior ethmoidal turbinated bone (middle turbinated bone), and from the lower walls of the anterior ethmoidal cells, there projects the thin, serrated unciform process, *Processus uncinatus.*

The ethmoid bone articulates with 15 bones; with 4 cranial bones, the sphenoid, the 2 sphenoidal turbinated *i. e. Ossicula Bertini,* the frontal, and 11 bones of the face; the 2 nasal bones, 2 superior maxillary, 2 lachrymal, 2 palate, 2 inferior turbinated, and the vomer.



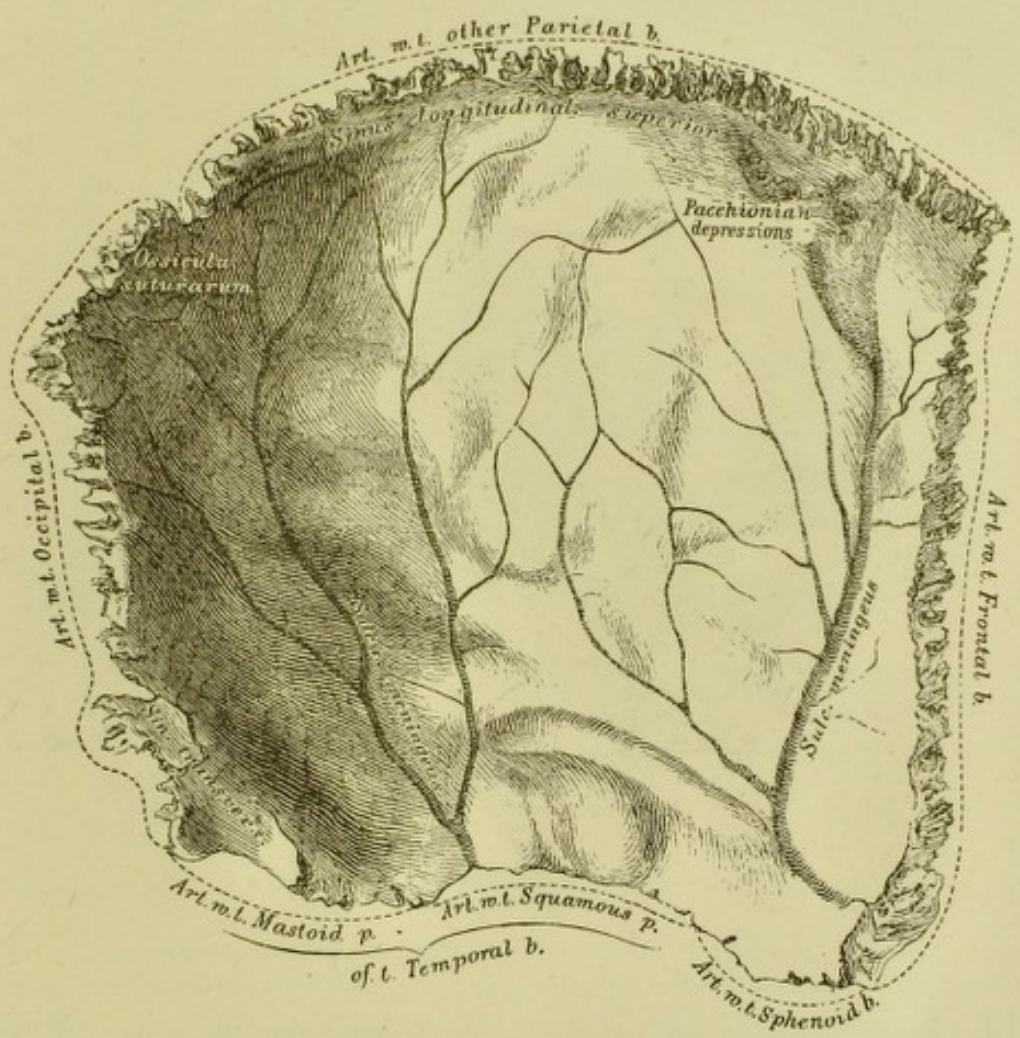
12. Left Parietal Bone, *Os parietale,* from the outside.

On the outer surface of the parietal bone about its center, the parietal eminence, *Tuber parietale,* projects; the surface is divided into 2 halves by the temporal ridge, *Linea semicircularis.*

The 4 borders are: the superior, *Margo sagittalis;* the inferior, *Margo temporalis (squamosus);* the anterior, *Margo coronalis,* and the posterior, *Margo lambdoideus.*

The 4 angles are: the anterior superior, *Angulus frontalis;* the anterior inferior, *Angulus sphenoidalis;* the posterior superior, *Angulus lambdoideus (occipitalis),* and the posterior inferior, *Angulus mastoideus.*

At the posterior fourth of the *Margo sagittalis* is the *Foramen parietale,* for an *Emissarium Santorini* (this is often wanting).

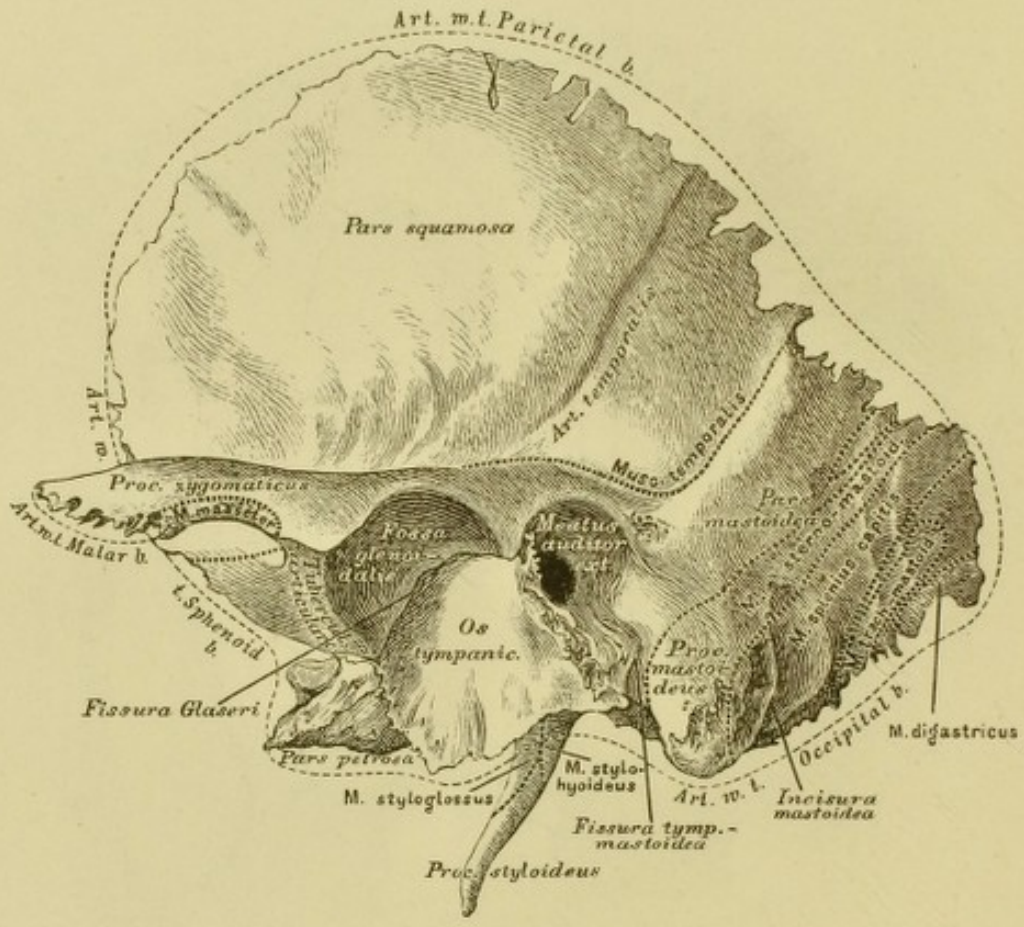


13. Left Parietal Bone, *Os parietale,* from the inner side.

The inner concave surface shows *Impressiones digitatae* and *Juga cerebralia,* and along the upper border Pacchionian depressions; further 2 tree-like, ramifying grooves, *Sulci meningei,* (for the middle meningeal artery and the accompanying veins); finally 2 venous *sulci.* Of the latter the one along the upper border forms with the one on the bone of the other side, a channel for the superior longitudinal sinus, *Sinus longitudinalis superior;* the second, at the posterior inferior angle of the bone is for the transverse sinus.

In the posterior superior angle of the figure a Wormian bone, *Ossiculum suturarum, Wormianum,* is represented.

The parietal bone articulates with 5 bones, with the parietal bone of the other side, the occipital bone, the frontal bone, the temporal bone and the sphenoid bone.

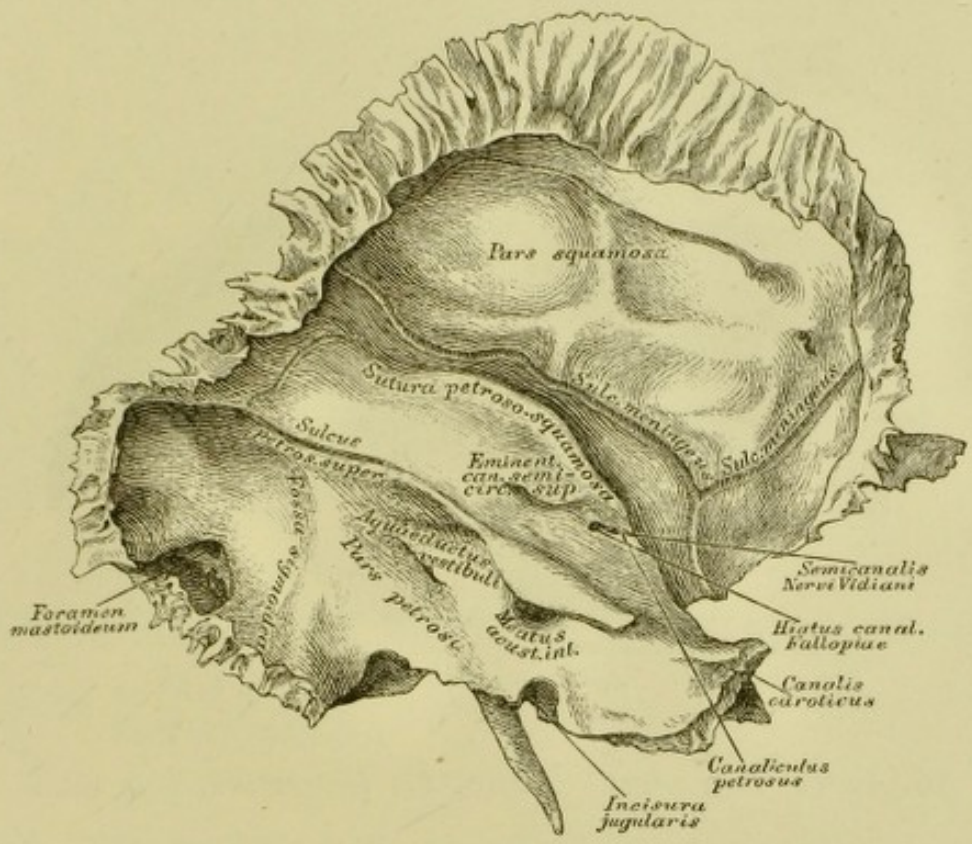


14. Left Temporal Bone, *Os temporum*, from the outside.

The temporal bone is divided into 3 parts: 1. the squamous portion, *Pars squamosa s. Squama*, 2. the petrous portion, *Pars petrosa*, and 3. the mastoid portion, *Pars mastoidea*.

The squamous portion has on the outer surface in front and above the *Meatus auditorius externus*, the zygomatic process, *Processus zygomaticus*, formed by 2 roots; between the roots the glenoid fossa, *Fossa glenoidalis* (for the condyle of the inferior maxilla); in front of this, the *Eminentia articularis* or *Tuberculum articulare*. The furrow for the temporal artery is not constant.

The mastoid portion shows on the outer surface the mastoid process, *Processus mastoideus*, which is grooved from below by the *Incisura mastoidea*, and is limited at the posterior periphery of the external auditory meatus by the *Fissura tympano-mastoidea* (in this the end orifice of the *Canaliculus mastoideus*). The borders are: the superior, strongly serrated, for articulation with the *Angulus mastoideus* of the parietal bone, and the posterior, slightly serrated for articulation with the inferior portion of the lateral border of the occipital bone.



15. Left Temporal Bone, *Os temporum,* from the inner side.

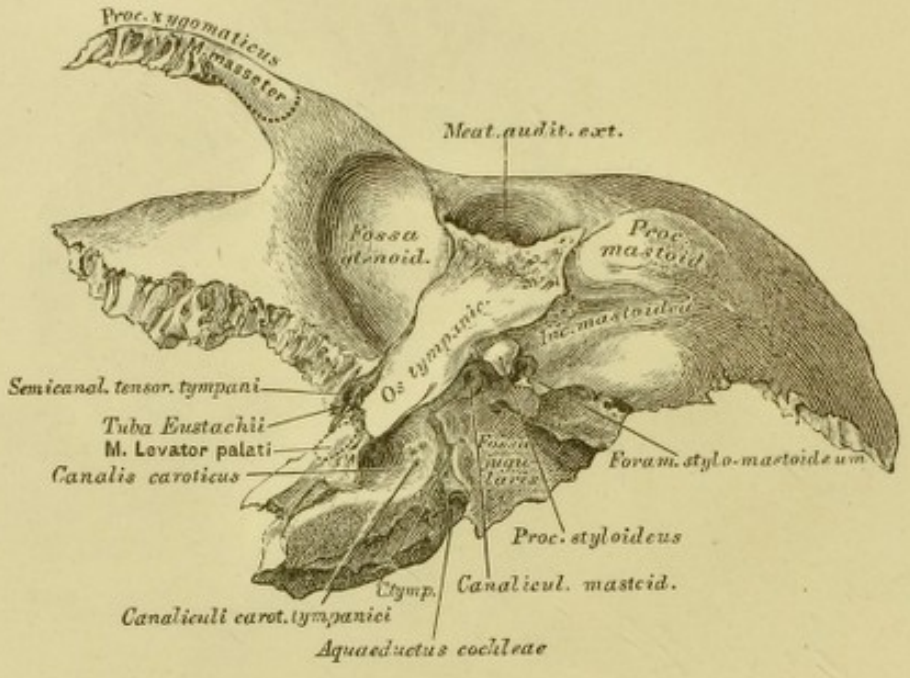
The squamous portion shows on its internal surface strong eminences and depressions for the cerebral convolutions, *Impressiones digitatae* and *Juga cerebralia,* and 2 grooves (for the middle meningeal artery and vein).

The petrous portion has 3 surfaces (posterior, superior and inferior) and 3 borders (superior, anterior and posterior).

On the smallest posterior surface the oval orifice of the *Meatus auditorius internus (Meatus acusticus internus),* 3‴ externally of this, that of the *Aquaeductus vestibuli.* The largest superior surface is separated from the squamous portion by the *Sutura (Fissura) petroso-squamosa;* it has an eminence for the superior semicircular canal, *Eminentia canalis semicircularis superioris.* Near the summit of the pyramid the inner opening of the carotid canal, *Canalis caroticus,* from which a groove *(Semicanalis Nervi Vidiani)* leads externally to a small foramen, the *Hiatus (Apertura spuria) canalis Fallopiae.* In this groove opens the small *Canaliculus petrosus.*

The upper border of the petrous portion is grooved for the superior petrosal sinus, *Sulcus petrosus superior;* the posterior border excavated by the *Incisura jugularis.*

The mastoid portion shows on its inner surface a deep groove, *Fossa sigmoidea* (for the *Sinus transversus);* a foramen, not always present, the *Foramen mastoideum* (for an *Emissarium Santorini),* leads from this groove to the external surface of the bone.

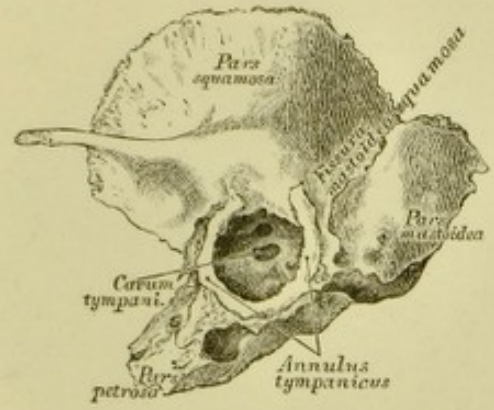


16. Left Temporal Bone, *Os temporum*, from below.

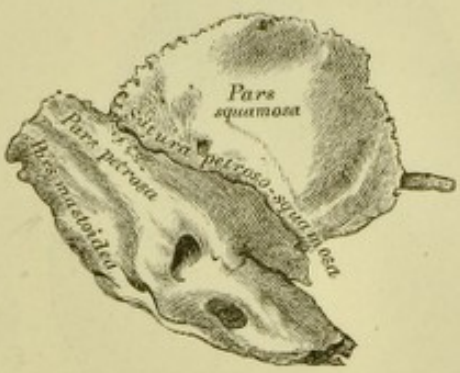
The inferior surface of the petrous portion forms at its external part a small plate of bone, *Os tympanicum*, which surrounds the *Meatus auditorius externus* inferiorly and anteriorly, and is separated from the glenoid fossa of the squamous portion by the Glaserian fissure, *Fissura Glaseri* (Fig. 14).

Passing from within outward we have: the *Foramen stylo-mastoideum*, below the external auditory meatus (termination of the *Aquaeductus Fallopii*); the *Processus styloideus*; the *Fossa jugularis* with the small orifice of the *Canaliculus mastoideus*. — Near the jugular fossa the lower opening of the *Canalis caroticus*, and above this two small canals, *Canaliculi carotico-tympanici* (to the tympanic carity); toward the posterior border the triangular orifice of the *Aquaeductus cochleae*. Between the *Incisura jugularis* and the lower opening of the carotid canal lies the *Fossula petrosa*, with the origin of the *Canaliculus tympanicus*.

At the shortest anterior border of the petrous portion (at its outer end), lies an opening divided into 2 halves by a thin plate of bone; the upper smaller one is the commencement of the *Semicanalis tensoris tympani*, the lower one the opening of the *Tuba Eustachii*.



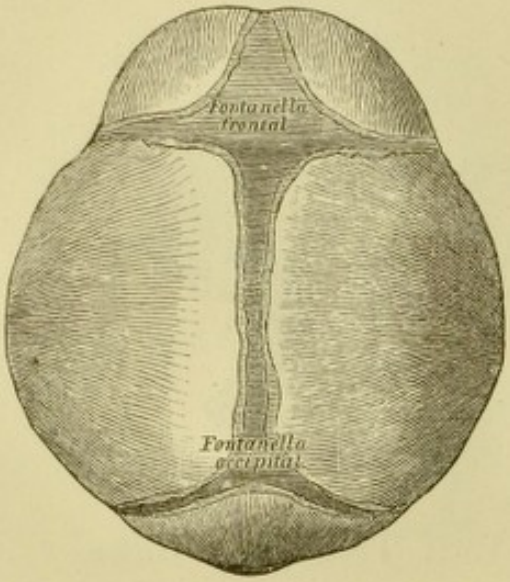
17. Left Temporal Bone at birth, from the outside.

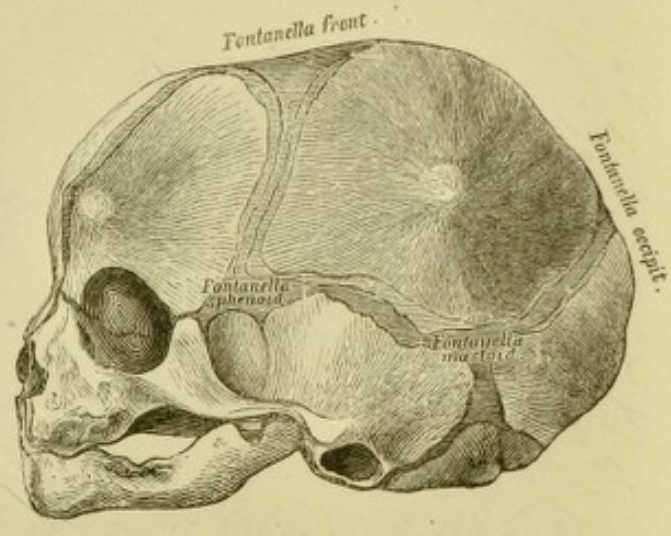


18. Left Temporal Bone at birth, from the inner side.

In the first year of life the temporal bone consists of three pieces: a) Squamous portion, *Pars squamosa*, b) Auditory process or *Annulus tympanicus*, and c) Petroso-mastoid portion, *Pars petroso-mastoidea*. The *Pars petroso-mastoidea* is separated from the *Pars squamosa* by the *Sutura petroso-squamosa* and the *Fissura mastoideo-squamosa* (Jos. Gruber). The *Annulus tympanicus* contains the *Membrana tympani;* in the tympanic cavity, *Cavum tympani* (behind the *Membrana tympani*) the *Foramen ovale* and *Foramen rotundum* can be seen.

The temporal bone articulates with 5 bones: with the occipital, the parietal, the sphenoid, the malar and the inferior maxillary bones.

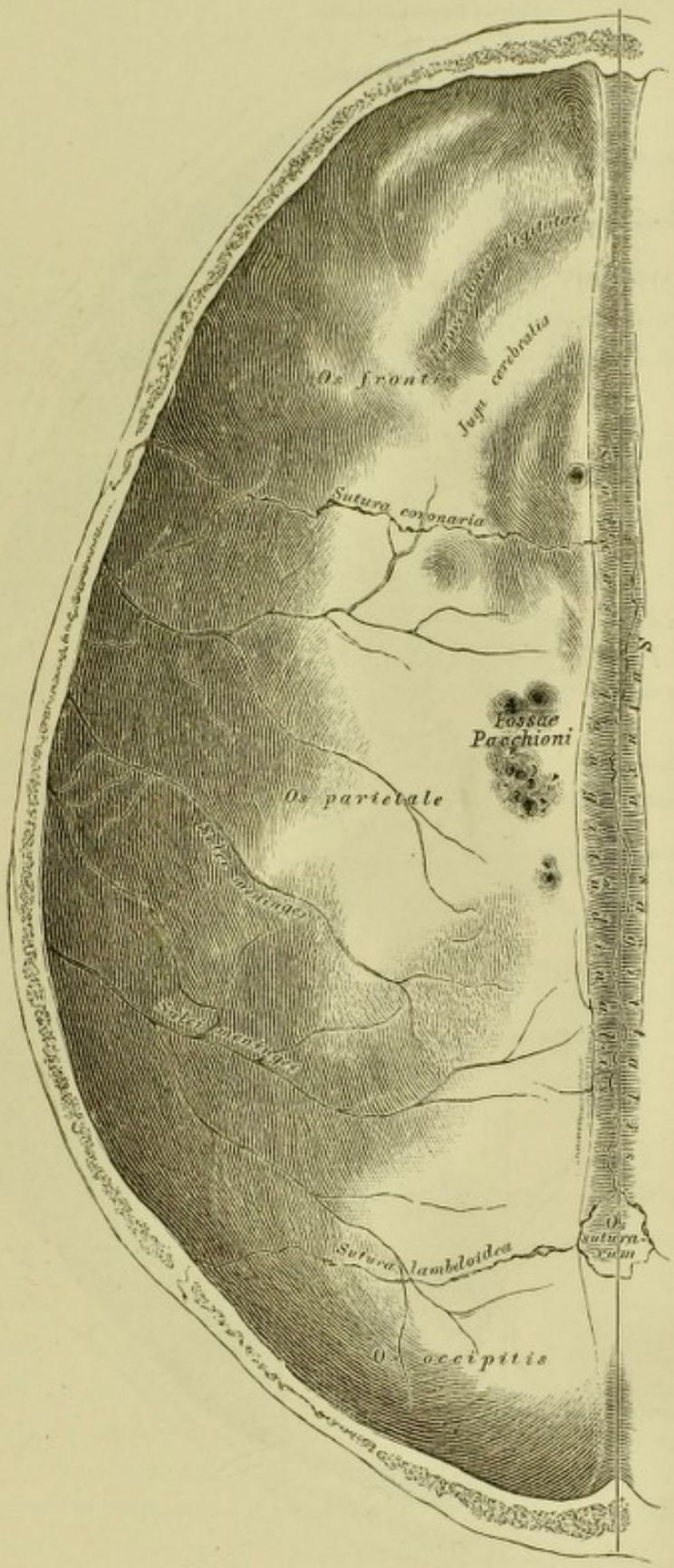




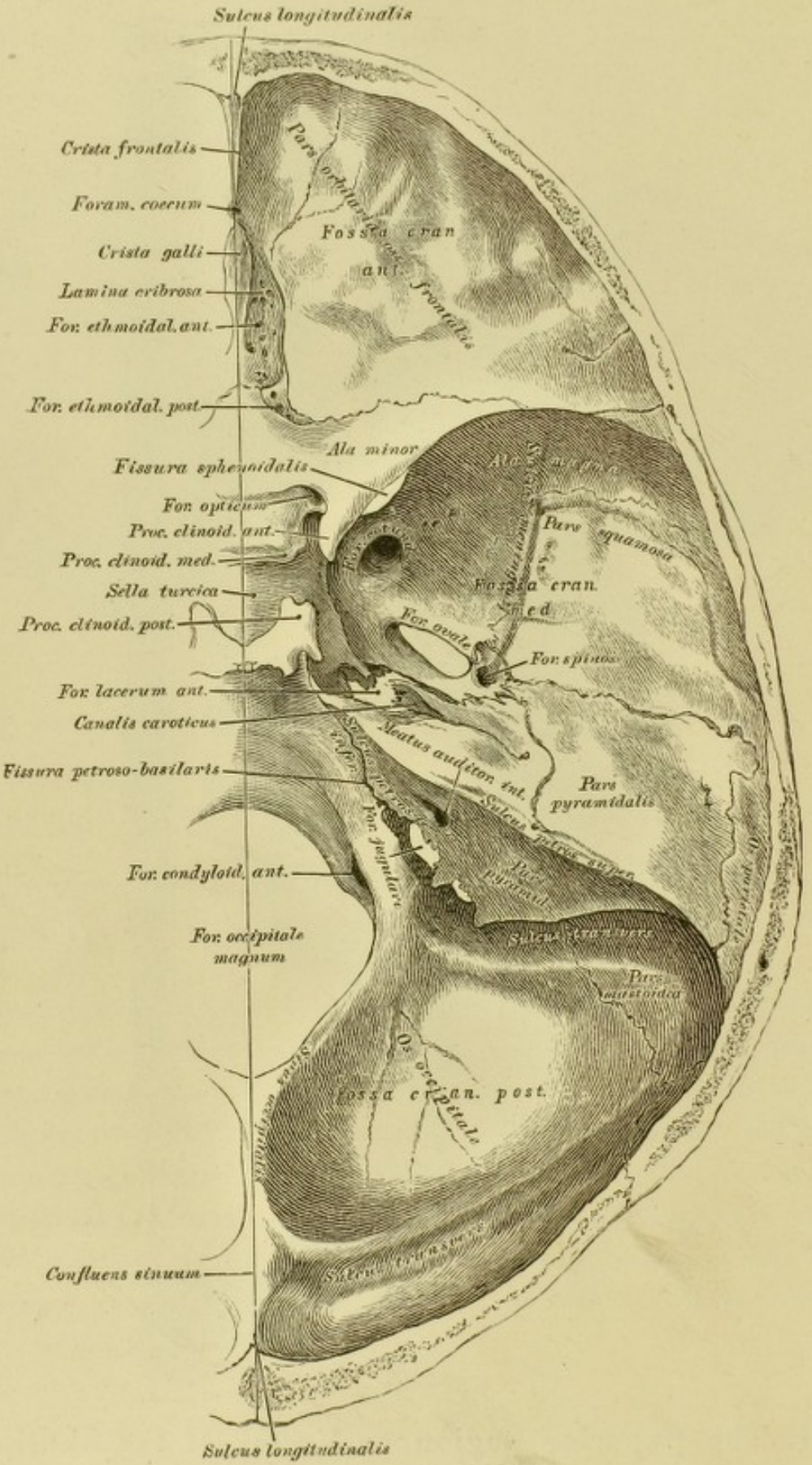
19. Skull of a Foetus, sup. view ($^1/_2$ nat. size).

20. Skull of a Foetus, side view ($^1/_2$ nat. size).

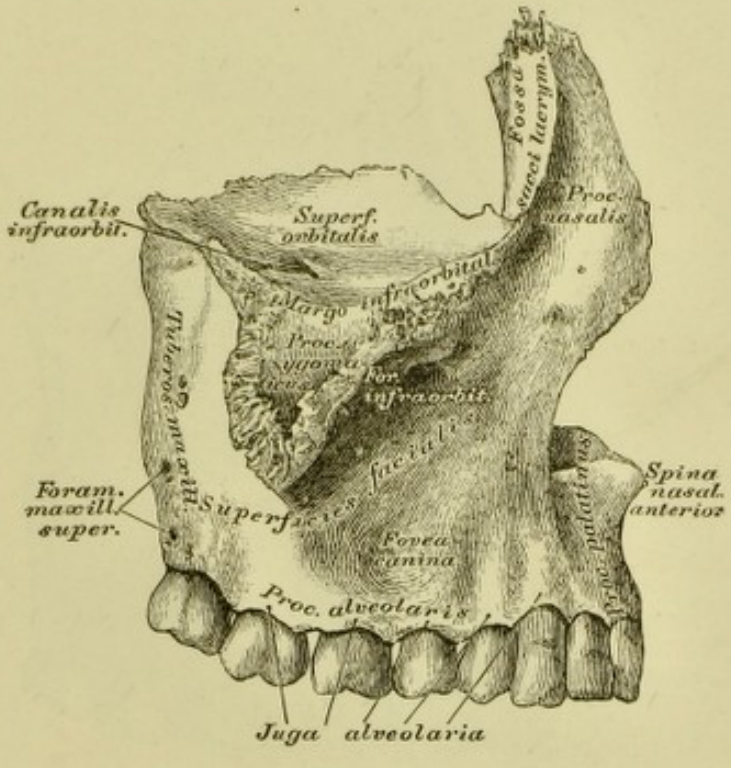
Fontanelles. There are: 1 anterior fontanelle, *Fontanella frontalis*, 1 posterior fontanelle, *Fontanella occipitalis*, 2 sphenoidal fontanelles, *Fontanellae sphenoidales*, and 2 mastoid fontanelles, *Fontanellae mastoides*. The anterior fontanelle is of rhombic form and remains till up to the second year of life; the smaller triangular posterior fontanelle is almost closed at the time of birth; the 2 sphenoidal fontanelles at the *Angulus sphenoidalis* and the 2 mastoid fontanelles at the *Angulus mastoideus* of the parietal bone have also almost disappeard at birth. The place of the fontanelles is taken later on by the sutures, the coronal, sagittal, lambdoid, mastoid and abnormal frontal sutures. If the brain is fully developed, the sutures blend by synostoses.



21. The Superior Region or Vertex of the Skull,
Fornix cranii,
from the inner side.



22. The Base of the Skull, *Basis cranii*, from the inner side.

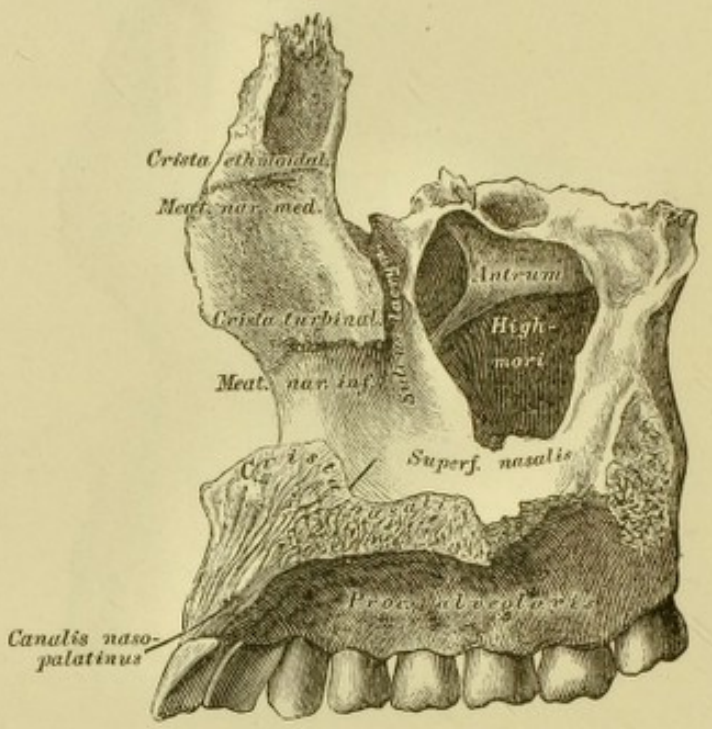


23. Right Superior Maxillary Bone, *Maxilla superior,*

from the outside.

The superior maxillary bone is divided into the body and 4 processes, the nasal process, *Processus nasalis seu frontalis,* the malar or zygomatic process, *Processus zygomaticus,* the palatine process, *Processus palatinus,* and the alveolar process, *Processus alveolaris.*

The body has 3 surfaces: the external or facial surface, *Superficies facialis,* the superior or orbital surface, *Superficies orbitalis,* and the internal or nasal surface, *Superficies nasalis.* The external surface is divided into an anterior or facial and a posterior or zygomatic portion; the anterior concave has at its upper border the infraorbital foramen, and below this the canine fossa, *Fovea canina;* the posterior convex is limited posteriorly by the maxillary tuberosity, *Tuberositas maxillaris,* on which are foramina, *Foramina maxillaria superiora,* leading to vessel- and nerve canals (posterior dental canals). The orbital surface forms with its anterior border a part of the *Margo infraorbitalis;* the posterior border forms with the inferior border of the orbital surface of the great wing of the sphenoid the *Fissura orbitalis inferior* (sphenomaxillary fissure); from this a furrow, which changes in its course to a canal, the infraorbital canal, leads to the infraorbital foramen.

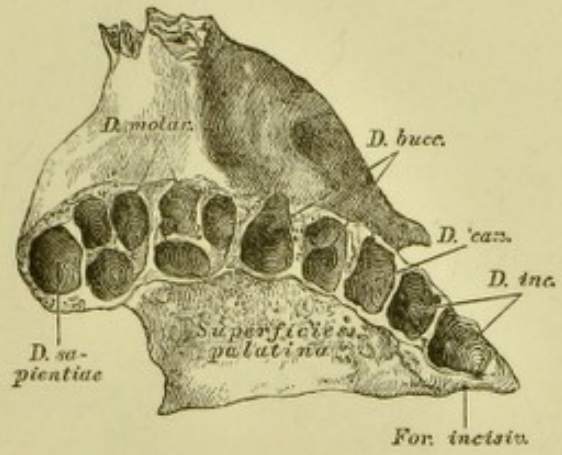


24. Right Superior Maxillary Bone, *Maxilla superior,* from the inner side.

The nasal surface of the body shows the large opening of the antrum of Highmore; in front of this a semi-canal, the lachrymal groove, *Sulcus lacrymalis.*

The outer surface of the nasal process of the superior maxilla (Fig. 23) is divided into an anterior and a posterior portion, by an elongation of the *Margo infraorbitalis;* the posterior portion forms the *Fossa sacci lacrymalis,* which is continued into the *Sulcus lacrymalis.* The inner surface of the nasal process is transversely cut by a rough crest, the superior turbinated crest or *Crista ethmoidalis* (not constant); a thumb's breadth below this the inferior turbinated crest or *Crista turbinalis,* passes transversely across the surface, from the lower end of the *Sulcus lacrymalis;* between both crests lies the middle meatus, *Meatus narium medius.*

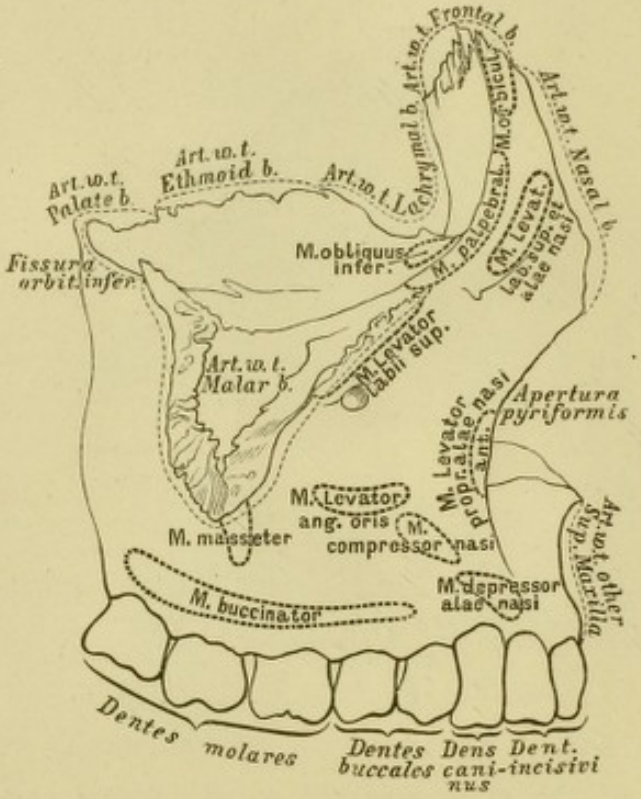
The zygomatic process (Fig. 23) is a rough triangular eminence and serves for articulation with the malar bone.



25. Right Superior Maxillary Bone, *Maxilla superior*, from below.

The palate process of the superior maxilla forms with that of the bone of the other side the anterior larger part of the hard palate; by the meeting of the inner borders of both palate processes the *Crista nasalis* (Fig. 24) is formed; this anteriorly passes into the anterior nasal spine, *Spina nasalis anterior*. Behind this lies the external orifice of the anterior or naso-palatine canal, *Canalis naso-palatinus*. Both naso-palatine canals converge and end at the under surface of the hard palate in the one *Foramen incisivum seu palatinum anterius*.

The alveolar process contains 8 alveoli for the reception of the teeth; its outer plate shows eminences, *Juga alveolaria*. The 8 teeth in these alveoli are: 2 incisor teeth, *Dentes incisivi;* 1 canine tooth, *Dens caninus;* 2 bicuspid teeth (2 roots), *Dentes buccales;* 3 molar teeth (3 roots) *Dentes molares*, whose last is also called the wisdom tooth, *Dens sapientiae*.



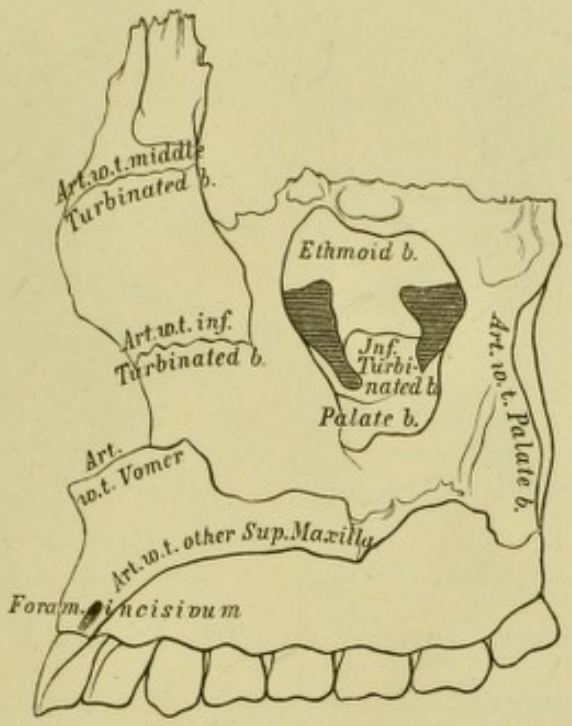
26. Right Superior Maxillary Bone, *Maxilla superior,*

from the outside, with the articulations of the bones and the insertion of the muscles.

The inner and posterior border of the orbital surface of the body of the superior maxilla articulates with the lachrymal bone, the ethmoid bone *(Lamina papyracea)*, and the palate bone.

The nasal process articulates with the nasal portion of the frontal bone, its anterior border touches at its upper half the nasal bone, the lower concave half forms with the same border of the opposite superior maxilla the *Apertura pyriformis narium;* the posterior border articulates with the lachrymal bone. On the inner surface the crests serve for articulation with the middle and inferior turbinated bones.

The malar process articulates with the malar bone.



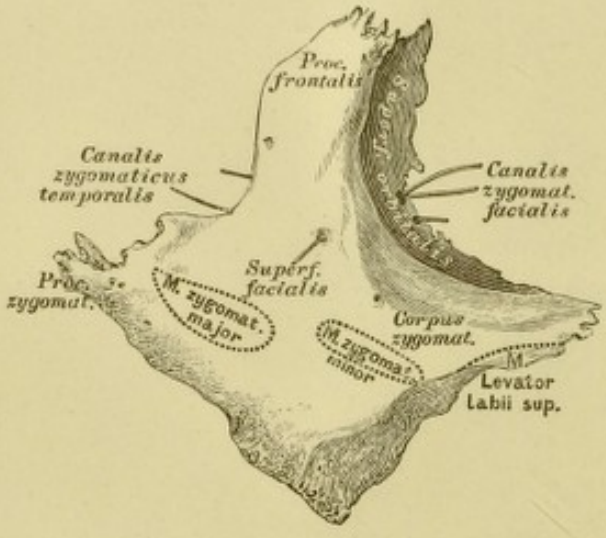
27. Right Superior Maxillary Bone, *Maxilla superior,*

from the inner side, with the articulations of the bones.

The nasal or internal surface of the body of the superior maxilla shows the opening of the antrum of Highmore, which is partly closed by the ethmoid, the inferior turbinated and the palate bones; the outer border of the nasal surface articulates with the perpendicular plate of the palate bone. The palatine process articulates at its inner border with the palatine process of the opposite superior maxilla; with the anterior half of the *Crista nasalis* the vomer articulates.

The *Processus alveolaris* carries 8 teeth (Fig. 25).

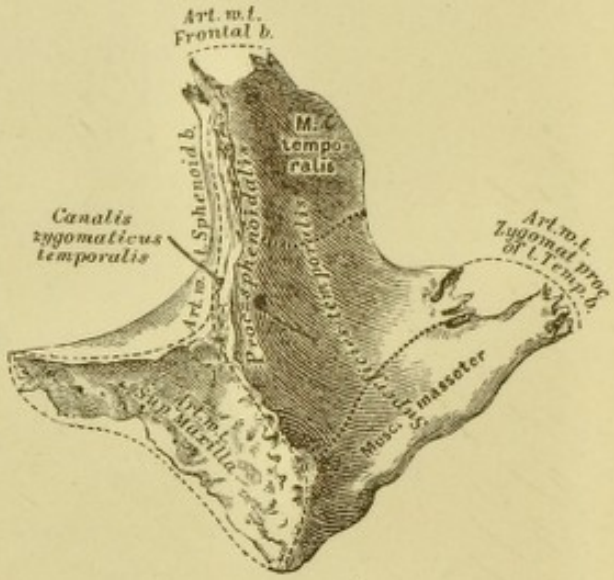
The superior maxilla therefore articulates with 9 bones: 2 cranial bones, the frontal and ethmoid, and 7 facial bones, the nasal, malar, lachrymal, palate, inferior turbinated, vomer and with the superior maxilla of the other side.



28. Right Malar Bone,

Os zygomaticum,

from the outside.



29. Right Malar Bone,

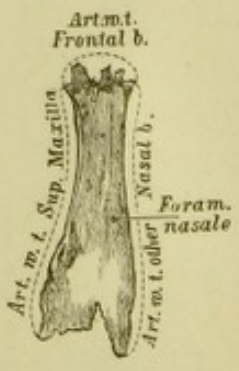
Os zygomaticum,

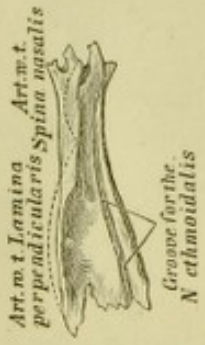
from the inner side.

The malar bone has 3 processes: the strongest frontal process, *Processus frontalis,* articulating with the frontal bone; the zygomatic process, *Processus zygomaticus,* which forms with the zygomatic process of the temporal bone the *Arcus zygomaticus,* and the smallest sphenoidal process, *Processus sphenoidalis,* which, looking backward, articulates with the anterior border of the orbital surface of the great wing of the sphenoid bone. Body is that portion which articulates with the zygomatic process of the superior maxilla. (This part is also called maxillary process.)

The surfaces are the facial (external), temporal (internal), and orbital. From the orbital surface to the facial surface runs the *Canalis zygomaticus facialis,* with an accessory canal to the temporal surface. Behind this canal there is a second, leading from the orbital cavity into the temporal fossa, the *Canalis zygomaticus temporalis.* (These canals are also called temporo-malar canals.)

The malar bone articulates with 4 bones: with 3 cranial bones, the frontal, sphenoid and temporal, and 1 bone of the face, the superior maxilla.



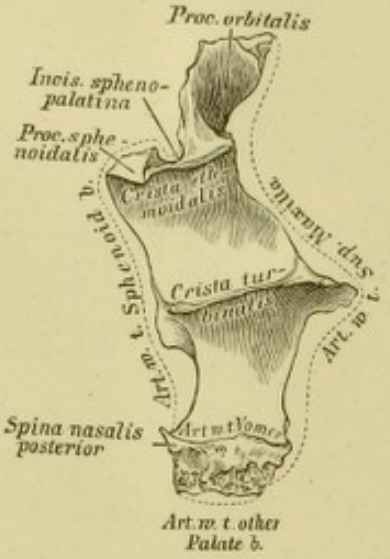


30. Right Nasal Bone, *Os nasale,* from the outside.

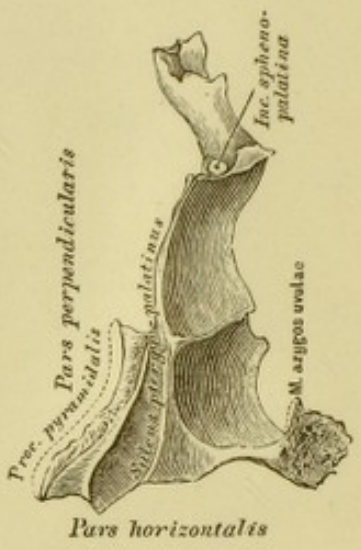
31. Right Nasal Bone, *Os nasale,* from the inside.

The nasal bones lie between the nasal processes of the superior maxillary bones, and touch each other with their inner borders. The superior short border articulates with the nasal notch of the frontal bone, the inferior helps to limit the *Incisura pyriformis narium*. The posterior surface looks toward the nasal cavity and has a groove for the *Nervus ethmoidalis*. One or more foramina, *Foramina nasalia*, perforate the substance of the bone.

Each nasal bone articulates with 4 bones: 2 of the cranium, the frontal and ethmoid bones, and 2 of the face, the superior maxillary and opposite nasal bones.



32. Left Palate Bone, *Os palatinum,* from the inside.



33. Left Palate Bone, *Os palatinum,* from behind.

The palate bone consists of 2 portions or plates placed at right angles to each other, the perpendicular plate, *Pars perpendicularis,* and the horizontal plate, *Pars horizontalis.*

The perpendicular plate shows on its inner surface 2 horizontal crests: the lower, the inferior turbinated crest, *Crista turbinalis,* for articulation with the inferior turbinated bone; the upper, the superior turbinated crest, *Crista ethmoidalis,* for the *Concha ethmoidalis inferior* (middle turbinated bone). The posterior border shows the *Sulcus pterygo-palatinus,* which forms with the similar sulcus on the pterygoid process of the sphenoid bone and the groove at the posterior angle of the body of the superior maxilla the pterygo-palatine canal, *Canalis pterygo-palatinus.* The superior border has two processes, separated by an intervening notch, the *Incisura spheno-palatina;* the anterior process is the orbital process, *Processus orbitalis* (often containing some *Cellulae palatinae);* the posterior sphenoidal process, *Processus sphenoidalis,* when articulated with the sphenoid bone, forms the groove on the inferior surface of the body of the sphenoid into a canal, the *Canalis spheno-palatinus.*

The horizontal plate forms the back part of the hard palate, the inner border (articulated with the horizontal plate of the other palate bone) the *Crista nasalis,* which is extended posteriorly into the posterior nasal spine, *Spina nasalis posterior.* At the place where the perpendicular and horizontal plates blend, is the pterygoid or pyramidal process, *Processus pyramidalis,* which is inserted into the pterygoid notch of the sphenoid bone. The pterygo-palatine canal, formed together with the sphenoid and superior maxillary bones, divides inferiorly into 3 canals, which open into the 3 posterior palatine foramina in the hard palate.

The palate bone articulates with 6 bones: 2 of the cranium, the sphenoid and ethmoid, and 4 of the face, the superior maxillary, the inferior turbinated, vomer and opposite palate bones.

34. Left Lachrymal Bone, *Os lacrymale,* from the outside.

35. Left Lachrymal Bone, *Os lacrymale,* from the inside.

The lachrymal bone, the smallest bone of the skull, shows on its external surface a vertical ridge, the *Crista lacrymalis,* by which the surface is divided into 2 parts. The anterior smaller is grooved and forms with a similar groove on the nasal process of the superior maxilla, the lachrymal groove, *Fossa sacci lacrymalis,* which is continued into the naso-lachrymal canal, *Canalis naso-lacrymalis.* The *Crista lacrymalis* terminates below in a hook-like process, the *Hamulus lacrymalis,* which is sometimes entirely absent. The internal surface of the lachrymal bone fills in the anterior ethmoidal cells.

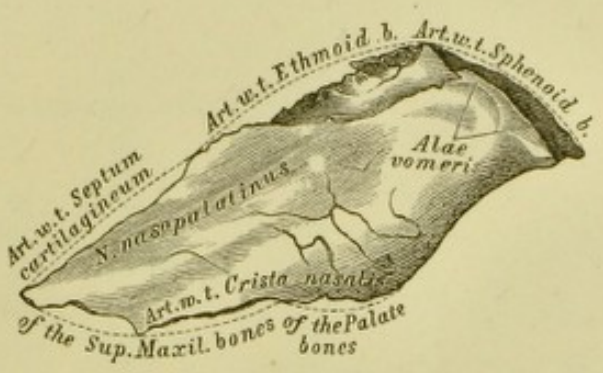
The lachrymal bone articulates with 4 bones: 2 of the cranium, the frontal and ethmoid bones, and 2 of the face, the superior maxillary and inferior turbinated bones.

36. Left Inferior Turbinated Bone, *Concha inferior,* from the inside.

37. Left Inferior Turbinated Bone, *Concha inferior,* from the outside.

The inferior turbinated bone is situated at the inner wall of the body of the superior maxilla; its concave surface looks toward this wall, its convex surface toward the *Septum narium.* The lower margin is rolled upon itself; at the upper margin arises the maxillary process, *Processus maxillaris,* which helps to make the opening of the antrum of Highmore smaller. In front of this process, the lachrymal process, *Processus lacrymalis,* is situated, partially forming the *Canalis naso-lacrymalis.* The ethmoidal process, *Processus ethmoidalis,* is not constant. The anterior and posterior ends of the bone come in contact with the inferior turbinated crest of the superior maxillary and palate bones.

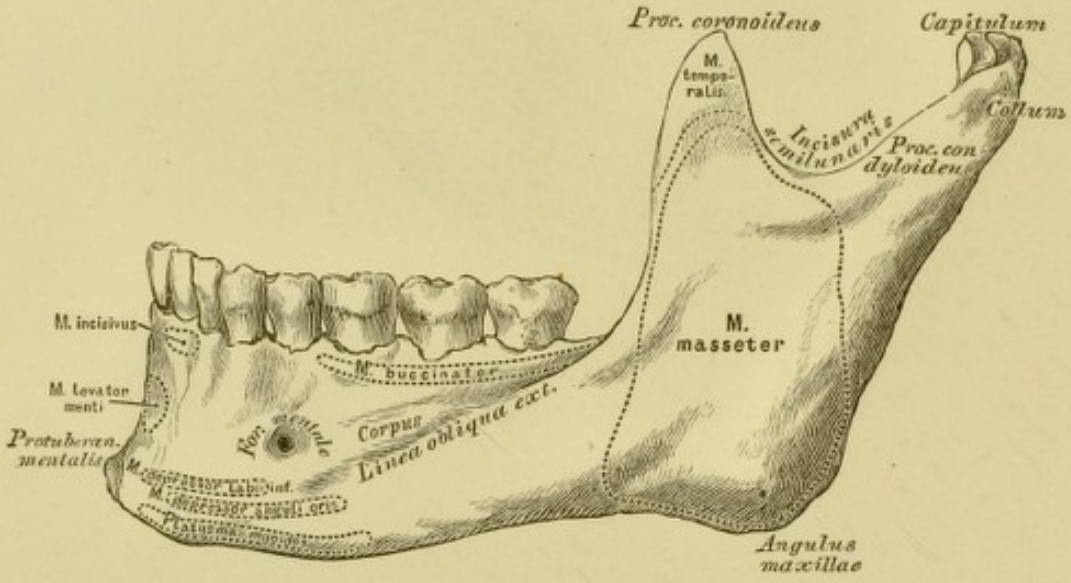
The inferior turbinated bone articulates with 4 bones: 1 cranial bone, the ethmoid, and 3 of the face, the superior maxillary, palate and lachrymal bones.



38. The Vomer, *Os vomeris.*

The vomer serves for the formation of the inferior part of the bony *Septum narium.* The superior border is separated, forming 2 alae, the *Alae vomeris,* between which the rostrum of the sphenoid is received. The inferior border touches the *Crista nasalis,* formed by both superior maxillary and both palate bones. The anterior longest border articulates at its upper portion with the perpendicular plate of the ethmoid bone, at its lower with the quadrangular cartilage of the septum, *Septum cartilagineum.* The posterior shortest border is free and forms the septum of the posterior nares, which separates these from each other, forming the two choanae.

The vomer articulates with 6 bones: 2 of the cranium, the sphenoid and ethmoid bones, and 4 of the face, the 2 superior maxillary and the 2 palate bones; finally with the quadrangular cartilage of the septum, *Cartilago quadrangularis s. Septum cartilagineum.*

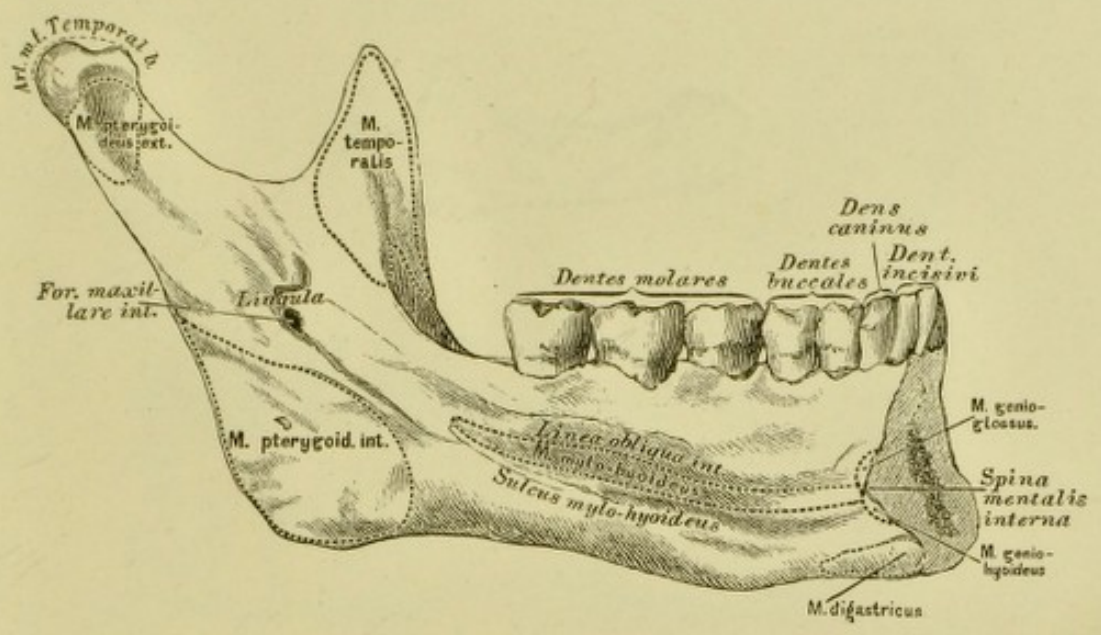


39. Inferior Maxillary Bone, *Maxilla inferior,*

from the outside.

The inferior maxilla is divided into the body and 2 rami.

In the middle of the anterior surface of the body is the mental protuberance, *Protuberantia mentalis;* 1″ further externally the mental foramen, *Foramen mentale,* under which the external oblique line, *Linea obliqua externa,* runs outward to the anterior border of the ramus. The lower border is broad, the upper divided into 16 alveoli, for that number of teeth. The 2 rami ascend from the posterior end of the body; their posterior border forms with the lower border of the body, the angle, *Angulus maxillae.* At the upper border there are 2 processes separated by the sigmoid notch, *Incisura semilunaris;* the anterior is the *Processus coronoideus,* the posterior the *Processus condyloideus.* The latter has a constricted neck, *Collum,* and a head, *Capitulum,* covered with cartilage, for articulation with the glenoid fossa of the temporal bone.



40. Inferior Maxillary Bone, *Maxilla inferior,*

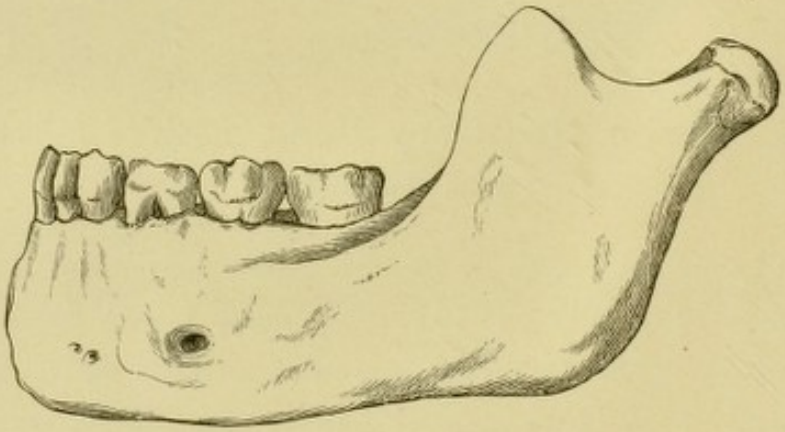
from the inside.

Body. In the middle of its inner (posterior) surface is a prominent one- or two-pointed tubercle, the *Spina mentalis interna* (genial tubercle); beneath this are 2 rough impressions each for the origin of the anterior belly of one of the digastric muscles. Externally to the tubercle, the internal oblique line, *Linea obliqua interna seu mylo-hyoidea*, commences. In the alveoli of the upper border there are on each side 2 incisor teeth, *(D. incisivi)*, 1 canine tooth *(D. caninus)*, 2 bicuspid teeth *(D. buccales)*, and 3 molar teeth *(D. molares)*, whose last is also called the wisdom tooth.

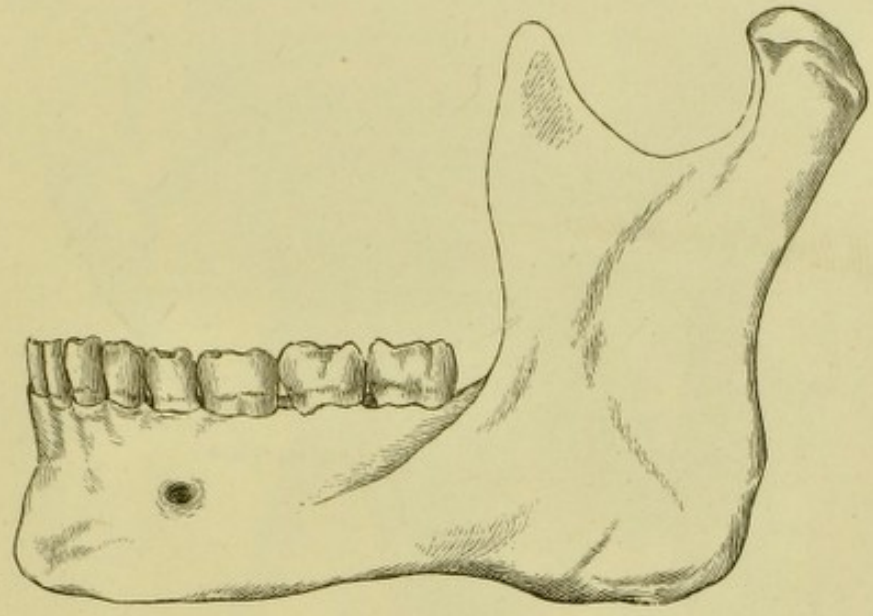
Rami. Each ramus shows in the middle of its inner surface the *Lingula*, behind which lies the inferior dental foramen, *s. Foramen maxillare internum*, forming the beginning of a canal, the inferior dental canal, *Canalis alveolaris inferior*, which runs through the substance of the body and ends at the mental foramen. From the *Foramen maxillare internum* a groove, the mylo-hyoidean groove, *Sulcus mylo-hyoideus*, runs obliquely downwards.

The inferior maxilla articulates with the glenoid fossae of both temporal bones.

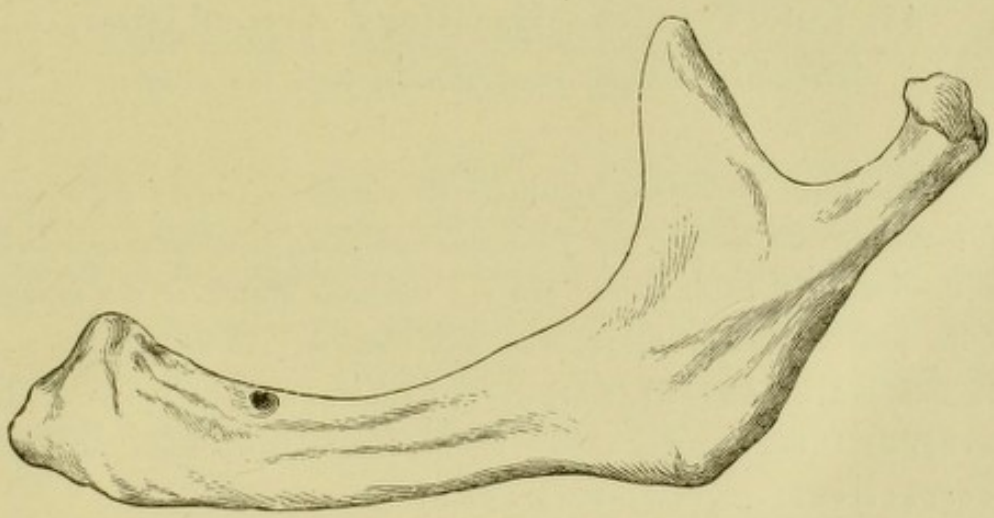
41. Inferior Maxilla at Birth.



42. Inferior Maxilla at Puberty.

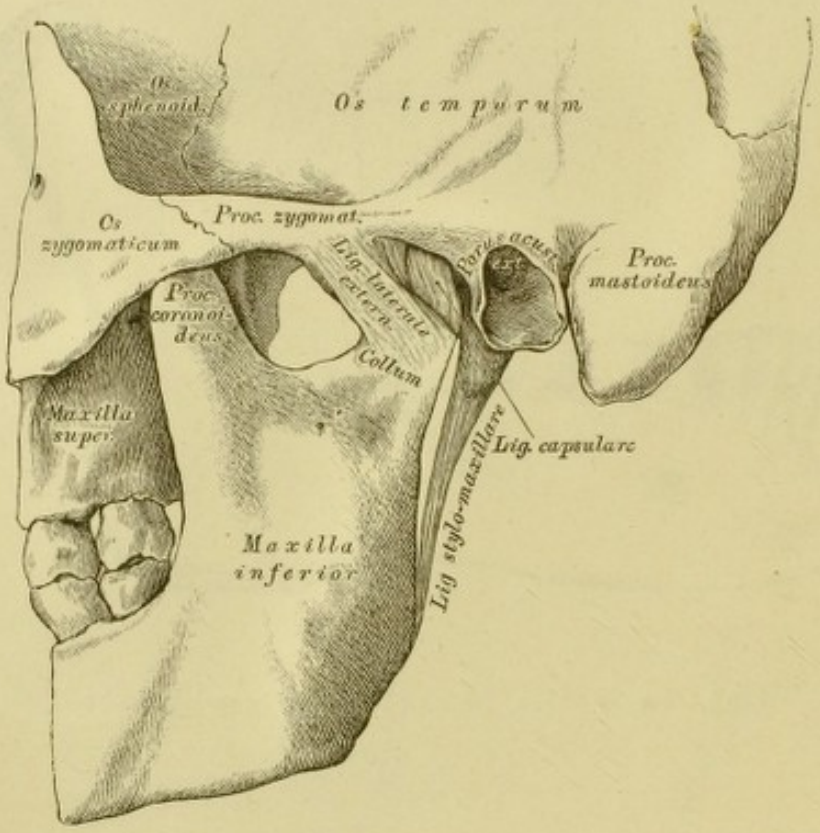


43. Inferior Maxilla of an Adult.



44. Inferior Maxilla in Old Age.

41.—44. Forms of the inferior maxilla at different periods of life (after Gray).

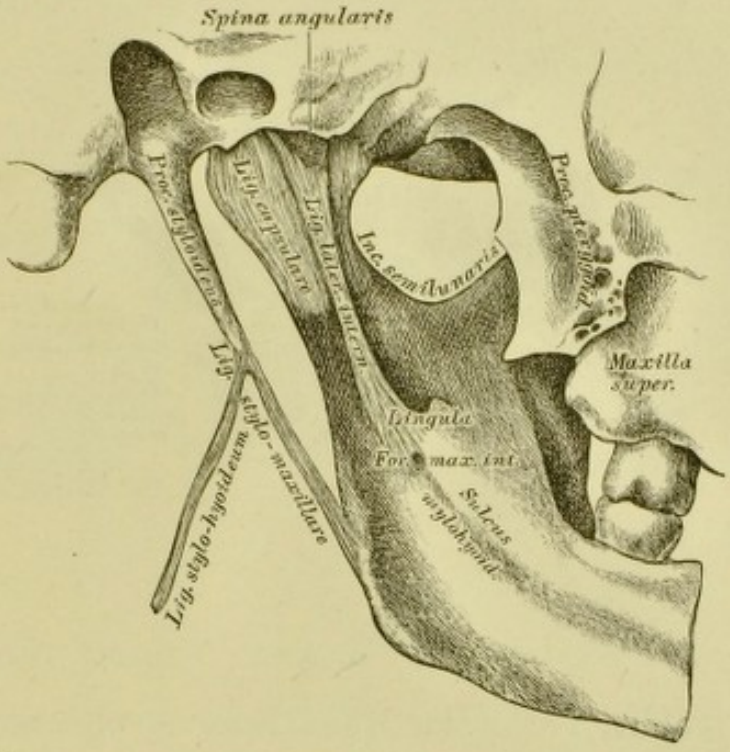


45. Left Temporo-Maxillary Articulation,

Articulatio temporo-maxillaris, from the outside.

The bony parts which constitute the temporo-maxillary articulation are: the glenoid cavity, the *Tuberculum articulare (Eminentia articularis)* of the temporal bone above, and the *Capitulum* (head) of the condyle of the inferior maxilla below. The soft parts of the articulation are: the thin and lax capsular ligament, the external lateral, the internal lateral, the stylo-maxillary ligaments, and the interarticular fibro-cartilage.

The *Ligamentum laterale externum* is a short, broad band, which runs obliquely downward and backward from the zygomatic process of the temporal bone to the *Collum* (neck) of the condyle of the lower jaw; the inner surface of this ligament is in relation with the interarticular fibro-cartilage and the capsule.

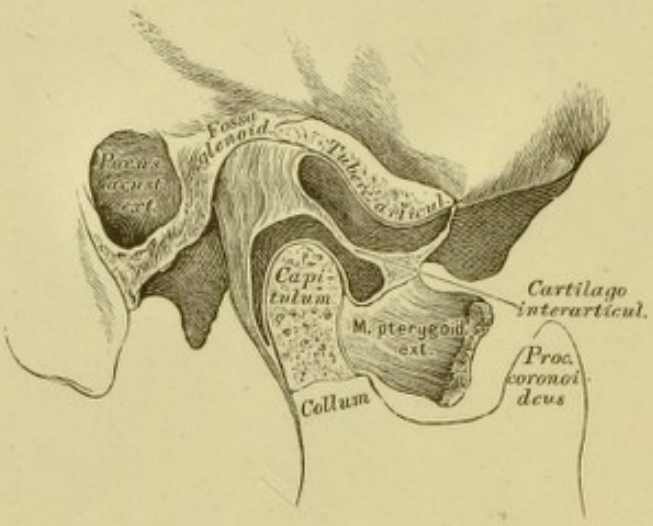


46. Left Temporo-Maxillary Articulation,

Articulatio temporo-maxillaris, from the inner side.

The *Ligamentum laterale internum* is a long narrow fasciculus, not in relation with the capsule; it runs from the spinous process, *Spina angularis,* of the sphenoid bone to the *Lingula* of the inferior dental canal.

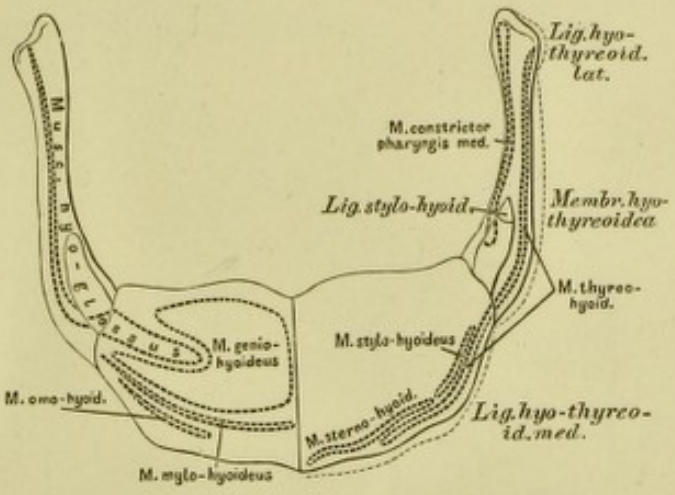
The *Ligamentum stylo-maxillare* (a part of the *Fascia buccopharyngea)* runs from the styloid process of the temporal bone to the angle and posterior border of the ramus of the lower jaw.



47. Right Temporo-Maxillary Articulation,

Articulatio temporo-maxillaris, vertical section.

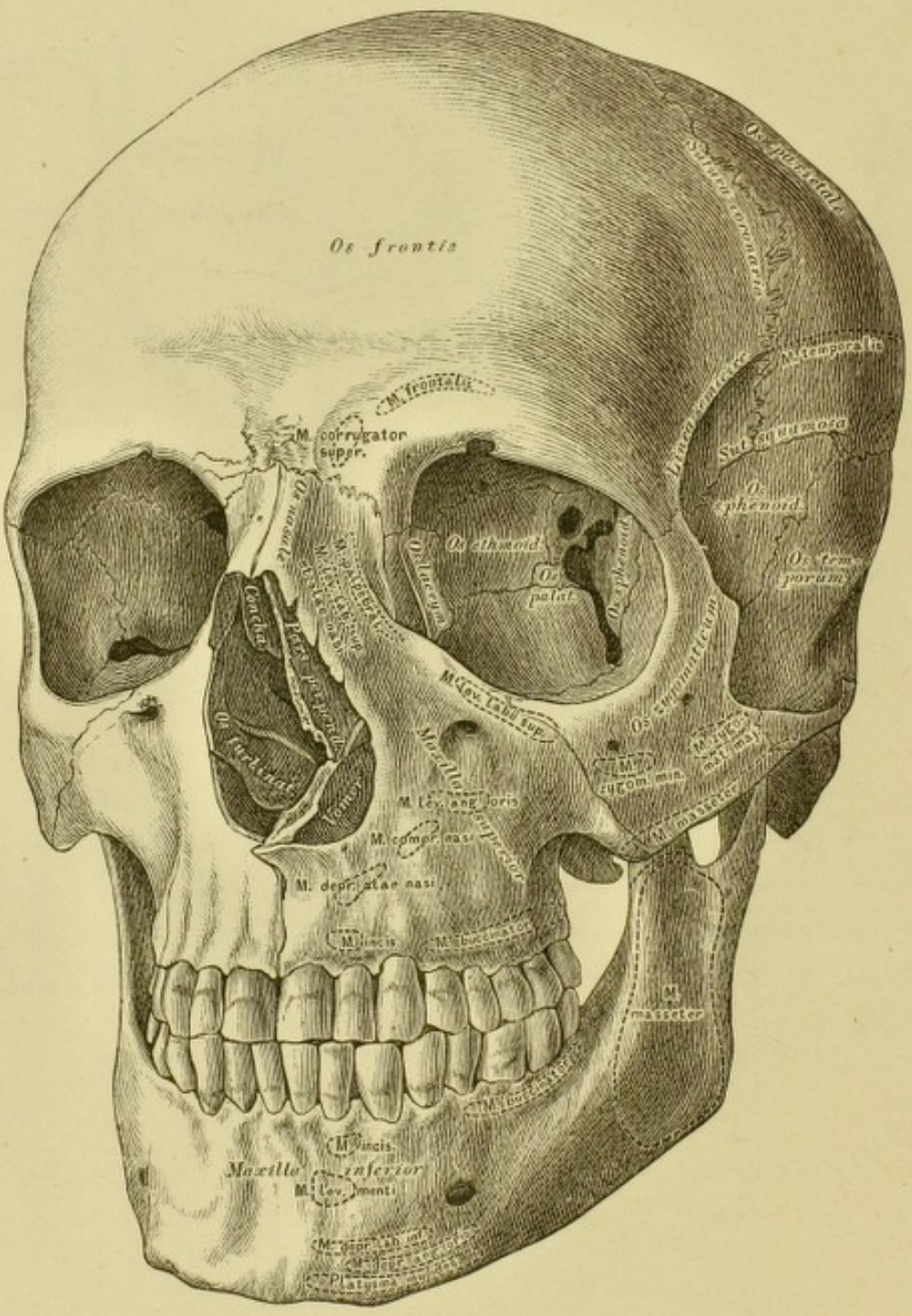
The cavity of the capsule is divided by the interarticular cartilage, *Cartilago interarticularis*, which is thinner in the middle, thicker toward the circumference, into 2 halves, each of which has a special synovial membrane. The circumference of the interarticular cartilage is connected with the capsule and the external lateral ligament; at its anterior surface the tendon of the external pterygoid muscle is inserted.



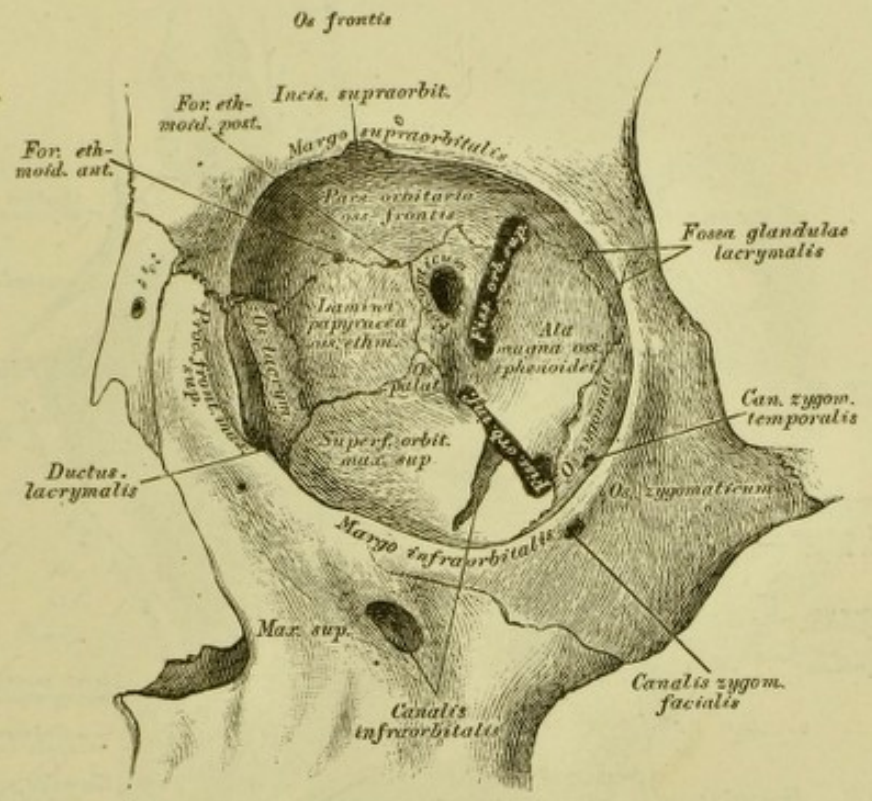
48. Hyoid Bone, *Os hyoides,* from before.

49. Hyoid Bone, *Os hyoides,* with the insertions of the muscles and ligaments.

The hyoid bone is divided into a middle piece, the body, and 2 pairs of lateral cornua. The greater cornua, *Cornua majora*, project from the lateral surfaces of the body, by means of 2 joints or synchondroses; at the angles of junction between the body and greater cornua, the 2 lesser cornua, *Cornua minora*, are attached by means of ligaments.



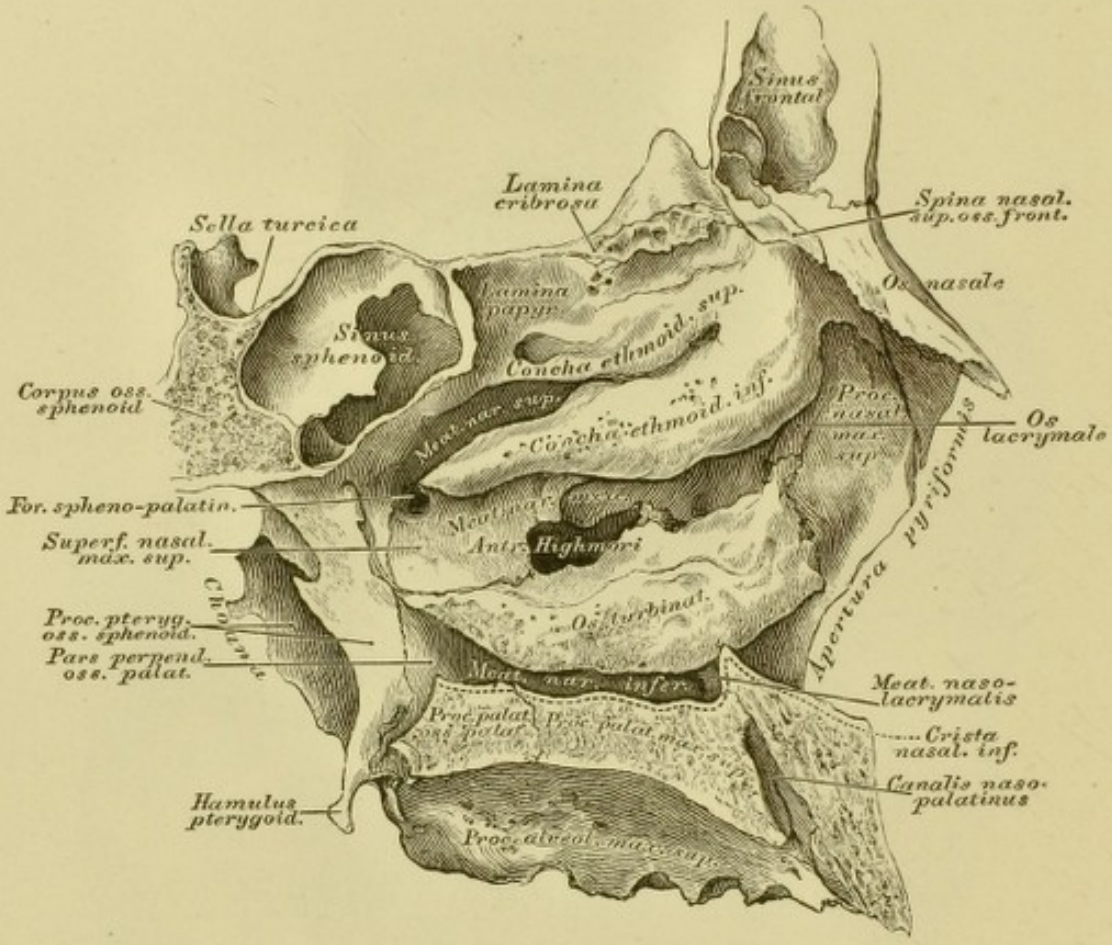
50. The Bony Skull, with the Cavities and Fossae of the Face.



51. Left Orbital Cavity, *Orbita.*

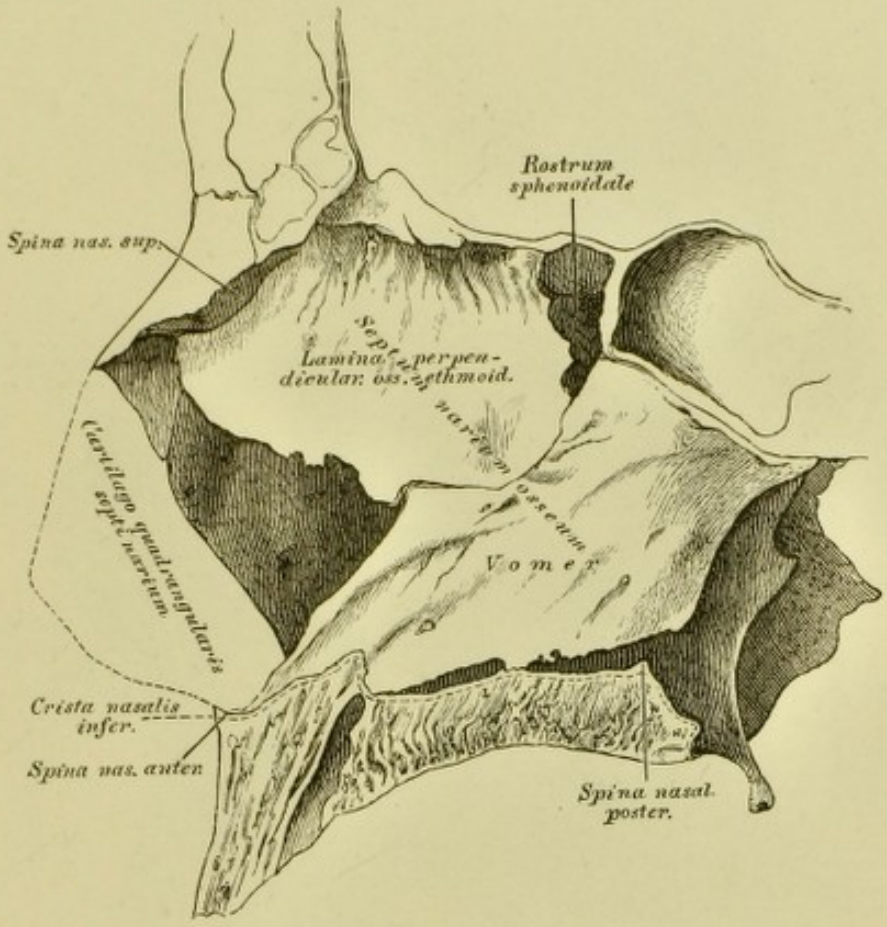
The outer wall of the orbit is formed by the malar bone and the greater wing of the sphenoid; the upper wall or roof by the orbital plate of the frontal bone; the inner wall by the nasal (frontal) process of the superior maxillary, the lachrymal and the *Lamina papyracea (Os planum)* of the ethmoid bones; the lower wall or floor by the orbital surface of the superior maxillary and the orbital process of the palate bones. The aperture of the orbit, *Apertura orbitalis*, is limited by the *Margo supra- et infraorbitalis;* behind the circumference, superior- and externally lies the lachrymal groove, *Fossa glandulae lacrymalis.*

Foramina and canals of the orbit. To the cranial cavity lead: the *Foramen opticum*, the *Fissura orbitalis superior* (sphenoidal fissure), the *Foramen ethmoidale anterius.* To the nasal cavity: the *Foramen ethmoidale posterius*, the *Ductus naso-lacrymalis.* To the temporal fossa: the *Canalis zygomaticus temporalis;* to the spheno-maxillary fossa *(Fossa pterygo-palatina)*, the *Fissura orbitalis inferior* (spheno-maxillary fissure). To the face lead: the *Canalis zygomaticus facialis*, the *Foramen supraorbitale (Incisura supraorbitalis)* and the *Canalis infraorbitalis.*



52. The Nasal Fossa, *Cavum narium.*

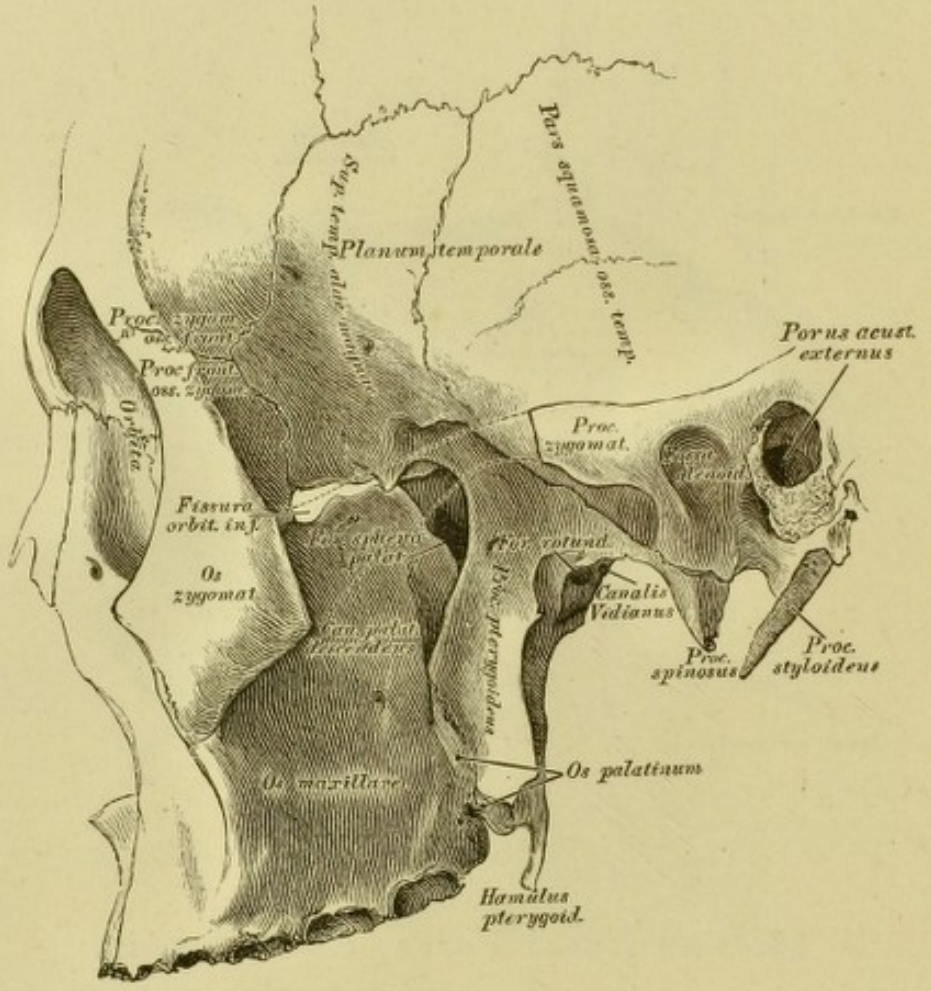
The nasal fossa is divided into the nasal fossa proper, and the sinuses *(Sinus frontalis, sphenoidalis, maxillaris)*. Superiorly the nasal fossa proper is bounded by the nasal bones and the *Lamina cribrosa* of the ethmoid bone; inferiorly by the palate process of the superior maxilla and the *Partes horizontales* of the palate bones. The lateral walls are formed above by the nasal process of the superior maxilla, the lachrymal bone, the *Lamina papyracea* of the ethmoid bone; further down by the internal or nasal surface of the superior maxilla *(Superfic. nasal. max. sup.)* the *Pars perpendicularis* of the palate bone, and the pterygoid process of the sphenoid *(Proc. pterygoid. oss. sphenoid.)*. The anterior wall is formed by the nasal bones; a large part of it is lacking; in its place is the *Apertura pyriformis*. The posterior wall is formed partly by the anterior surface of the body of the sphenoid *(Corpus oss. sphenoid.)*, below this are two openings, the *Choanae* (posterior nares). Each choana is limited above by the body of the sphenoid bone, externally by its pterygoid process *(Proc. pteryg. oss. sphenoid.)*, internally by the vomer and inferiorly by the *Pars horizontalis* of the palate bone.



53. The Nasal Fossa, *Cavum narium.*

The nasal fossa is divided by the bony septum of the nose, *Septum narium osseum*, into two halves; this septum consists of the perpendicular plate of the ethmoid bone (*Lamina perpendicular. oss. ethmoid.*) and the vomer, and runs from the *Lamina cribrosa* and *Spina nasalis superior* to the *Crista nasalis inferior*. The bony parts of the ethmoidal labyrinth, the *Concha ethmoidalis superior* (superior turbinated bone), *Concha ethmoidalis inferior* (middle turbinated bone) and the inferior turbinated bone (Fig. 52) form bony prominences on the walls of the nasal fossa. Between the turbinated bones are the meatuses, *Meatus narium*, three on each side, viz: the superior, between the superior and middle turbinated bones; the middle, between the middle and inferior turbinated bones; the inferior, between the inferior turbinated bone and floor of the nasal fossa. In the superior open the posterior and middle ethmoidal cells, and the spheno-palatine foramen; in the middle, the anterior ethmoidal cells, the antrum of Highmore, and the frontal sinus; in the inferior the naso-lachrymal duct.

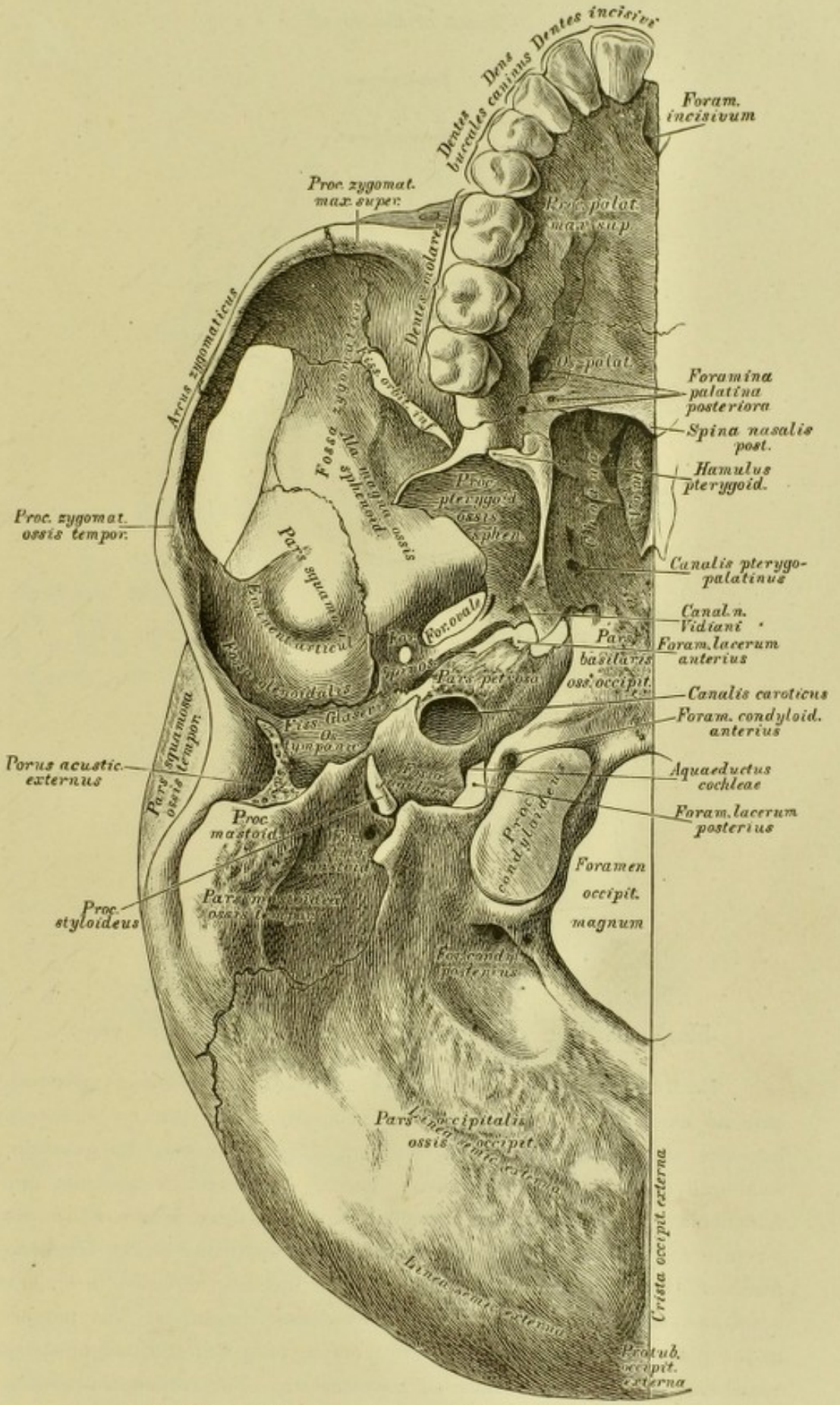
Foramina and canals of the nasal fossa. To the cranial cavity lead the *Foramina cribrosa;* to the mouth the *Canalis naso-palatinus;* to the spheno-maxillary fossa the *Foramen spheno-palatinum;* to the orbit the *Foramen ethmoidale posterius*, the *Ductus naso-lacrymalis;* to the face the *Apertura pyriformis* and the *Foramina nasalia.*



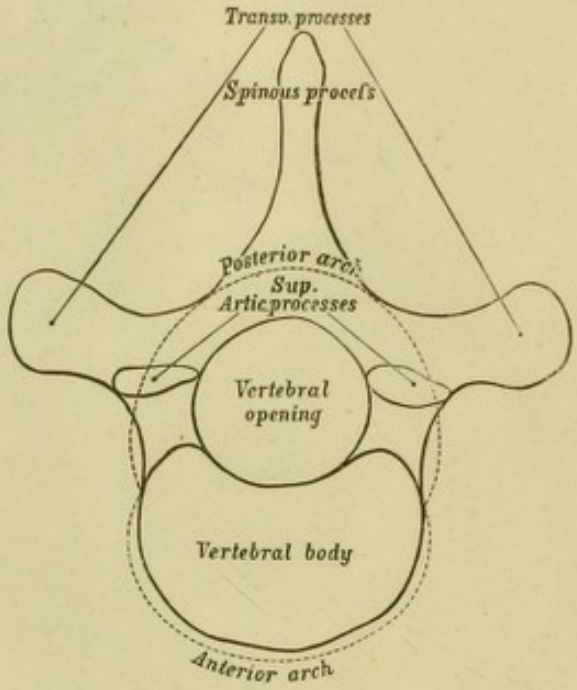
54. The Pterygo-palatine or Spheno-maxillary Fossa, *Fossa pterygo-palatina s. spheno-maxillaris.*

The temporal fossa, *Fossa temporalis*, formed by the squamous portion of the temporal bone, the temporal surface of the great wing of the sphenoid, the zygomatic process of the frontal bone, and the frontal process of the malar bone deepens inferiorly, internally and anteriorly, between the superior maxilla, pterygoid process of the sphenoid and palate bones forming the pterygo-palatine fossa. Usually only the deepest part of the fossa, formed by the pterygoid process of the sphenoid and palate bones is called pterygo-palatine fossa, while the broader part lying between the superior maxillary and sphenoid bones is called the spheno-maxillary fossa.

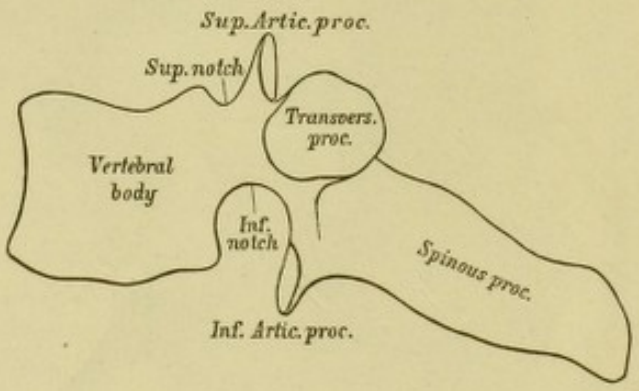
Foramina and canals of the pterygo-palatine fossa. To the cranial cavity leads the *Foramen rotundum;* to the orbit the *Fissura orbitalis inferior;* to the nasal fossa the *Foramen spheno-palatinum;* to the mouth the *Canalis palatinus descendens;* to the base of the cranium the *Canalis Vidianus.*



55. The Base of the Skull, from below.

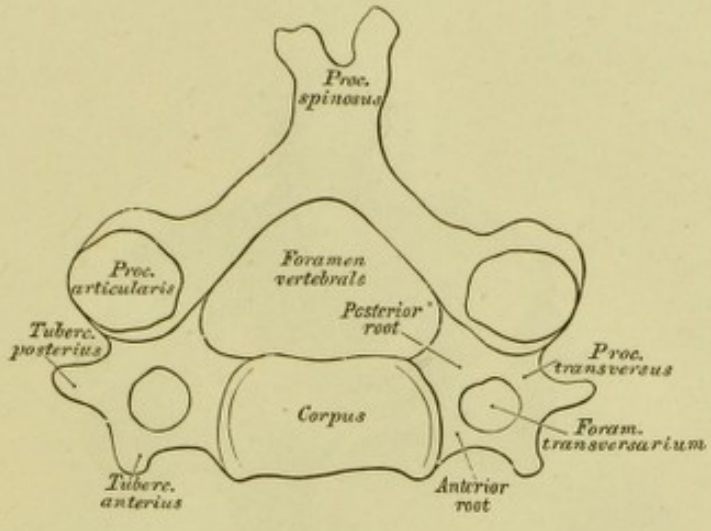


56. Outline of a True Vertebra, superior view.



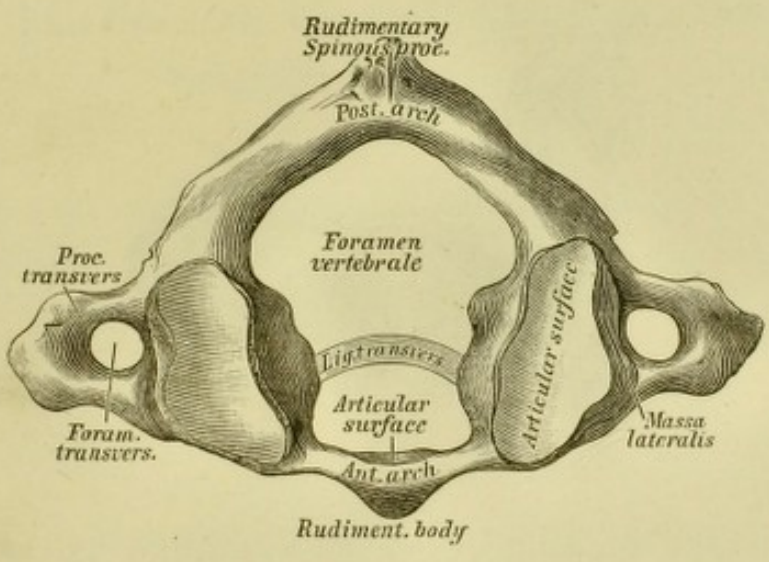
57. Outline of a True Vertebra, lateral view.

Each true vertebra has a central opening *(Foramen vertebrale)* and an anterior and posterior semi-arch; the anterior semi-arch becomes the body of the vertebra, *Corpus vertebrae;* the posterior semi-arch or arch, *Arcus vertebrae,* has 7 processes: 3 muscular and 4 articular processes. Of the muscular processes there is one spinous process, *Processus spinosus,* and 2 transverse processes, *Processus transversi.* Of the articular processes 2 look upwards, *Processus articulares ascendentes,* and 2 downwards, *Processus articulares descendentes.* The notches at the place where the arch and body touch, form with the neighbouring vertebrae the intervertebral foramina, *Foramina intervertebralia.*



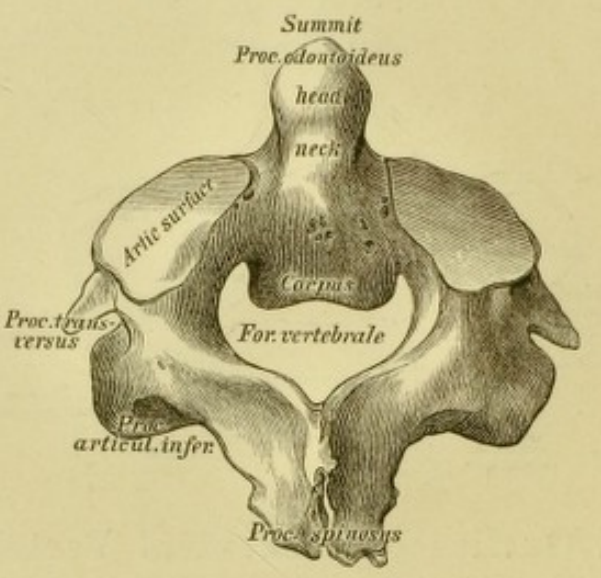
58. Outline of a Cervical Vertebra.

The transverse process is pierced by a foramen, the *Foramen transversarium*, which is bound by an anterior and posterior root; the body low; body and arch form an equilateral triangle; the spinous process is bifid; the perforated transverse process has an anterior and a posterior tubercle, *Tuberculum anterius et posterius.*

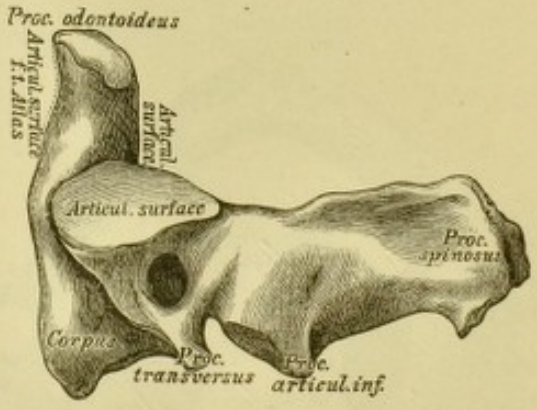


59. The First Cervical Vertebra, *Atlas,* superior view.

The atlas consists of an anterior arch, a posterior arch, and 2 lateral masses, *Massae laterales atlantis,* formed at the point where the arches unite; it has no articular processes and no spinous process; instead of the articular processes there are superior grooved and inferior flat articular surfaces. In the middle of the posterior surface of the anterior arch lies the articular surface for the odontoid process of the second cervical vertebra.

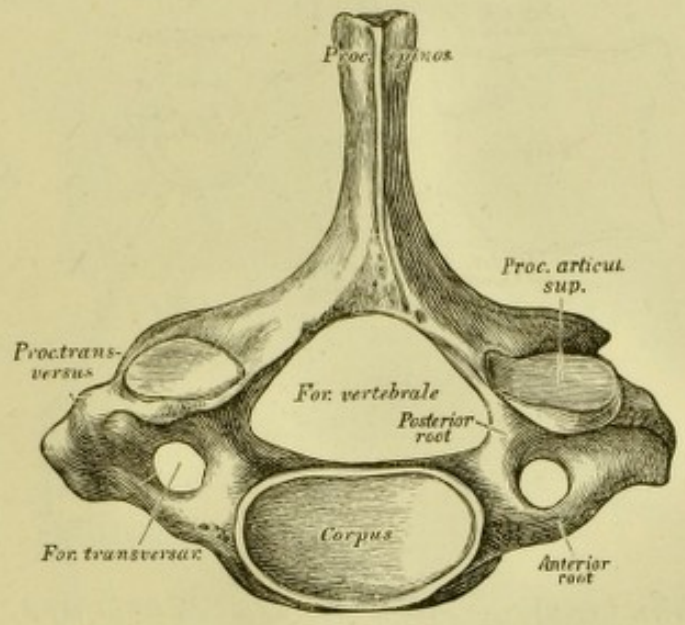


60. The Second Cervical Vertebra or Axis, *Epistropheus*, superior view.



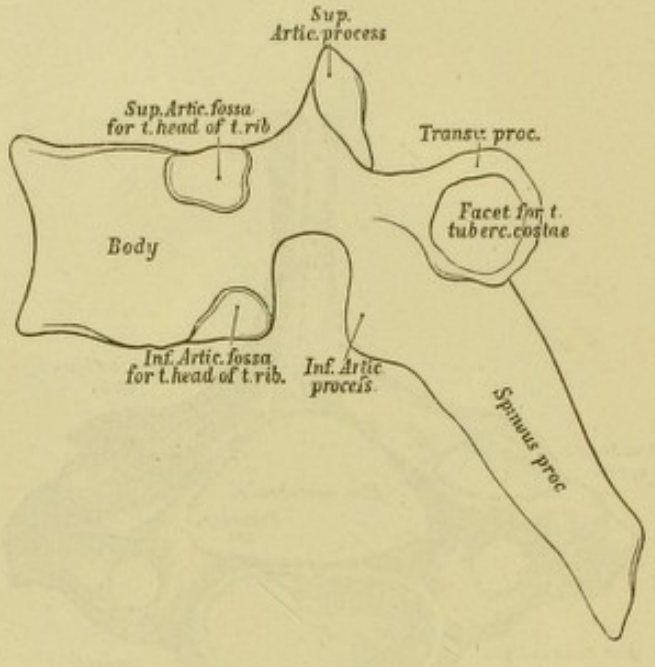
61. The Second Cervical Vertebra or Axis, *Epistropheus*, side view.

The body has a tooth-like process, *Processus odontoideus*, which is divided into an apex, head and neck; its anterior and posterior surfaces are covered with cartilage. Near the odontoid process are 2 articular surfaces for articulation with the atlas. The spinous process is of large size and sometimes bifid.



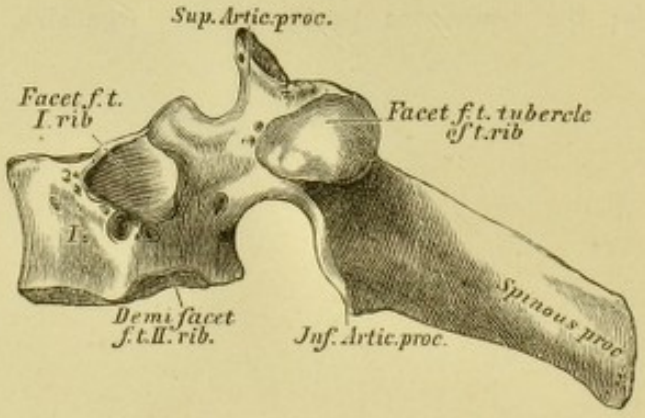
62. The Seventh Cervical Vertebra, *Vertebra prominens,* superior view.

The seventh cervical vertebra has a long, not bifurcated spinous process; the transverse process is of large size, especially its posterior root.



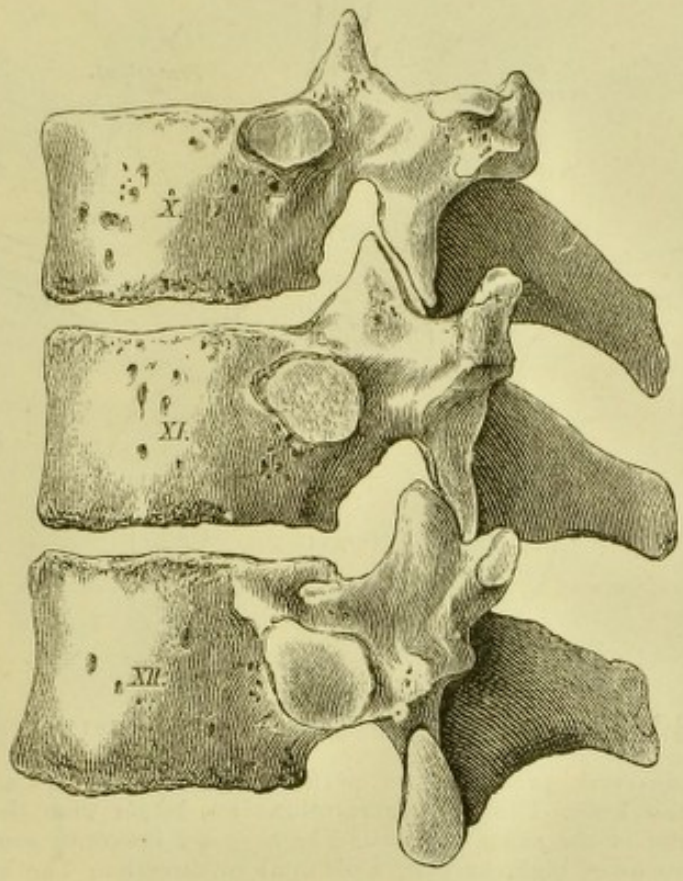
63. Outline of a Dorsal Vertebra.

The 12 dorsal vertebrae are marked by articular demi-facets covered with cartilage, at the side of the body, of which there is one at the upper, one at the lower border; with the neighbouring vertebrae they form the *Foveae articulares* for the heads of the ribs. The vertebral foramen circular, the spinous processes long, directed obliquely downwards, especially at the middle dorsal vertebrae. The transverse processes have anteriorly articular surfaces, covered with cartilage, for the tubercles of the ribs, *Tubercula costarum*.



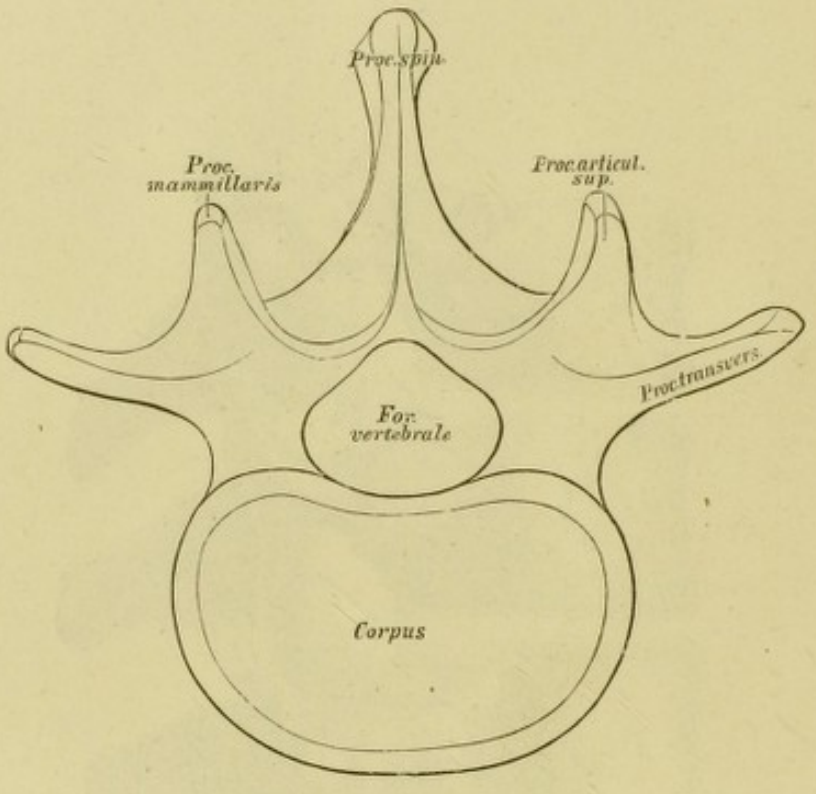
64. The First Dorsal Vertebra, side view.

The first dorsal vertebra has on the side of the body an upper articular facet for the head of the first rib (sometimes the articular facet is formed jointly with the seventh cervical vertebra) and a demi-facet for the second rib.



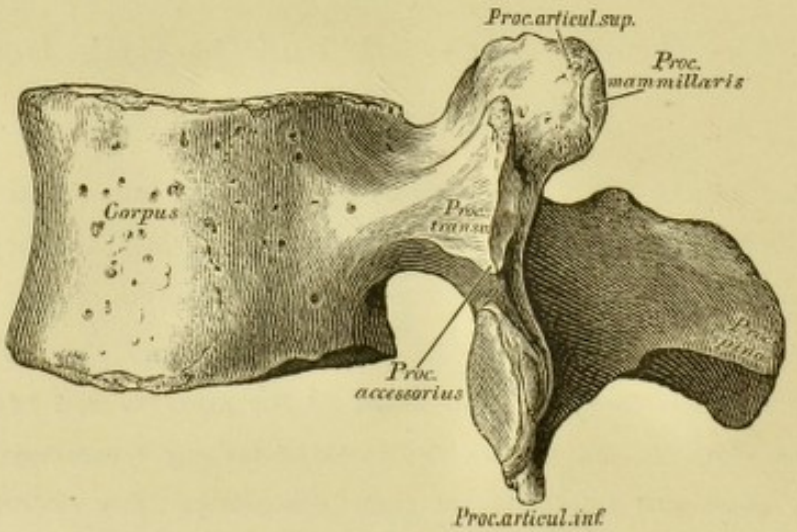
65. The Tenth, Eleventh and Twelfth Dorsal Vertebrae, side view.

The tenth dorsal vertebra has on the side of its body, at the upper border, an incomplete articular facet, which is completed by the inferior articular facet of the body of the ninth dorsal vertebra. The body of the eleventh and twelfth dorsal vertebrae has complete articular facets for the heads of the eleventh and twelfth ribs. From the ninth to the twelfth dorsal vertebrae the transverse processes are very short and tubercular at their extremities. The articular facets of the transverse processes, which are covered with cartilage, are either only slightly indicated or entirely wanting at the eleventh and twelfth dorsal vertebrae. The *Fovea articularis* of the eleventh and twelfth dorsal vertebrae sometimes resembles an uneven protuberance.



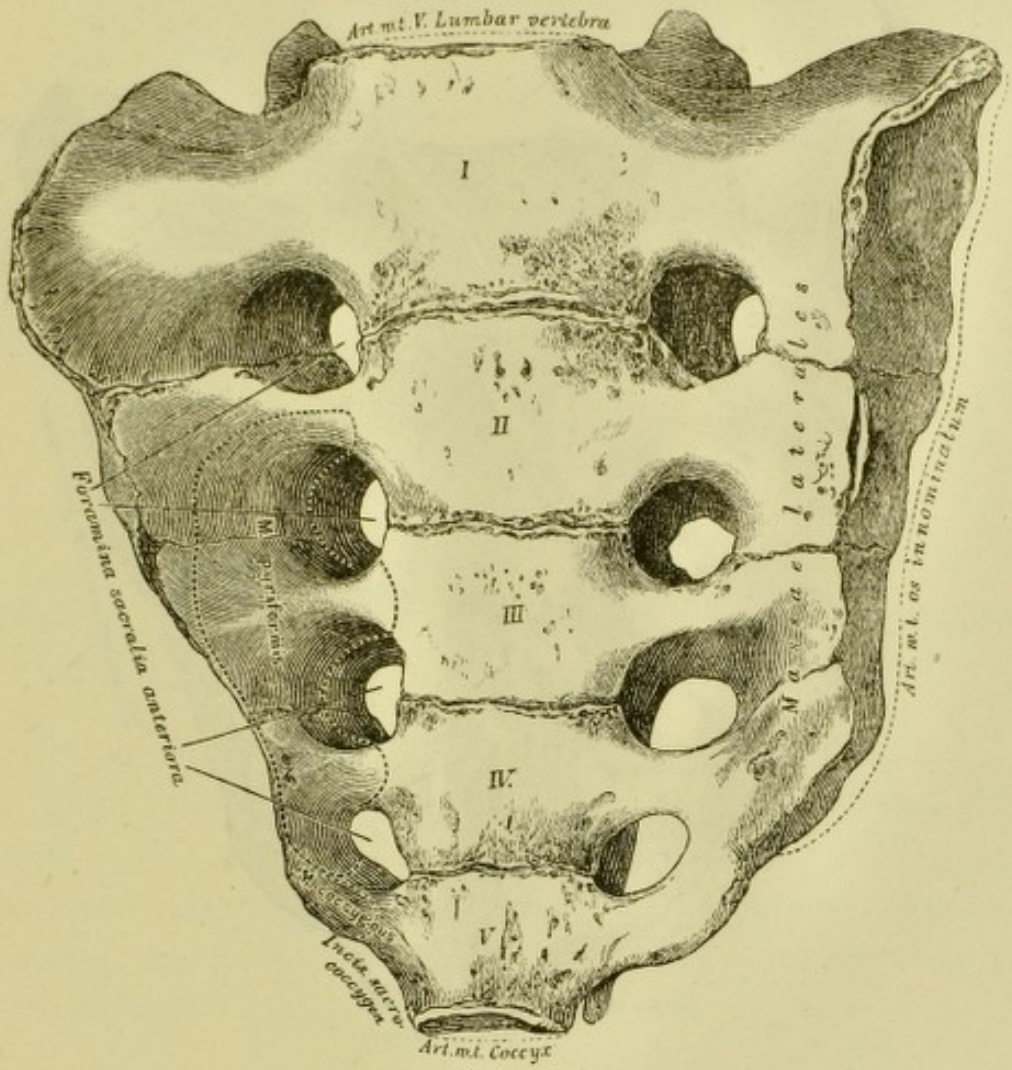
66. Outline of a Lumbar Vertebra.

The transverse processes not perforated; they have no articular facets, neither has the body. The lumbar vertebrae are larger than the cervical and dorsal vertebrae of the same skeleton. The *Foramen vertebrale* somewhat round; the spinous processes high, narrow, horizontal in direction. The articular facets of the superior articular processes look inwards and backwards; those of the inferior articular processes outwards and forwards.



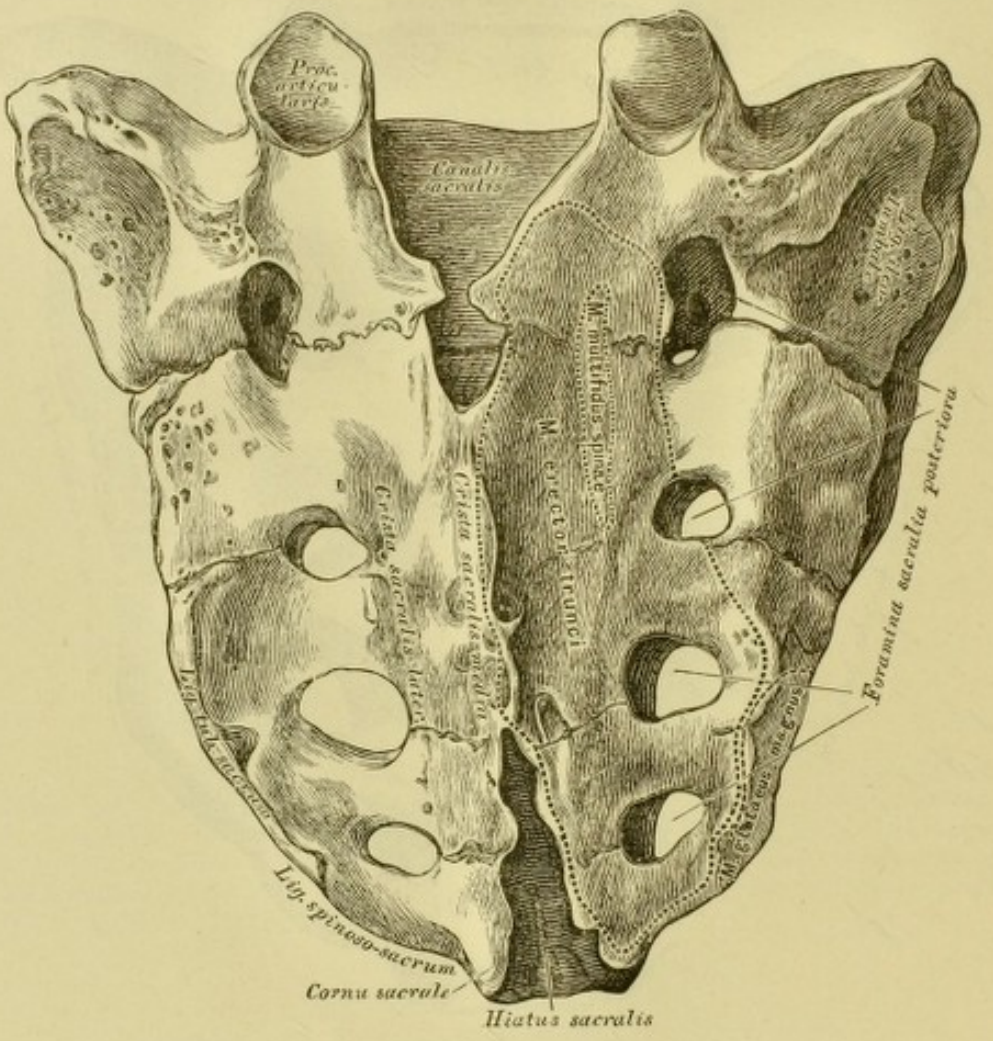
67. Lumbar Vertebra, *Vertebra Lumbalis,* side view.

The body somewhat higher in front than behind; between the superior articular process and the transverse process is a rough prominence, *Processus accessorius,* at the outer border of the superior articular process, the *Processus mammillaris.*



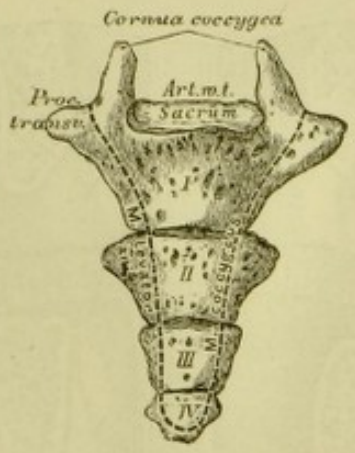
68. The Sacral Bone, *Os sacrum,* anterior view.

The sacrum consists of 5 vertebrae united with each other; it has a base, an anterior and a posterior surface and 2 lateral borders. The base is articulated with the V. lumbar vertebra. The anterior surface is concave, and has 4 pairs of foramina, *Foramina sacralia anteriora;* each pair is connected by a horizontal ridge; external to these are the lateral masses, *Massae laterales ossis sacri.* The lateral borders which are articulated at their upper parts with the *Ossa innominata,* approach each other inferiorly, and form the apex below; this serves for articulation with the coccyx; near this apex the lateral borders present a semilunar notch, *Incisura sacro-coccygea.*



69. The Sacral Bone, *Os sacrum,* posterior view.

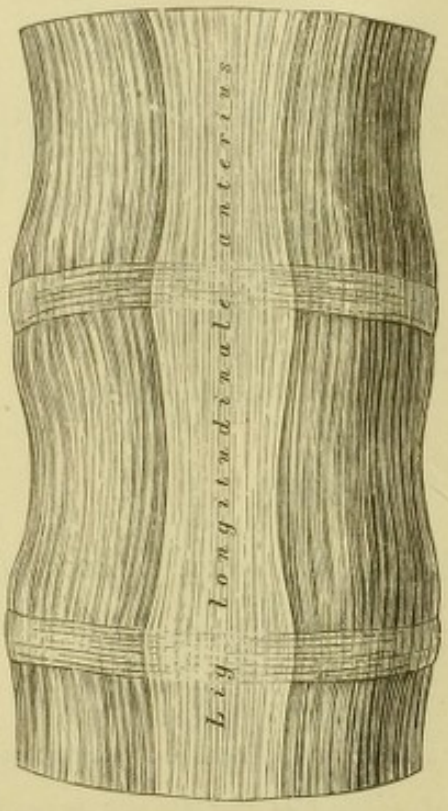
Behind the base is the triangular opening of the sacral canal, *Canalis sacralis,* which pierces the sacrum and is a continuation of the *Canalis vertebralis;* on both sides of it the superior articular processes of the first sacral vertebra project. The posterior surface is convex; along it runs the *Crista sacralis media;* on both sides are the *Cristae sacrales laterales.* At the lower end of the *Crista sacralis media* is the inferior opening of the sacral canal, the *Hiatus sacralis;* at the sides of it are the *Cornua sacralia,* indistinct descending articular processes of the fifth sacral vertebra. The posterior sacral foramina, *Foramina sacralia posteriora,* are smaller and more irregular than the anterior.



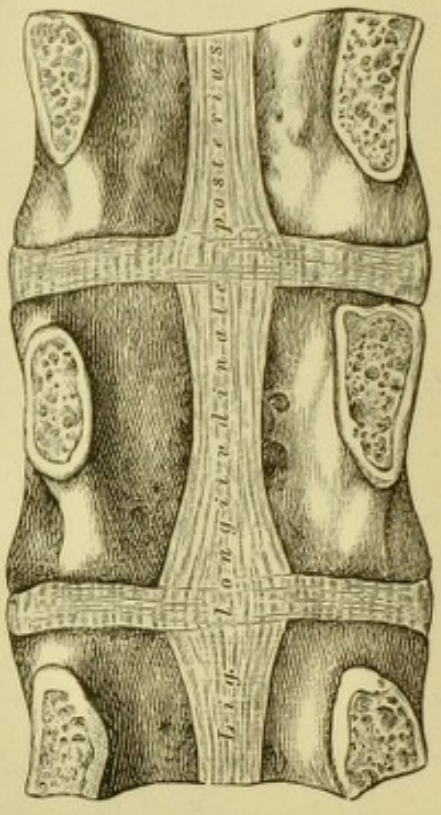
70. The Coccyx, *Os coccygis,* anterior view.

71. The Coccyx, *Os coccygis,* posterior view.

The coccyx consists of 4 (very seldom 5) pieces of bone, rudiments of the vertebral bodies. The first piece has the *Cornua coccygea,* rudimentary ascending articular processes; also rudimentary transverse processes. Between the cornua is the place of articulation of the coccyx with the apex of the sacrum.

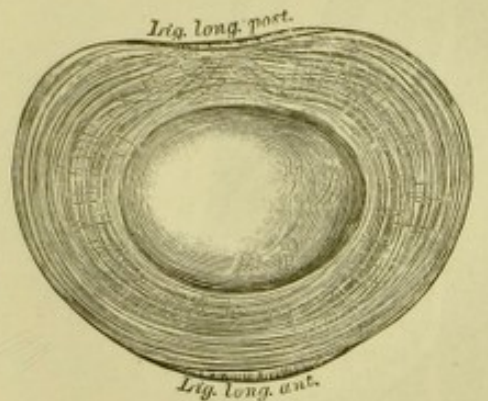


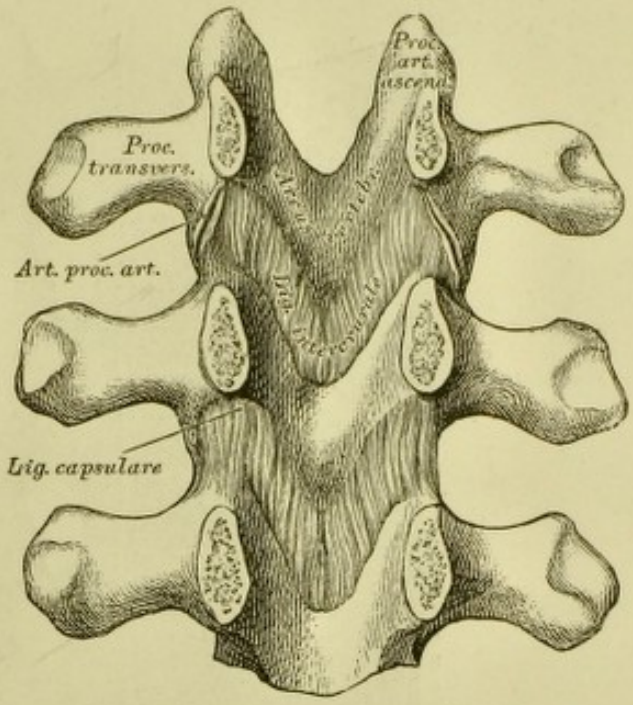
72. The Anterior Common or Longitudinal Ligament, *Ligamentum longitudinale anterius.*



73. The Posterior Common or Longitudinal Ligament, *Ligamentum longitudinale posterius.*

The *Ligamentum longitudinale anterius* is attached above to the basilar portion of the occipital bone, is at first narrow (Fig. 77), but soon becomes broader, runs along the anterior surface of the vertebral column, and is lost below in the periosteum of the sacrum. The weaker *Ligamentum longitudinale posterius* runs along the posterior surface of the vertebral bodies, within the spinal canal from the axis to the sacrum; it becomes somewhat broader at each intervertebral disc.





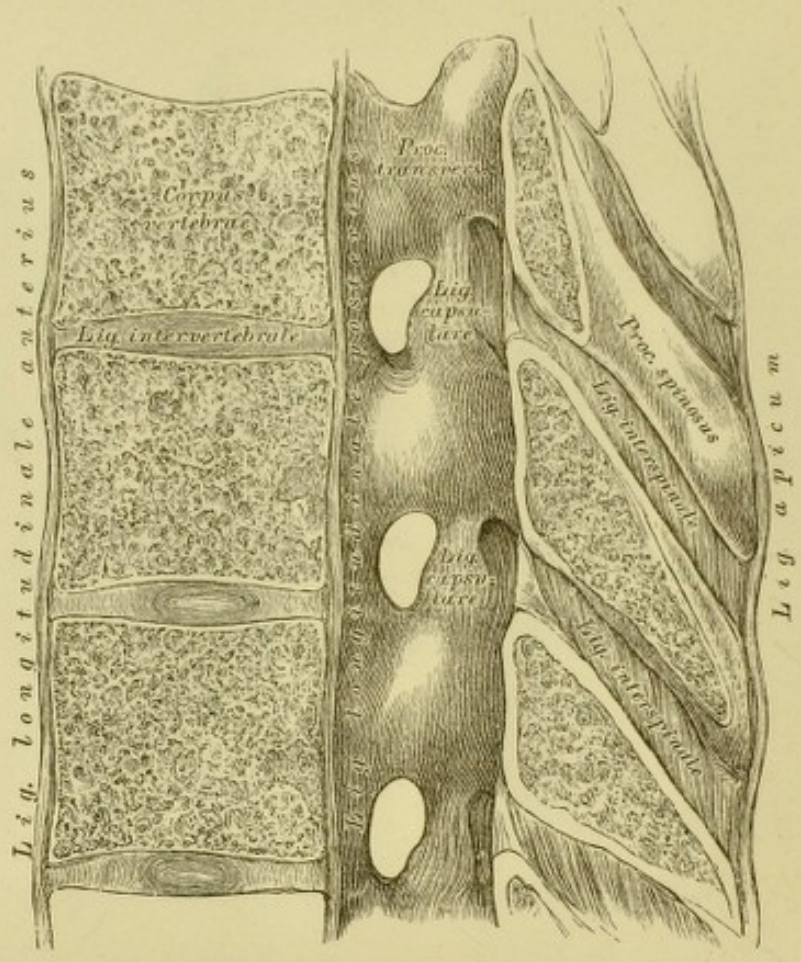
74. The Intervertebral Substance, *Fibro-cartilago intervertebralis.*

75. The *Ligamenta subflava s. Ligamenta intercruralia.*

Each intervertebral disc consists of a broad fibrous ring, which contains in its center a softer substance rising up somewhat on section. With the fibrous ring the *Ligamentum longitudinale anterius* and *posterius* are closely connected.

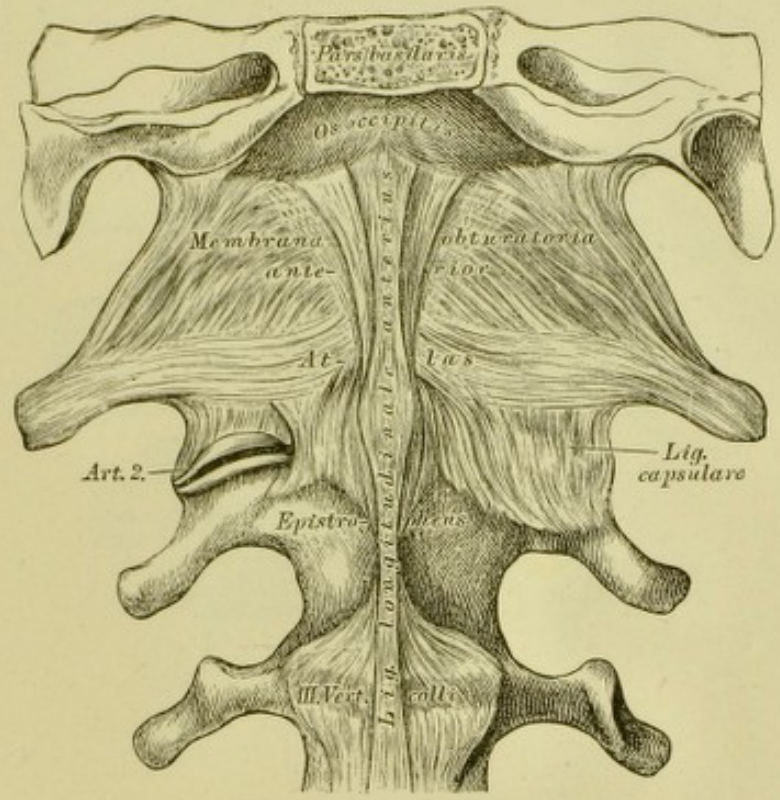
The *Ligamenta subflava* consist of elastic fibres and are attached each between the laminae of 2 vertebrae, so that they run from the lower margin of the lamina above to the posterior surface of the lamina below.

The ascending and descending articular processes of the vertebrae form articulations, *Articulationes processuum articularium*, which are surrounded by capsular ligaments.



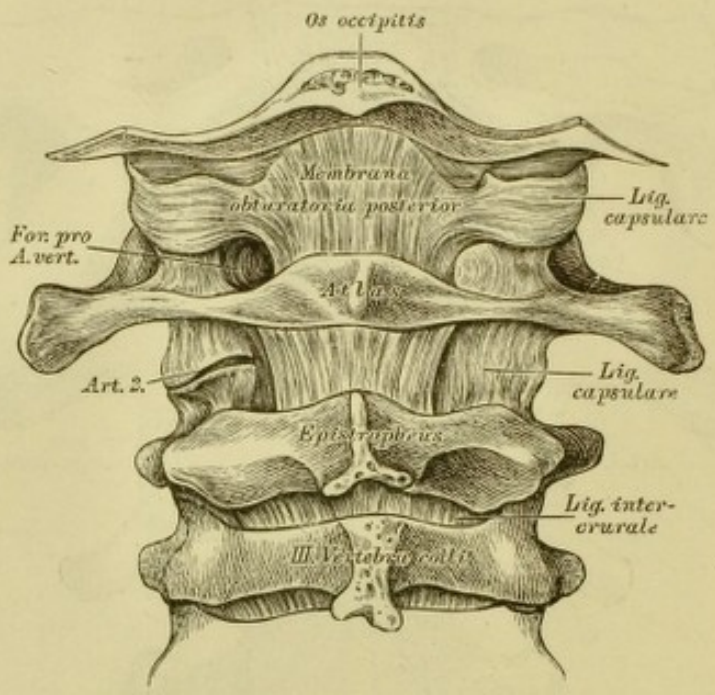
76. The Inter-spinous Ligaments, *Ligamenta interspinalia*, and the Inter-transverse Ligaments, *Ligamenta intertransversalia.*

The *Ligamenta interspinalia* lie each between 2 spinous processes; their posterior thickened margin forms the supra-spinous ligaments or *Ligamenta apicum*. The supra-spinous ligaments run from the seventh cervical vertebra down to the *Crista sacralis media;* from the seventh cervical vertebra up to the external occipital protuberance their place is taken by the *Ligamentum nuchae.*



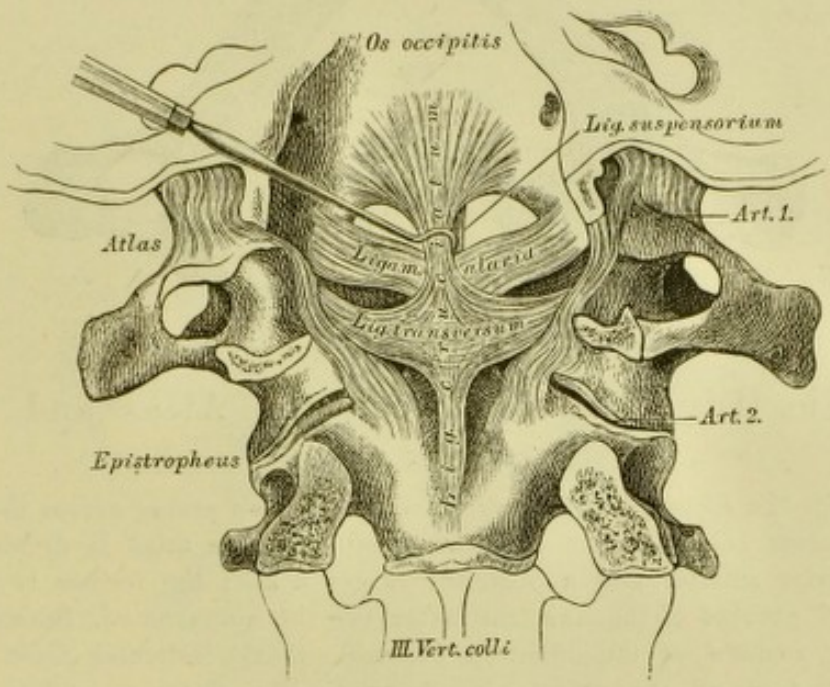
77. The Anterior Obturator Membrane, *Membrana obturatoria anterior.*

The space between the anterior arch of the atlas and the anterior border of the *Foramen magnum* of the occipital bone is filled out by the *Membrana obturatoria anterior*. In the figure the articulation between the articular surfaces of the atlas and the axis and the capsular ligament surrounding the articulation are shown as *Art. 2*; likewise the insertion of the *Ligamentum longitudinale anterius* which in the region of the upper cervical vertebrae is still roundish and narrow.



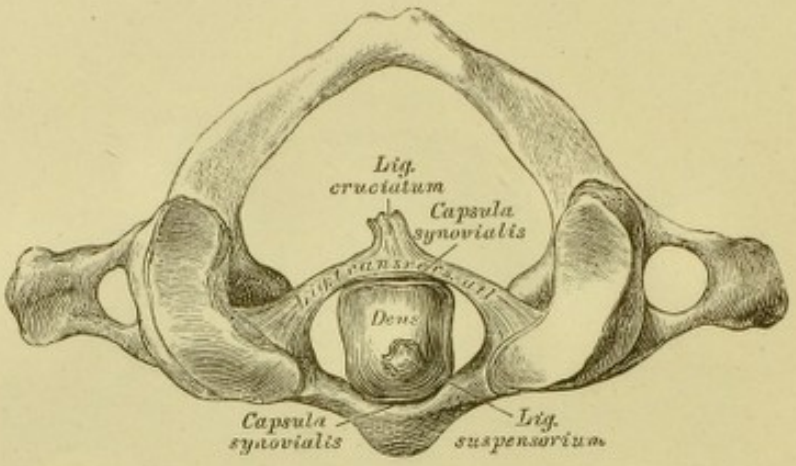
78. The Posterior Obturator Membrane, *Membrana obturatoria posterior.*

The space between the posterior arch of the atlas and the posterior border of the *Foramen occipitale magnum* is closed by the *Membrana obturatoria posterior;* this membrane is weaker than the anterior obturator membrane, and is perforated on both sides at its outer border by the *Arteria vertebralis*, which fills out the space shown in the figure, runnig upwards from the *Foramen transversarium* of the atlas to the *Foramen occipitale magnum.*



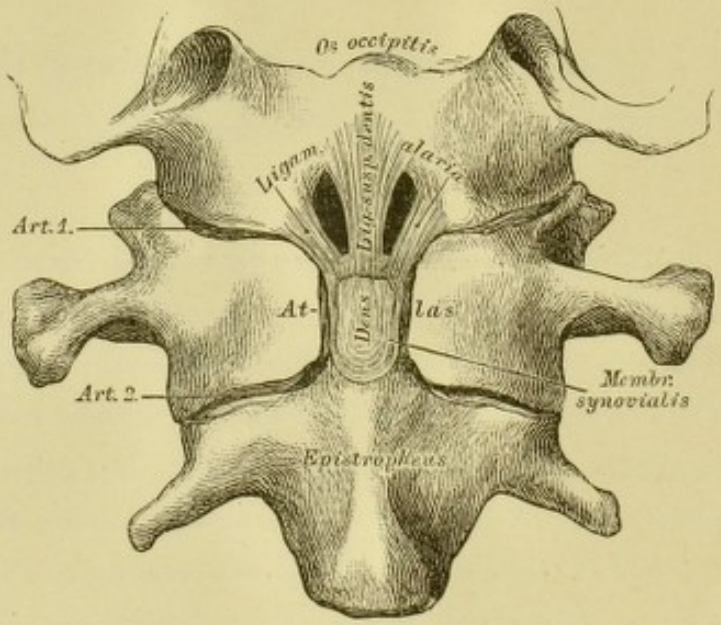
79. The Ligaments between the Axis, Atlas and Occipital Bone, seen from the vertebral canal.

The strong transverse ligament, *Ligamentum transversum atlantis*, presses the odontoid process of the axis toward the articular surface of the anterior arch of the atlas. From the upper border of this ligament a ligamentous crus goes to the anterior border of the *Foramen occipitale magnum*, and a similar crus from its lower border to the body of the axis; the vertical crura form with the *Ligamentum transversum* the crucial ligament, *Ligamentum cruciatum*. The odontoid process is fixed at the anterior border of the *Foramen magnum* by three ligaments, of which the middle is called *Ligamentum suspensorium*, the two lateral *Ligamenta alaria*. In the figure the capsular ligaments of the occipito-atloid articulations are also shown. The upper vertical crus of the crucial ligament is drawn somewhat aside, to show the *Ligamentum suspensorium*.



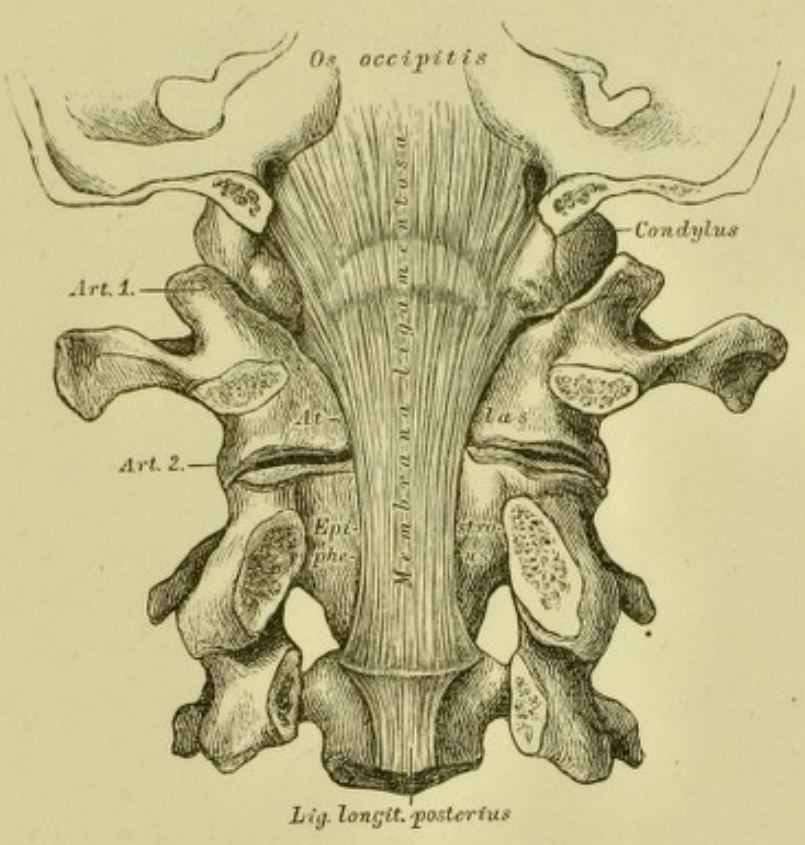
80. The Ligaments between the Atlas and Axis, superior view.

By the *Ligamentum transversum atlantis* which arches across the odontoid process *(Dens)* of the axis the opening of the atlas is divided into an anterior smaller and a posterior larger space; the former is for the odontoid process of the axis, the latter for the spinal cord. Between the anterior surface of the odontoid process and the articular facet of the anterior arch of the atlas, also between the posterior surface of the odontoid process and the *Ligamentum transversum* arching across it, are synovial capsules.



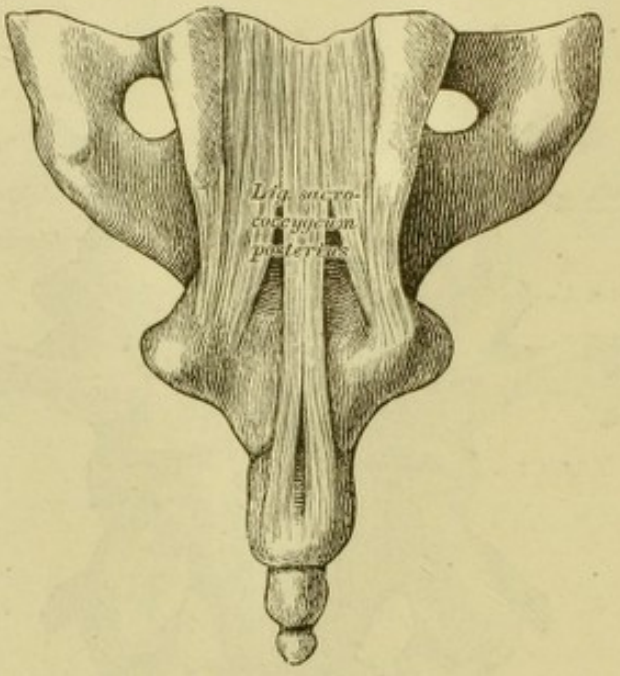
81. The *Ligamentum suspensorium dentis* and the *Ligamenta alaria,* after opening of the anterior arch of the Atlas.

The *Ligamentum suspensorium dentis* runs from the summit of the odontoid process to the anterior border of the *Foramen magnum;* the *Ligamenta alaria* run from both sides of the summit of the odontoid process to the lateral borders of the *Foramen magnum* and to the inner surface of the condyloid processes.



82. Ligaments between Axis, Atlas and Occipital Bone.

The ligaments between the axis, atlas and occipital bone are covered in the *Canalis medullae spinalis* by a fibrous membrane, which arises above the anterior border of the *Foramen occipitale magnum* and ends at the lower border of the body of the axis, close to the commencement of the *Ligamentum longitudinale posterius*. *Hyrtl* calls this ligament *Membrana ligamentosa;* other authors mention it as the *Apparatus ligamentosus*.



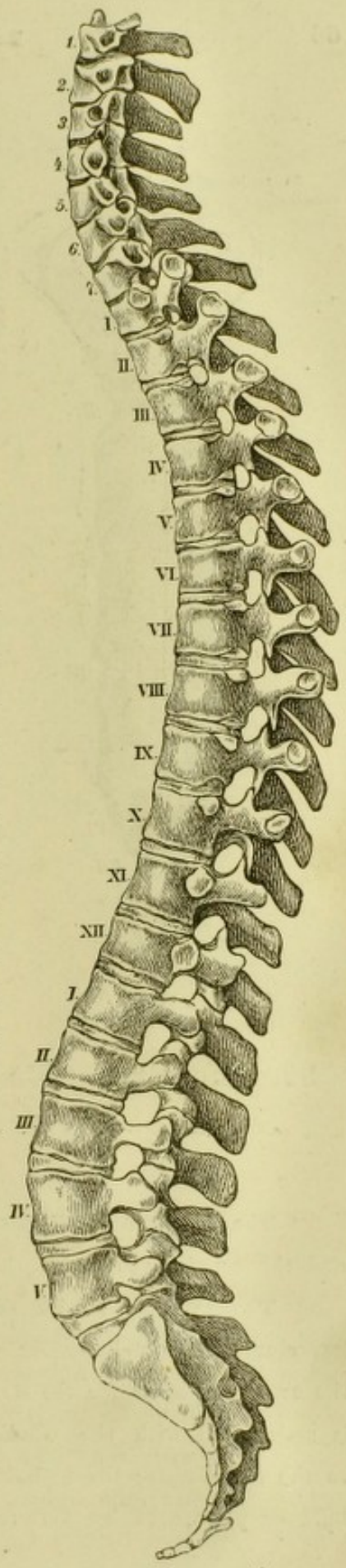
83. Ligaments between Sacrum and Coccyx.

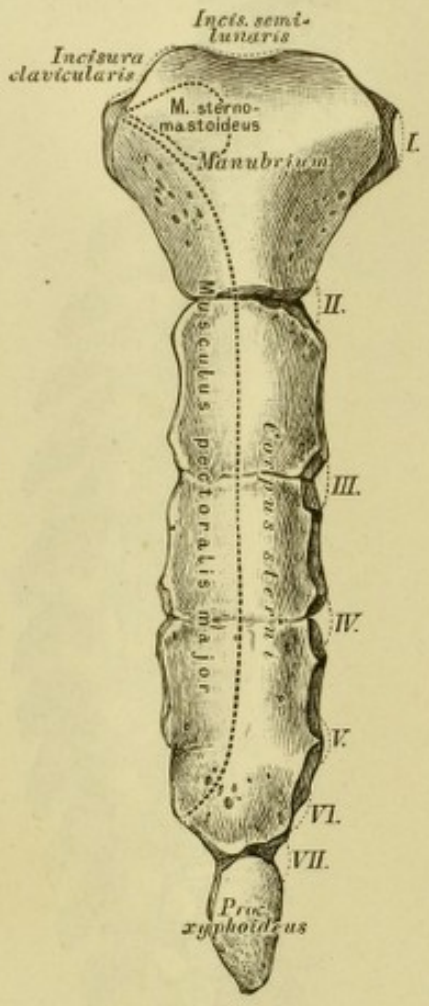
Between the apex of the sacrum and the first piece of the coccyx there is a disc of fibro-cartilage; also between the separate pieces of the coccyx. The strenghtening ligaments are the anterior, posterior and lateral *Ligamenta sacro-coccygea*. The *Ligamentum sacro-coccygeum posterius* lies between the sacrum and cornua of the coccyx and closes the *Hiatus sacro-coccygeus*.

84. The Vertebral Column,

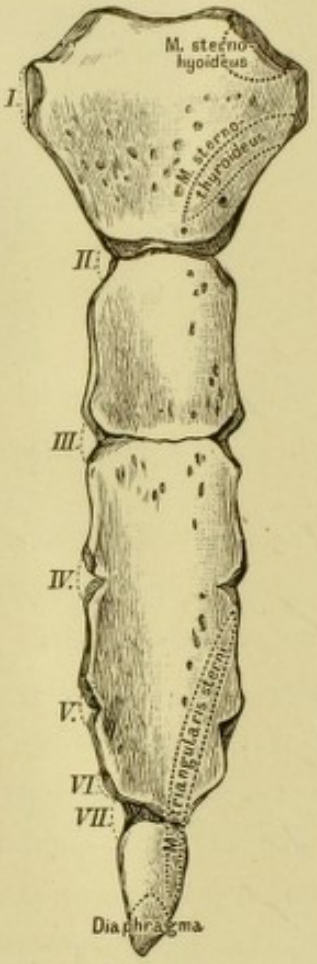
Columna vertebralis, side view.

The vertebral column presents the following curves: in the cervical portion a tolerably marked convexity anteriorly; in the dorsal region a well marked convexity posteriorly; in the lumbar region a well marked convexity anteriorly, and in the sacral and coccygeal portions a convexity posteriorly. The most marked, anterior convex curve, is at the place where the lumbar portion of the vertebral column joins with the sacrum, where the last lumbar vertebra forms the promontory, *Promontorium.*





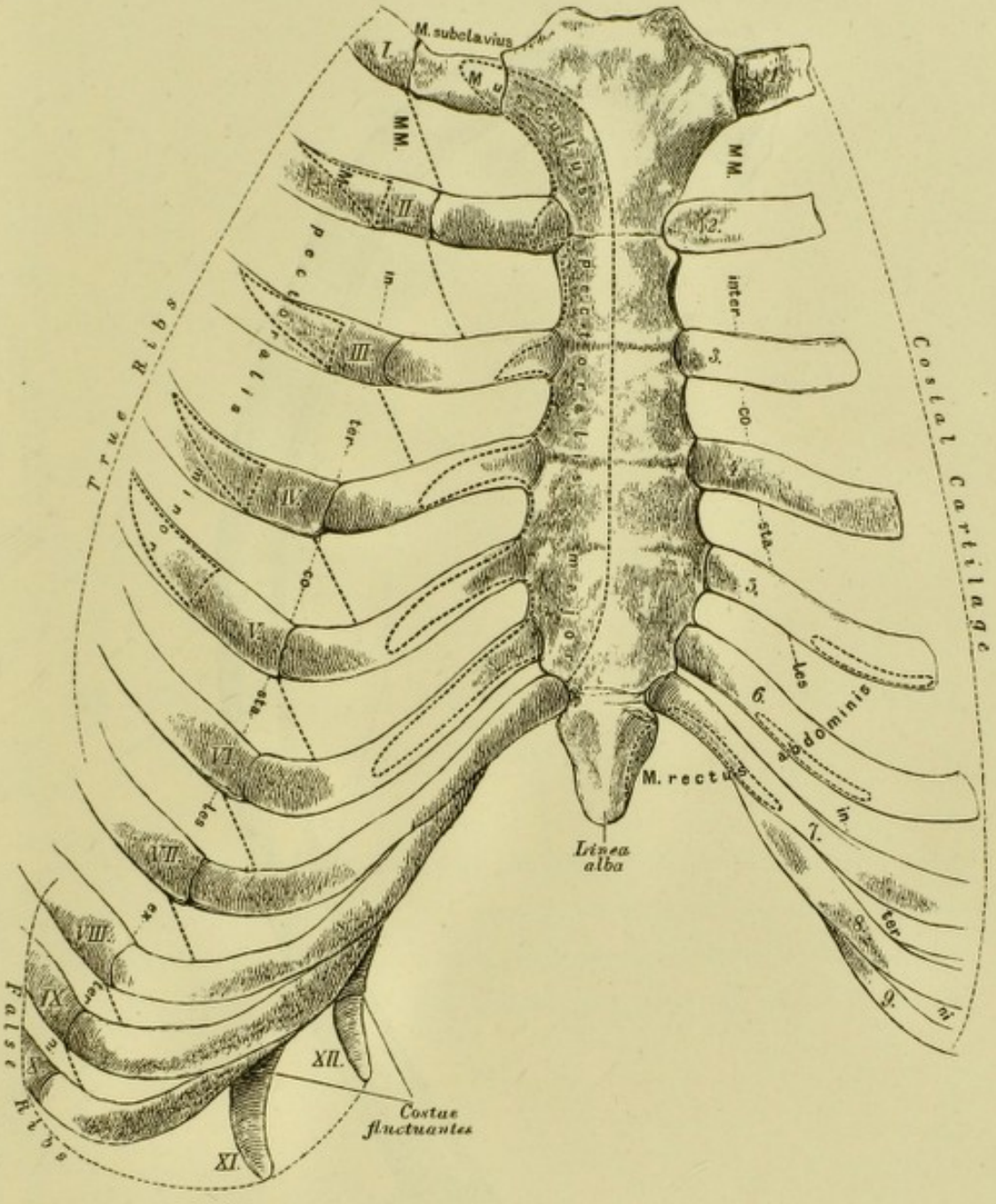
85. The Breast-Bone, *Sternum,* from before.



86. The Breast-Bone, *Sternum,* from behind.

The *Sternum* is divided into the *Manubrium, Corpus* or *Gladiolus,* and the ensiform or xiphoid appendix, *Processus xyphoideus.*

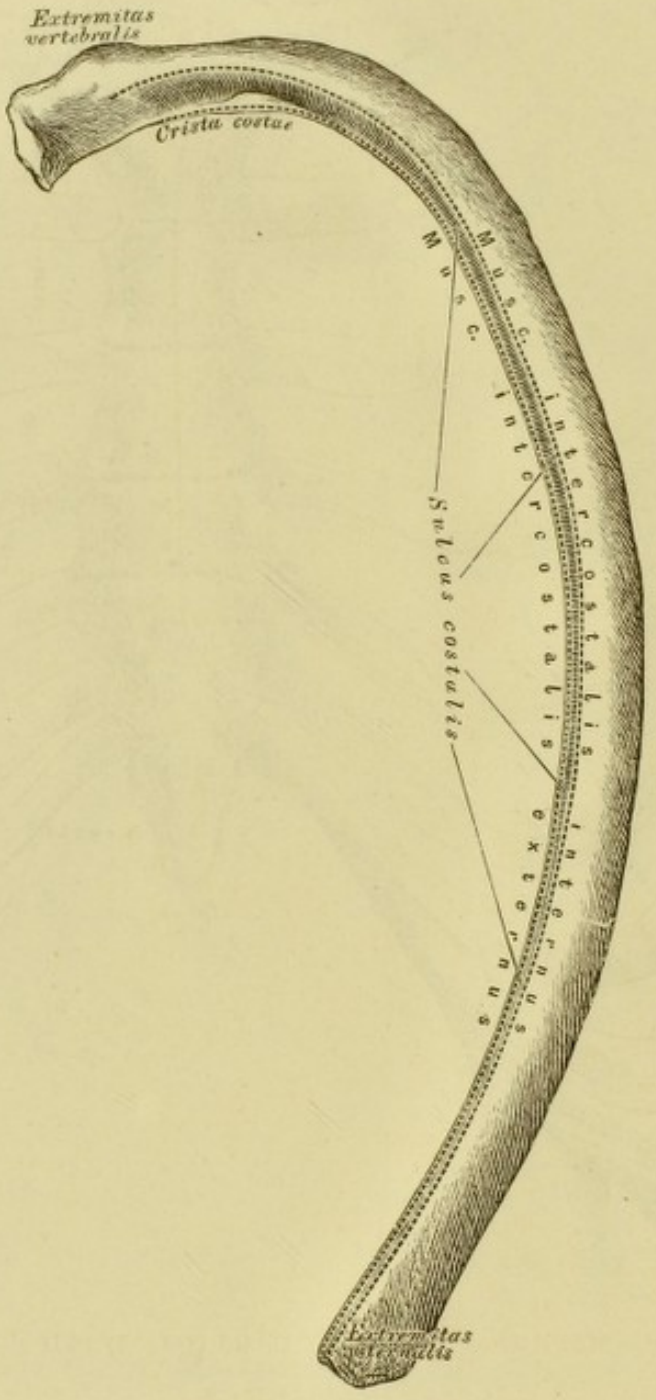
The superior border of the *Manubrium* presents in its center the interclavicular notch or *Incisura semilunaris,* on both sides of wich are the articular facets for the sternal end of the clavicle; the inferior border is articulated with the *Gladiolus.* The *Gladiolus* is three times as long as the *Manubrium;* the xiphoid appendix appears either curved, pointed, bifid or perforated by a round hole.



87. The *Sternum* in Articulation with the Costal Cartilages.

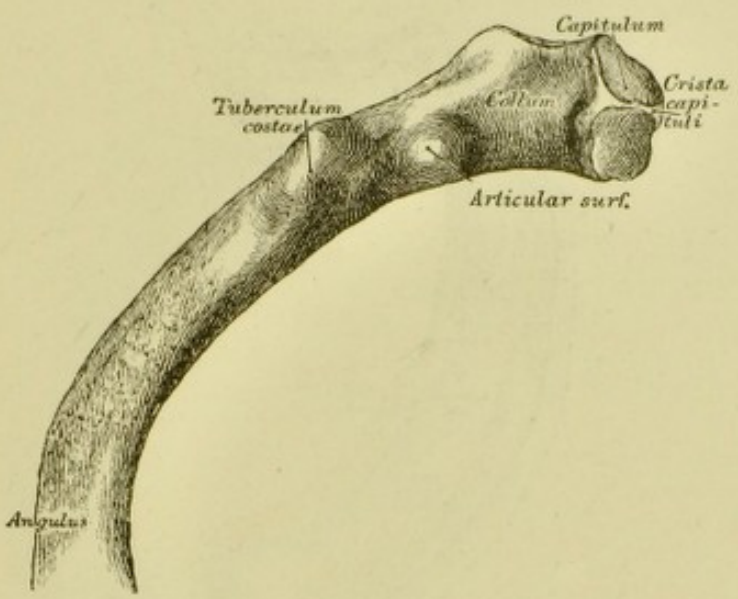
The *Sternum* is in articulation at its lateral borders with seven costal cartilages. Only the first costal cartilage is continuous with the *Sternum;* the others are articulated with the *Sternum* in synovial cavities; the articular facets become shallower and shallower from the second to the seventh costal cartilage, and the seventh is placed in a very small concavity at the point of union of the *Gladiolus* and xiphoid appendix.

The ribs whose cartilages articulate with the *Sternum* are called true, *Costae verae;* those ribs whose cartilages articulate with each other, or those which end free, without any articulation are called false, *Costae spuriae.* True ribs are the upper seven pairs; false ribs the lower five pairs.



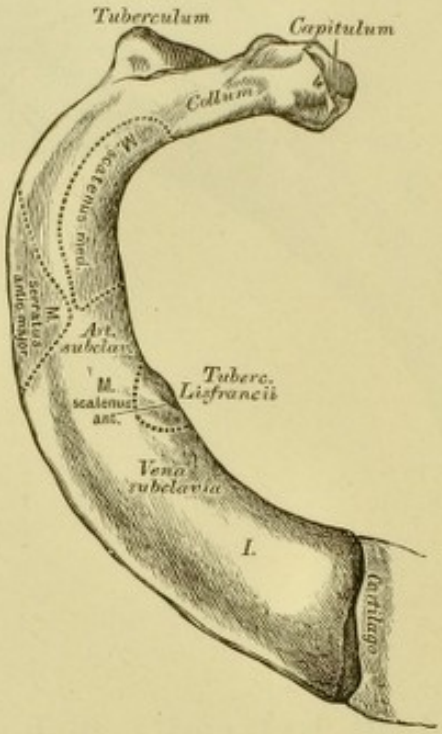
88. The Bony Portion of a True Rib.

Each rib consists of a bony portion and a costal cartilage; the bony portion has an external convex and an internal concave surface, a superior rounded border, and an inferior border containing a groove, *Sulcus costalis*, which deepens especially toward the vertebral extremity of the rib; the part where the outer edge of the groove is highest, is called *Crista costae*.



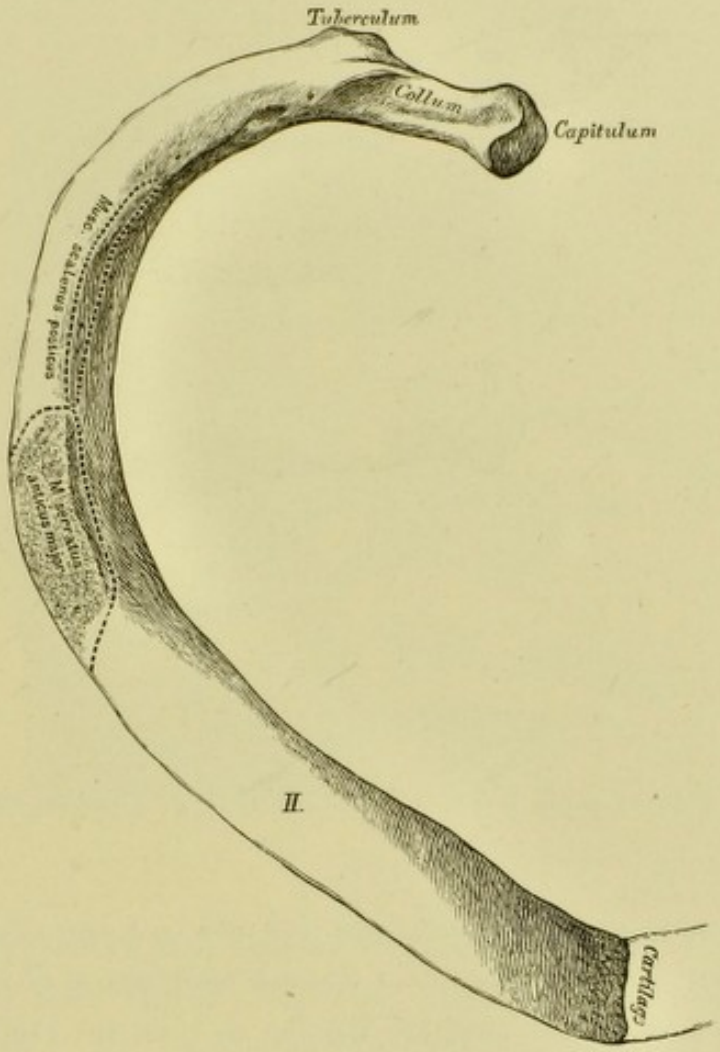
89. The Vertebral Extremity of a Rib, *Extremitas vertebralis.*

The vertebral extremity has a head, *Capitulum*, covered with cartilage, which shows on those ribs articulated with two vertebral articular surfaces, two facets separated by a ridge, the *Crista capituli*. The flattened portion of the ten upper ribs behind the head is called the neck, *Collum*.



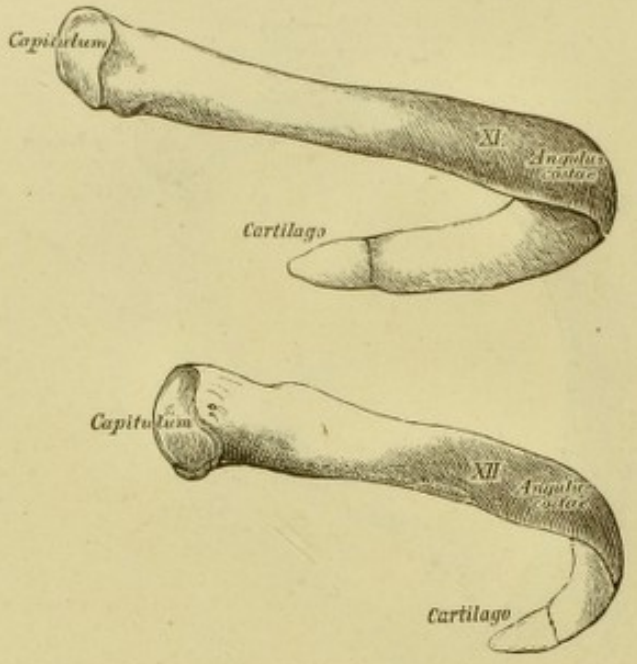
90. The First Rib, superior view.

The first rib shows an upper and an under surface, an outer and an inner border. It has a round head, *Capitulum*, with a single articular facet, when the first dorsal vertebra alone forms the articular fossa; when the articular fossa is formed by the seventh cervical and first dorsal vertebrae, the articular facet of the head is also a double one. At the inner border there is a tubercle, the *Tuberculum Lisfranci*, which is not always very well developed.



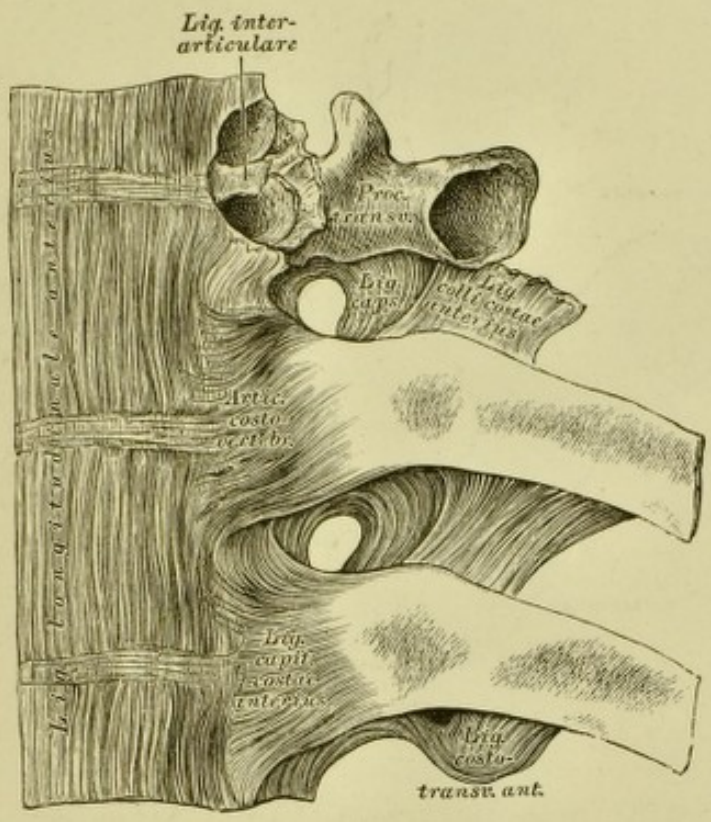
91. The Second Rib, superior view.

At the place where the neck, *Collum*, is continued into the shaft, there is on every rib the tuberosity or tubercle, *Tuberculum costae*, covered with cartilage, for articulation with the articular surface of the transverse process of the lower of the two vertebrae with which the rib is connected. At the back part of the external surface is a rough line, the angle, *Angulus costae* (Fig. 89); it is well developed only from the third to the tenth ribs, but coincides with the tubercle in the first and second ribs. The second rib has at its external surface a rough prominence for the attachment of the serratus magnus muscle, *M. serratus anticus major*.



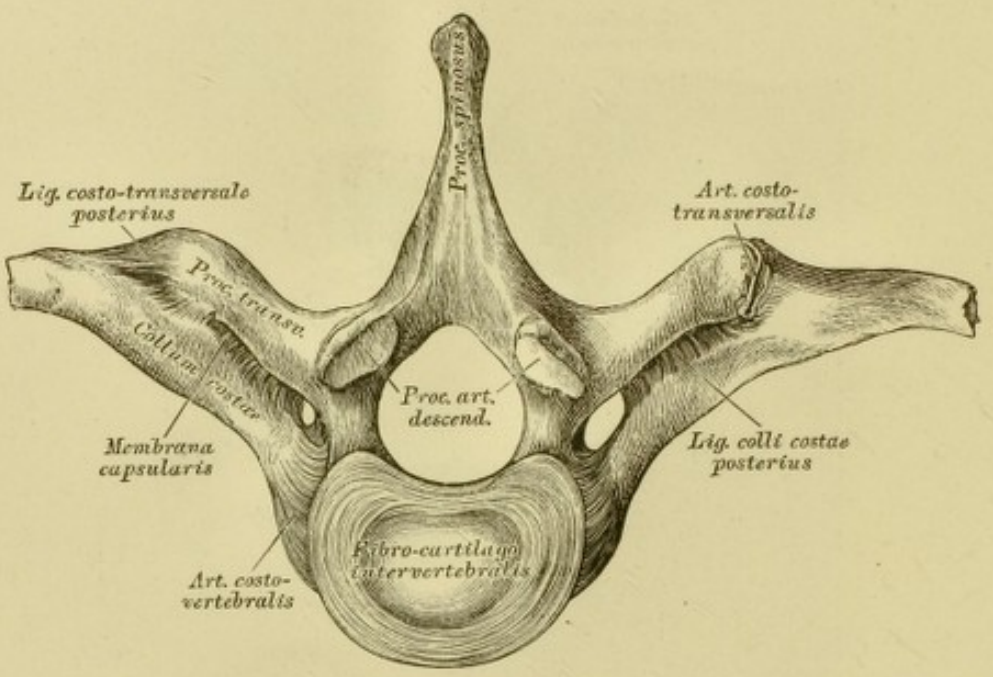
92. The Eleventh and Twelfth Ribs, *Costae fluctuantes.*

The eleventh and twelfth ribs end free and are of all the ribs the two most moveable; they have a round head with a single articular facet. The tubercle and neck are wanting in both, the rough line forming the *Angulus costae* only slightly marked. Their cartilages are very short, round and pointed. The twelfth rib is the shortest of all.



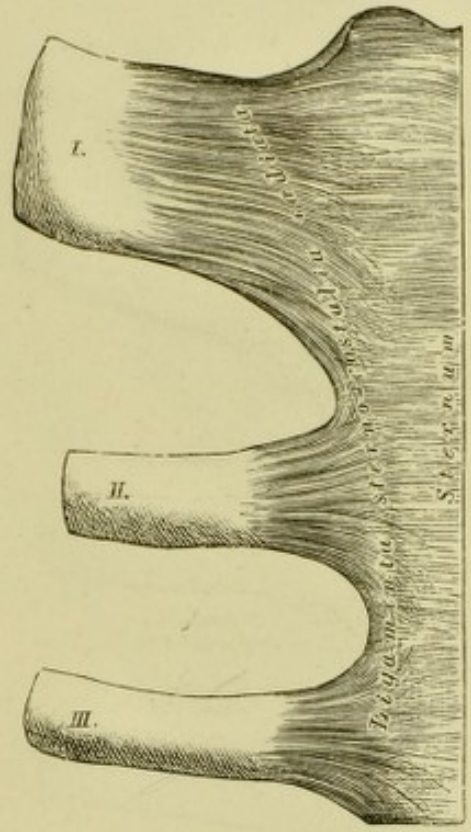
93. Articulations between the Posterior Ends of the Ribs and the Vertebrae, *Articulationes costo-spinales,* anterior view.

Between the heads of the ribs and the articular fossae of the vertebral bodies are articulations, *Articulationes costo-vertebrales,* surrounded by a capsule, and covered by the *Ligamentum capituli costae anterius* (anterior costo-vertebral). When the head of the rib has two articular facets (second to tenth ribs), the articular cavity is divided by the *Ligamentum interarticulare* (continuation of the intervertebral disc to the *Crista capituli*) into two parts. The articular cavity of the eleventh and twelfth ribs is always single, that of the first rib usually single; sometimes, when the articular fossa is formed by the seventh cervical and first dorsal vertebrae, double, divided by a *Ligamentum interarticulare.*



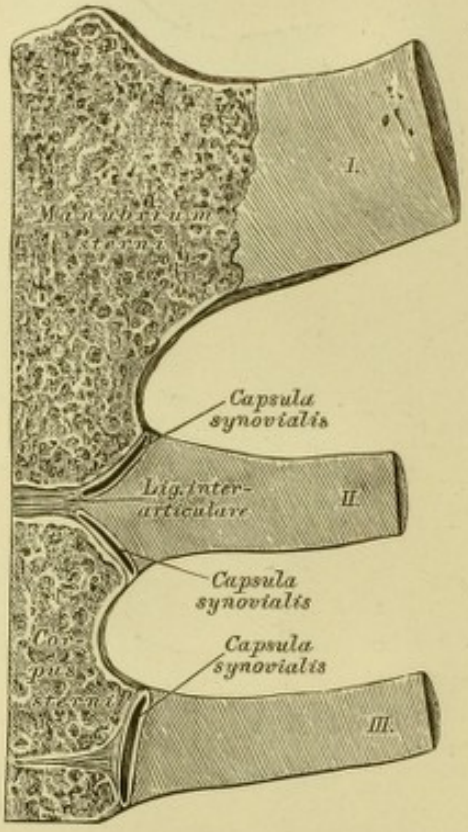
94. Articulations between the Posterior Ends of the Ribs and the Vertebrae, *Articulationes costo-spinales*, inferior view.

Between the tubercles of the ribs and the transverse processes of the vertebrae are the costo-transverse articulations, *Articulationes costo-transversales;* they are not present on the eleventh and twelfth ribs. These articulations are surrounded by thin capsules and strengthened by the following ligaments: by the *Ligamentum costo-transversale posterius* (posterior costo-transverse), passing from the rough portion of the *Tuberculum costae* to the summit of the transverse process of the vertebra; by the *Ligamentum colli costae anterius* (anterior costo-transverse, Fig. 93) passing between the transverse process and upper border of the neck of the rib; and the *Ligamentum colli costae posterius* (middle costo-transverse), placed between the transverse process and the posterior surface of the neck of the rib.



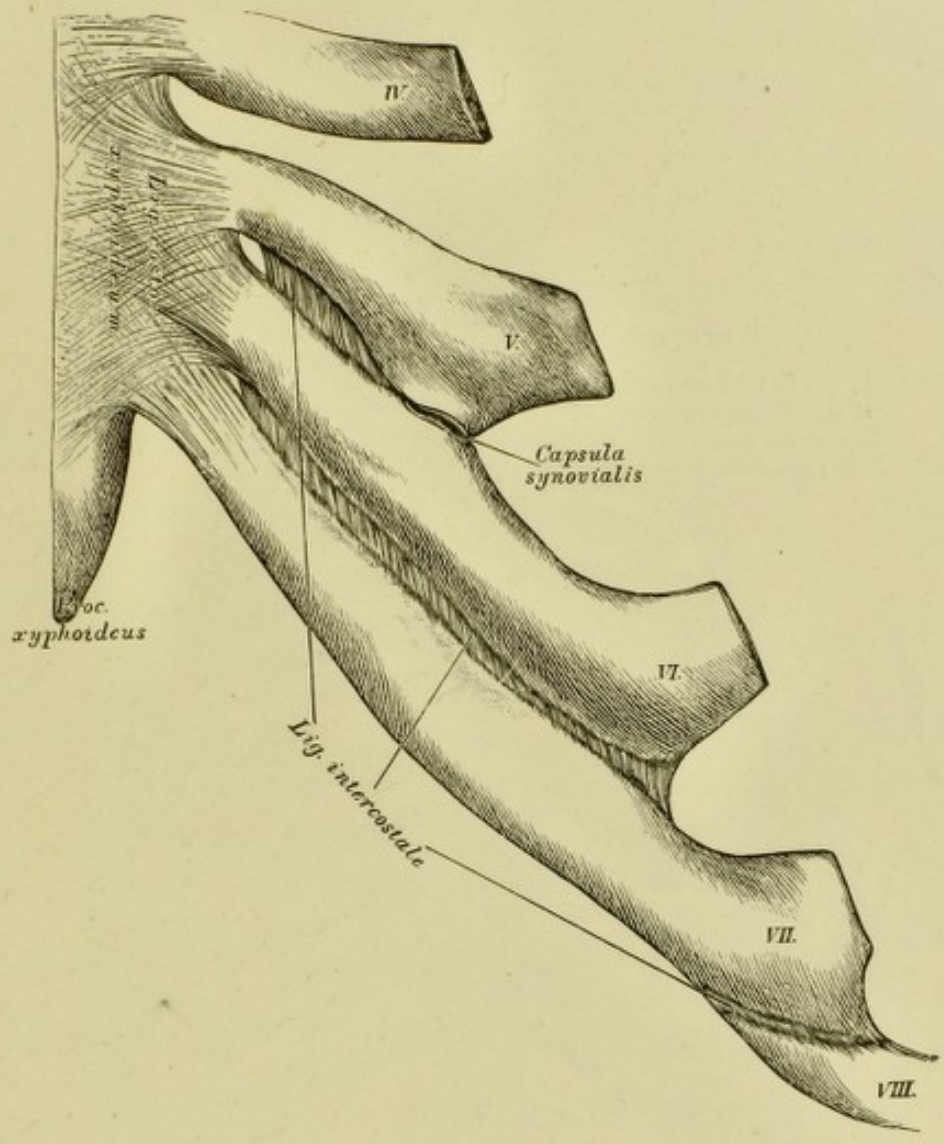
95. Articulations between the Anterior Ends of the Ribs and the Sternum, *Articulationes costo-sternales,* anterior view.

The articulations between the anterior ends of the ribs and the sternum are found from the second to the seventh ribs; the cartilage of the first rib is united directly to the *Manubrium sterni* (articulation here extremely rare). Each of these articulations consists of a synovial capsule, which is covered on the anterior surface by fibrous bands, *Ligamenta sterno-costalia radiata.*



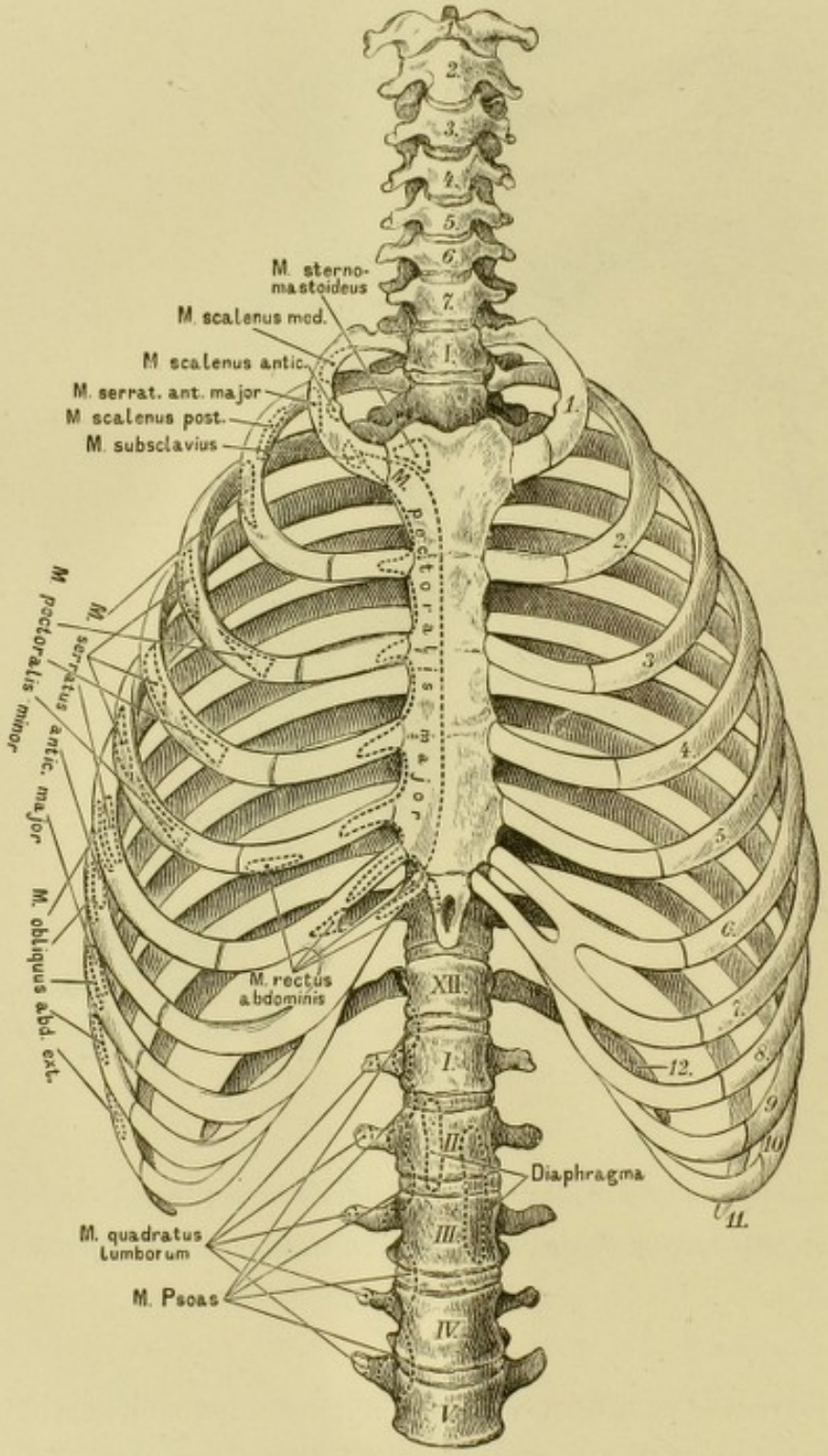
96. Articulations between the Anterior Ends of the Ribs and the Sternum, *Articulationes costo-sternales,* in section.

The figure shows the direct connection between the bone of the *Manubrium sterni* and the cartilage of the first rib; the articular cavity between the cartilage of the second rib and the sternum is usually a double one, formed by a continuation of the cartilage between the *Manubrium* and *Corpus sterni.* The cavities of the other costo-sternal articulations are single; they may be wanting entirely at the sixth and seventh costal cartilage.

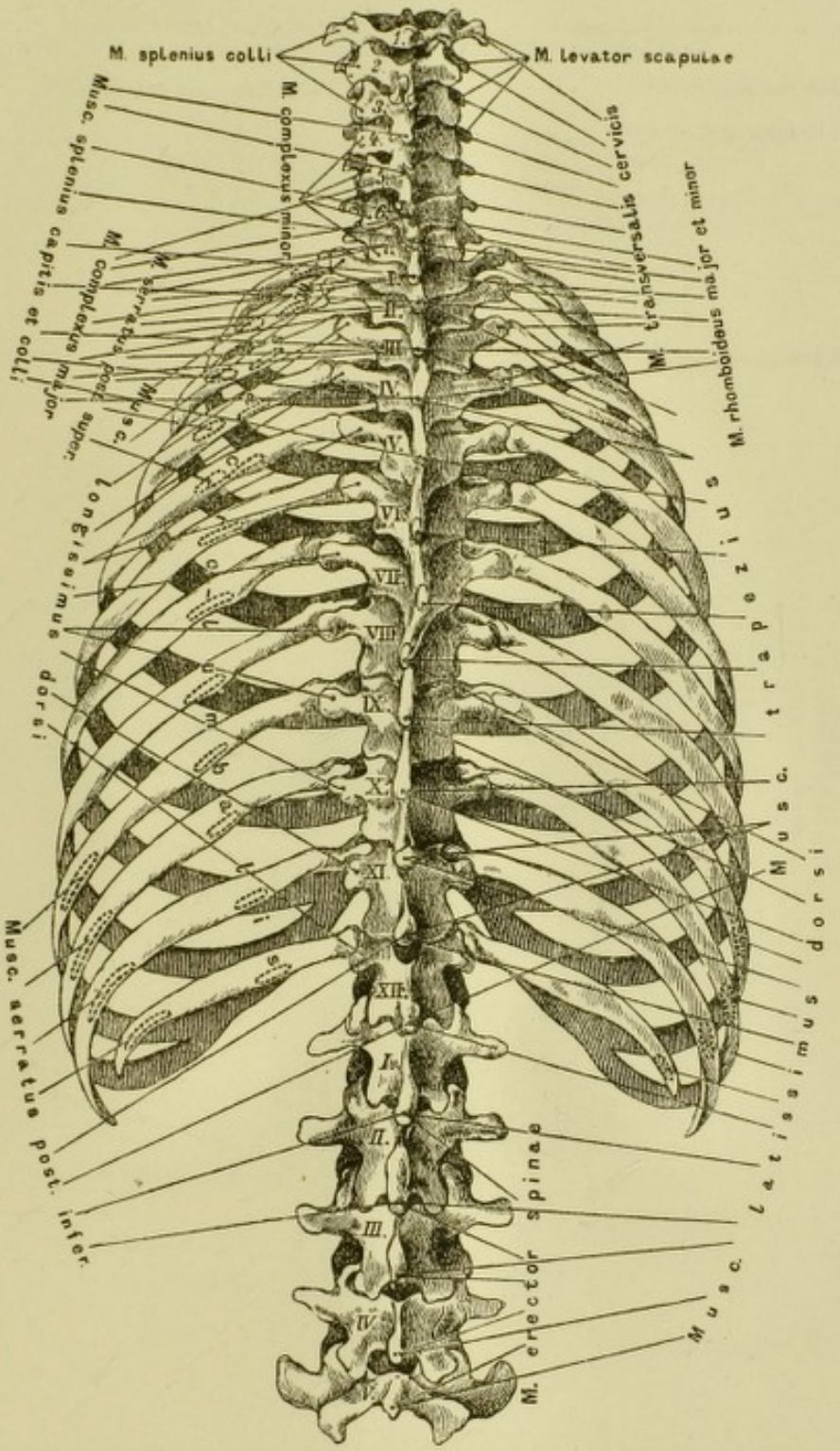


97. Articulations between the Anterior Ends of the Ribs and the Sternum, *Articulationes costo-sternales*, anterior view.

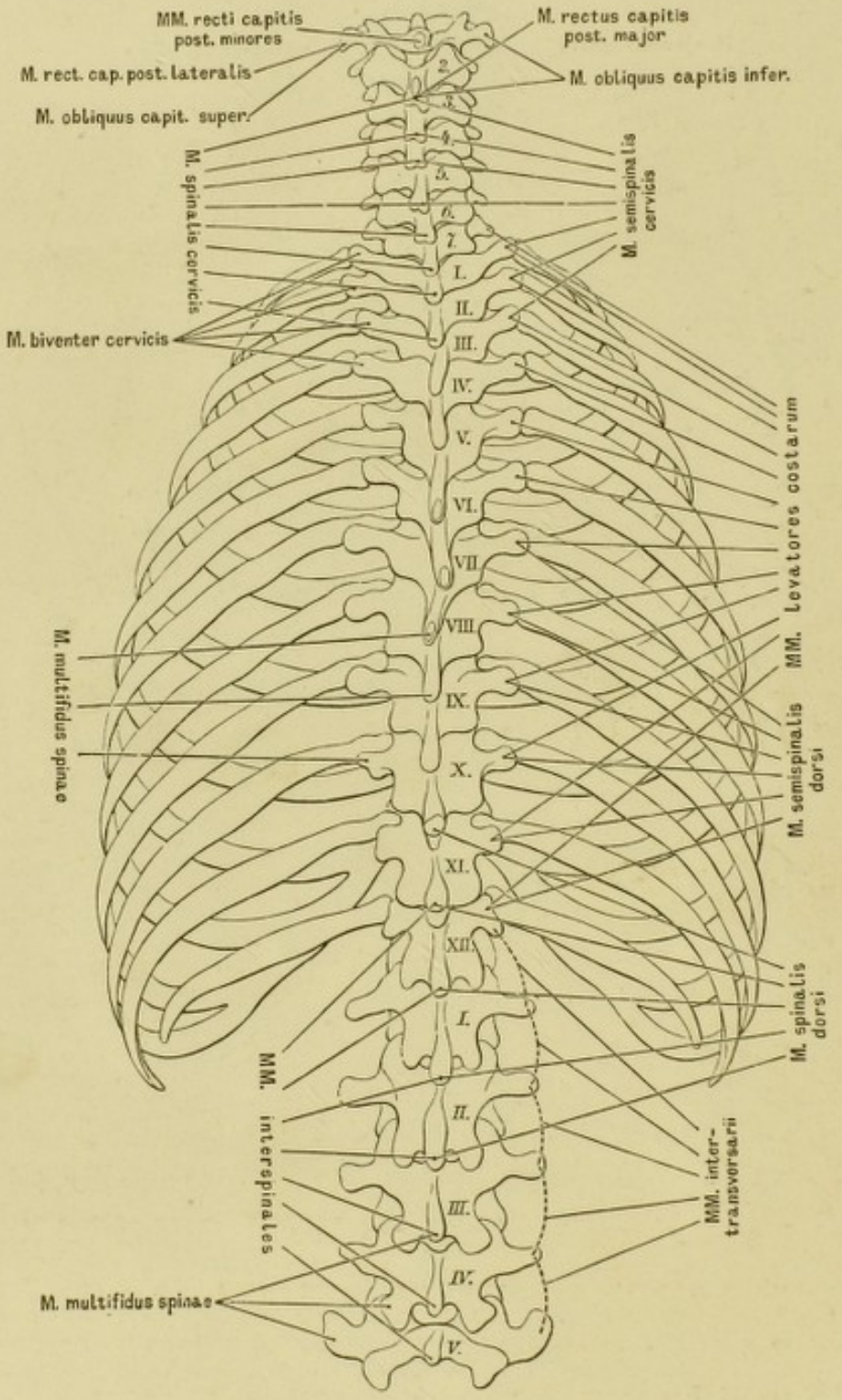
Between the cartilages of the sixth and seventh ribs and the xiphoid appendix of the sternum is the *Ligamentum costo-xyphoideum*. Articular cavities with synovial capsules are sometimes also present at those places where one costal cartilage is contiguous with another.



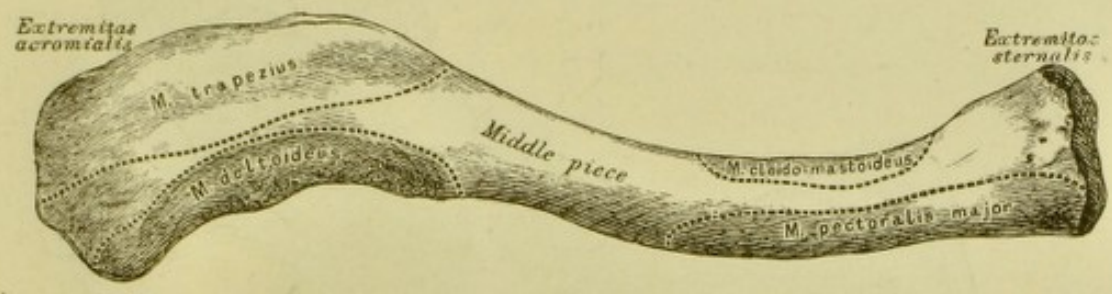
98. The Thorax and Vertebral Column, anterior view, with the insertions of the muscles of the neck, chest, abdomen and back.



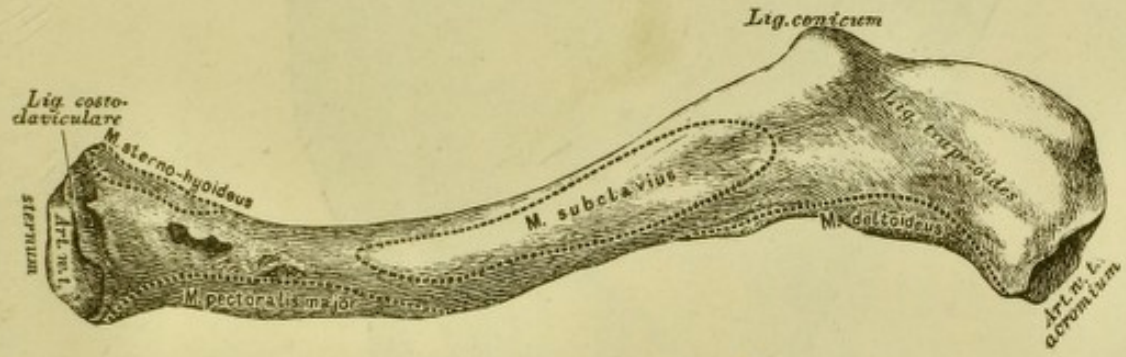
99. The Thorax and Vertebral Column, posterior view, with the insertions of the broad and some of the long muscles of the back.



100. The Thorax and Vertebral Column, posterior view, with the insertions of the deep muscles of the neck and back.

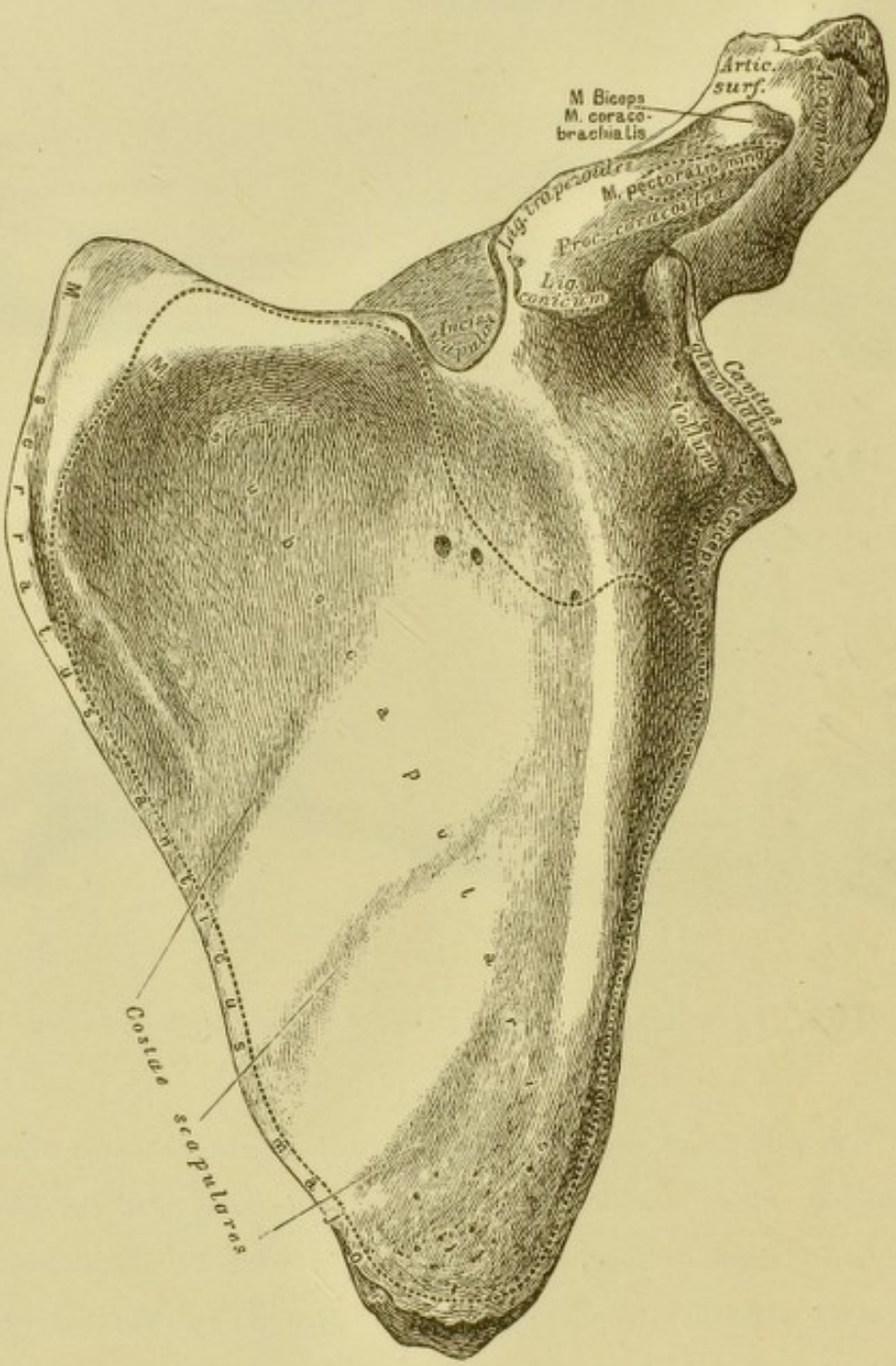


101. The Right Clavicle, *Clavicula*, from before.



102. The Right Clavicle, *Clavicula*, from below.

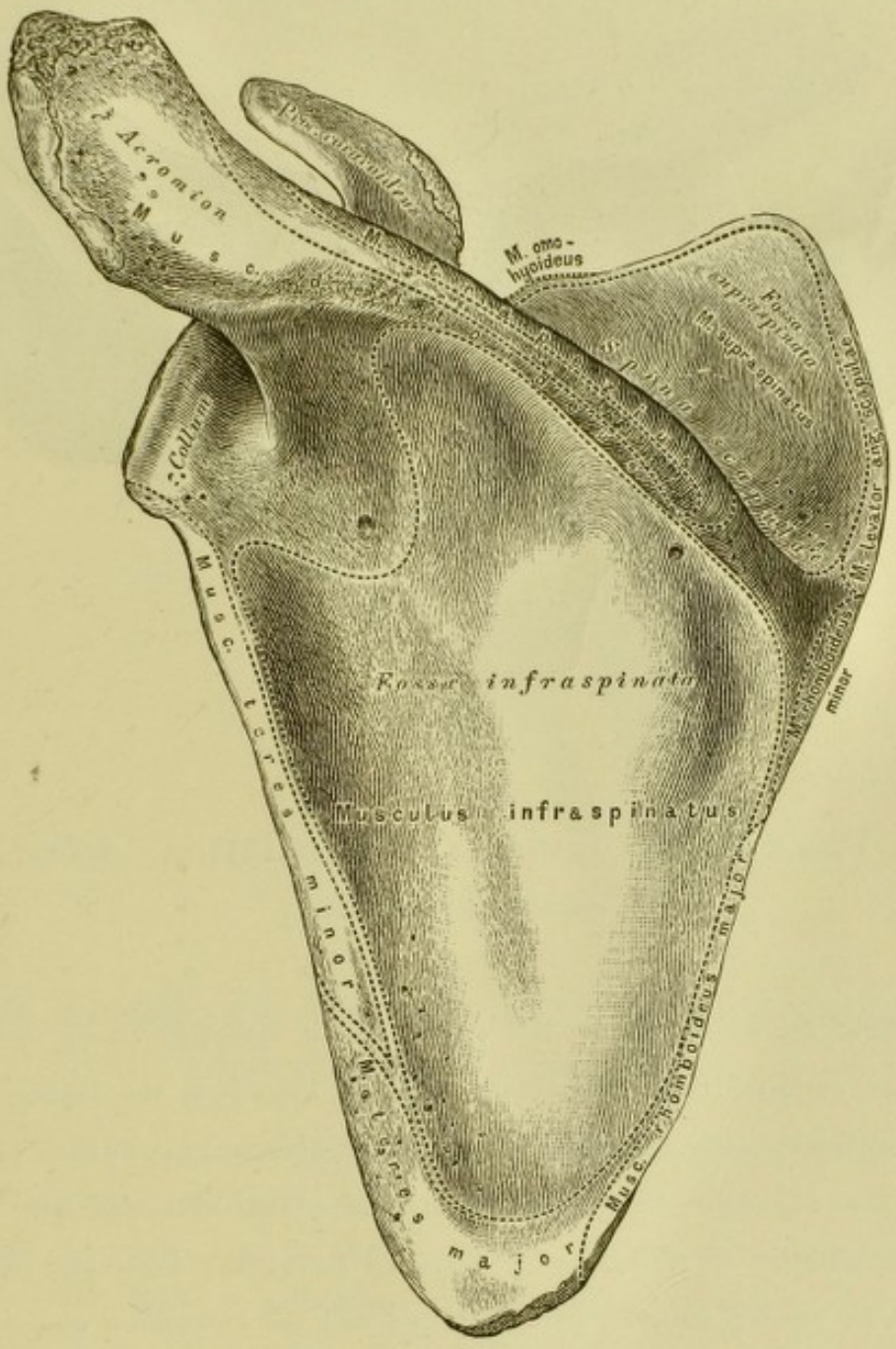
The collar-bone consists of an internal or sternal end, *Extremitas sternalis*, whose saddelike articular facet articulates with the *Incisura clavicularis* of the *Sternum*, an outer or acromial end, *Extremitas acromialis*, articulated with the acromion; and a middle piece. The clavicle is curved like an italic *f*, so that the convexity is directed forwards at the inner two thirds, the concavity at the outer third.



103. The Left Shoulder-Blade, *Scapula*, from before.

The scapula has: an anterior, a posterior surface, an internal, external and superior border, an inferior, superior external and superior internal angle, finally two processes. The bone covers the posterior surface of the 2. to the 7.—8. ribs.

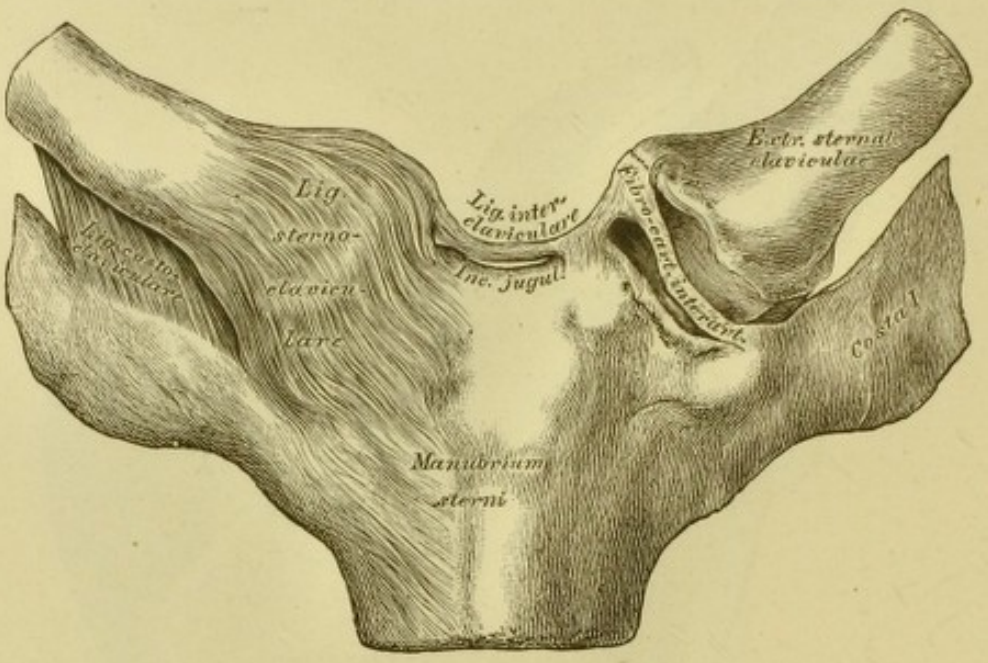
The anterior surface is somewhat concave, and is marked by 3—5 ridges, *Costae scapulares* (for insertions of muscles). The shortest superior border has at its outer end the deep supra-scapular notch, *Incisura scapulae*. At the superior external, thickened angle is the glenoid cavity, *Cavitas glenoidalis*, for the head of the humerus; the slightly depressed surface which surrounds the head, is called the neck, *Collum*.



104. The Left Shoulder-Blade, *Scapula,* from behind.

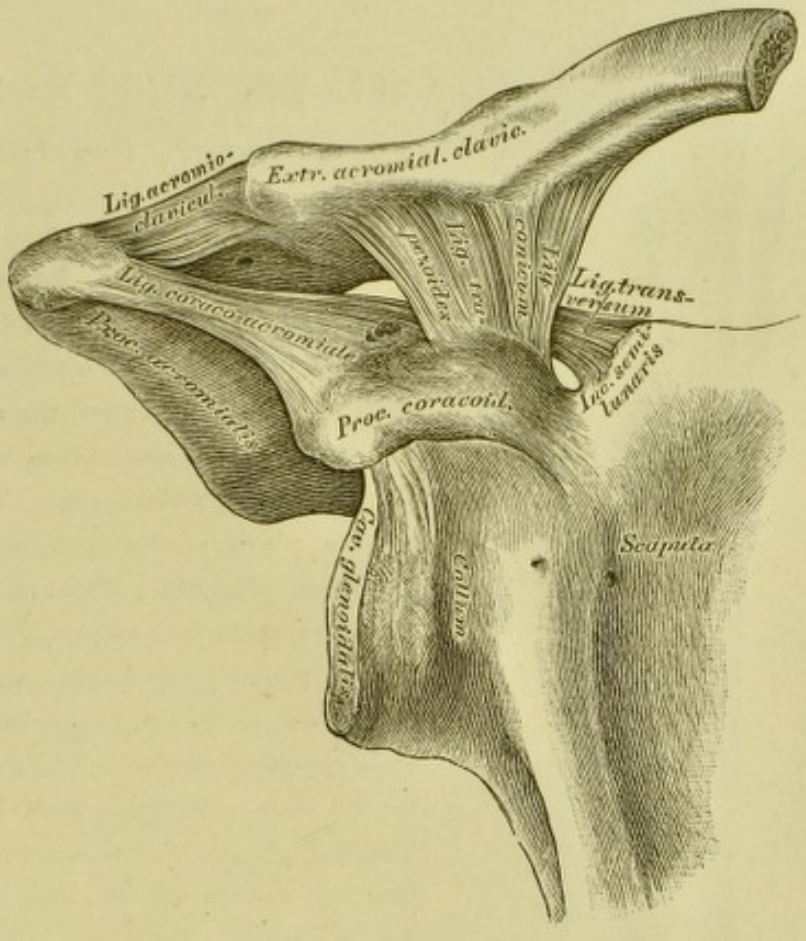
The posterior surface of the scapula is divided by the spine, *Spina scapulae,* into the supra- and infraspinous fossae, *Fossa supra- et infraspinata.* The spine is continued into the broad acromion process, which overhangs the glenoid cavity, and is connected by an articular facet with the clavicle. The second process is the coracoid process, *Processus coracoideus,* which arises between the *Incisura scapulae* and *Cavitas glenoidalis,* over which latter it curves forwards and outwards.

The scapula articulates with the clavicle and the humerus.



105. The Sterno-Clavicular Articulation, *Articulatio sterno-clavicularis.*

The fibrous capsule of this articulation is especially strong on the anterior surface; the strengthening band is known as the *Ligamentum sterno-clavicular;* the articular cavity has interposed an interarticular fibro-cartilage, whose circumference is closely connected with the fibrous capsule. As strengthening ligaments serve: the *Ligamentum interclaviculare* passing between both clavicles, and the *Ligamentum costo-clavicular* passing from the cartilage of the first rib to the under rough surface of the sternal end of the clavicle.

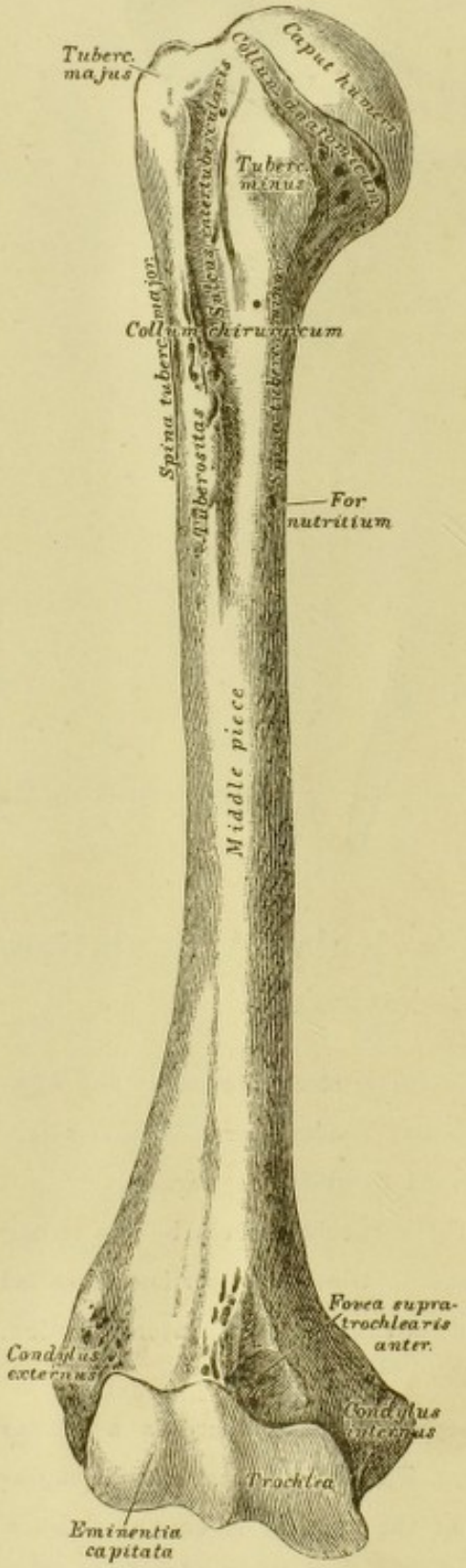


106. The Right Acromio-Clavicular Articulation, *Articulatio acromio-clavicularis.*

The fibrous capsule of this articulation is strengthened by the *Ligamentum acromio-claviculare;* in the articular cavity there is an interarticular fibro-cartilage developed in different degrees.

The clavicle is articulated with the coracoid process by the strong coraco-clavicular ligament, whose internal triangular portion is called conoid ligament, *Ligamentum conicum,* and its external quadrilateral portion, trapezoid ligament, *Ligamentum trapezoides.*

Between the acromion and coracoid processes there is a fibrous band, the strong coraco-acromial ligament. The *Incisura semilunaris* (suprascapular notch) at the superior border of the scapula is converted by a transverse ligament, *Ligamentum transversum,* into a foramen (for the passage of the suprascapular nerve).



107. The Right Humerus,

Os humeri, from before.

The humerus forms at its upper extremity the head, *Caput humeri*, covered with cartilage; the furrow below it is called the anatomical neck, *Collum anatomicum*, while the surgical neck, *Collum chirurgicum*, lies at the place of insertion of the *M. teres major* (Fig. 109). Below the furrow the lesser tuberosity, *Tuberculum minus*, projects forwards, while the greater tuberosity, *Tuberculum majus*, projects outwards, being external to the lesser; between both runs the bicipital groove, *Sulcus intertubercularis* (for the tendon of the long head of the *M. biceps*). From the tuberosities the *Spina tuberculi majoris* and the *Spina tuberculi minoris* run downwards.

At the external surface of the shaft or middle piece, which has 3 surfaces, there is a rough triangular impression, *Tuberositas* (place of insertion of the *M. deltoides*); at the upper third of the inner border is the *Foramen nutritium*.

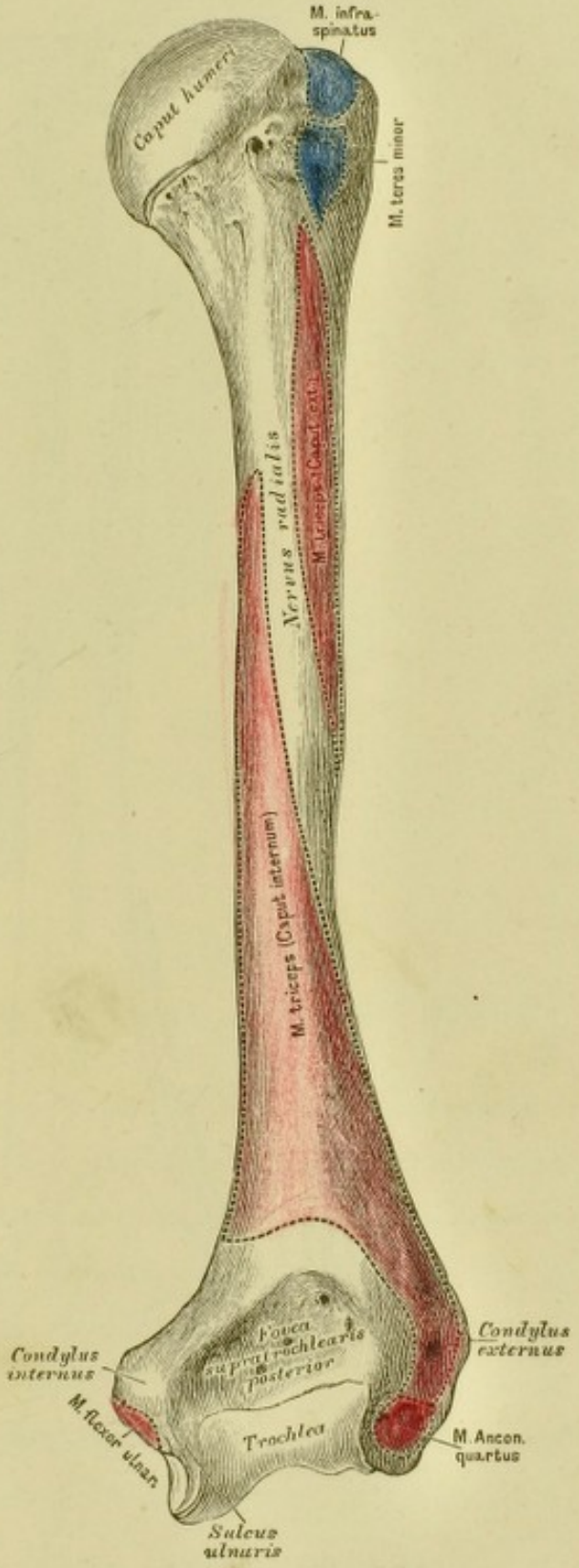
At the lower extremity of the humerus are: the trochlea, and the capitellum, *Eminentia capitata*, the former for articulation with the ulna, the latter for articulation with the radius.

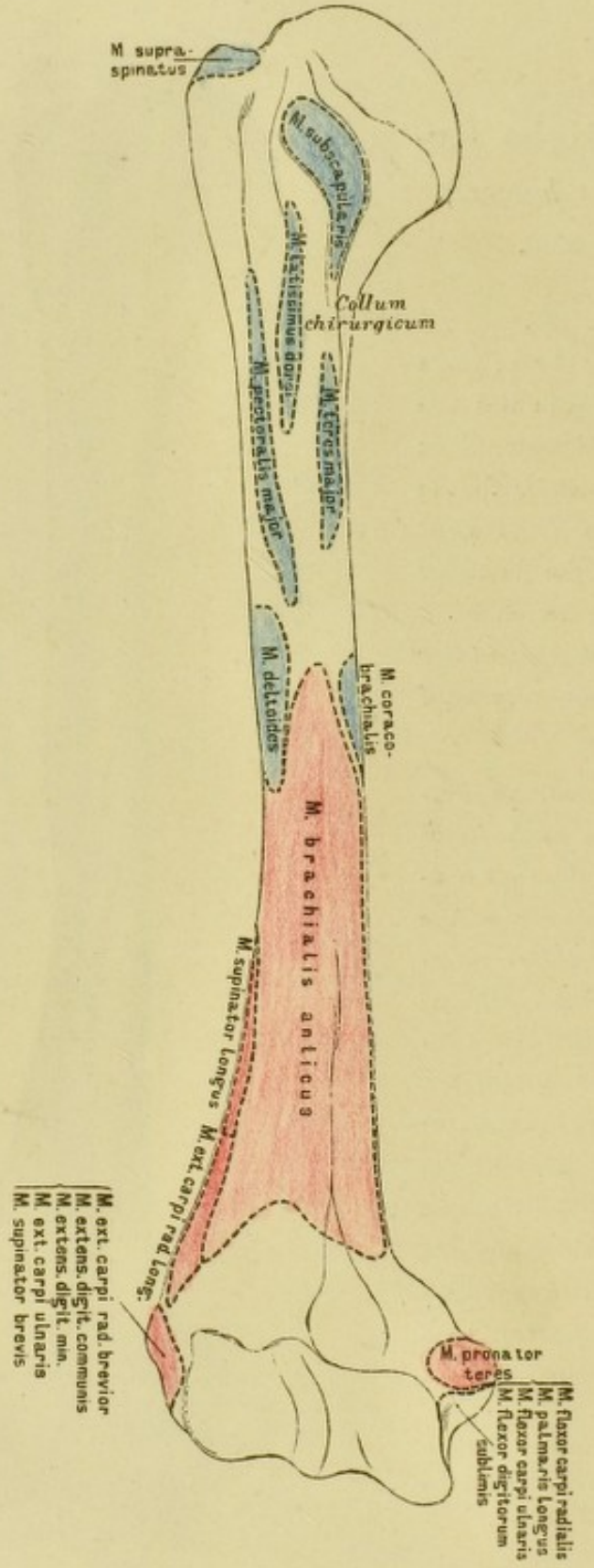
108. The Right Humerus, *Os humeri,* from behind.

Above the trochlea on the anterior side lies the shallow coronoid fossa, *Fovea supratrochlearis anterior* (for the coronoid process of the ulna) (Fig. 107), on the posterior side the deep olecranon fossa, *Fovea supratrochlearis posterior* (for the olecranon process of the ulna).

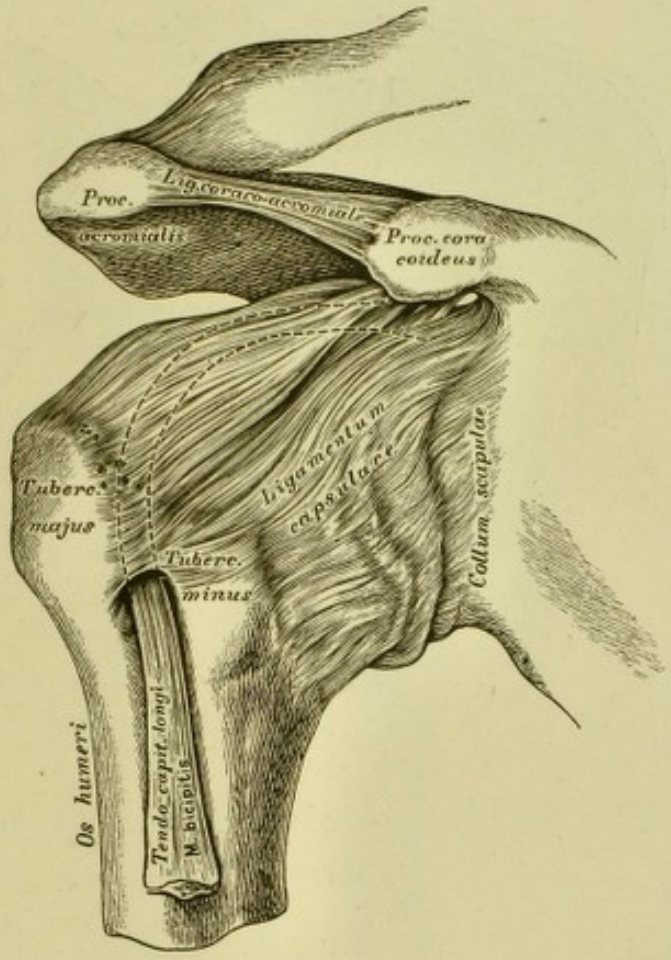
Above the trochlea and capitellum there is on the inner side the larger internal condyle, *Condylus internus*, on the outer side the smaller external condyle, *Condylus externus;* the former serves for the insertion of the flexor muscles, the latter for the insertion of the extensor muscles of the hand. Between the trochlea and the internal condyle a small furrow, *Sulcus ulnaris* (for the ulnar nerve), runs along the posterior side.

The humerus articulates with three bones; with the scapula, ulna and radius.



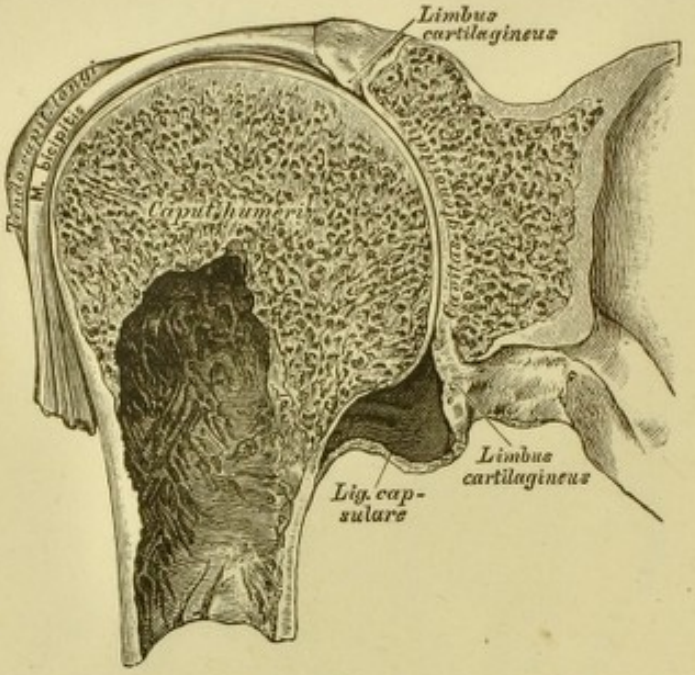


109. The Right Humerus, *Os humeri*,
from before, with the insertions of the muscles.



110. The Right Shoulder-Joint, *Articulatio humeri.*

The shoulder-joint is surrounded by a lax fibrous capsule, which is strengthened by the coraco-humeral or accessory and glenoid ligaments. The articulation is free on all sides, only at the superior circumference it is protected by the coraco-acromial ligament which is spread like a bridge between the acromion and coracoid processes. The fibrous capsule, which stretches from the circumference of the glenoid cavity of the scapula to the anatomical neck of the humerus, covers the bicipital groove between both tuberosities, thereby changing it into a canal.



III. The Shoulder-Joint, *Articulatio humeri*, in section.

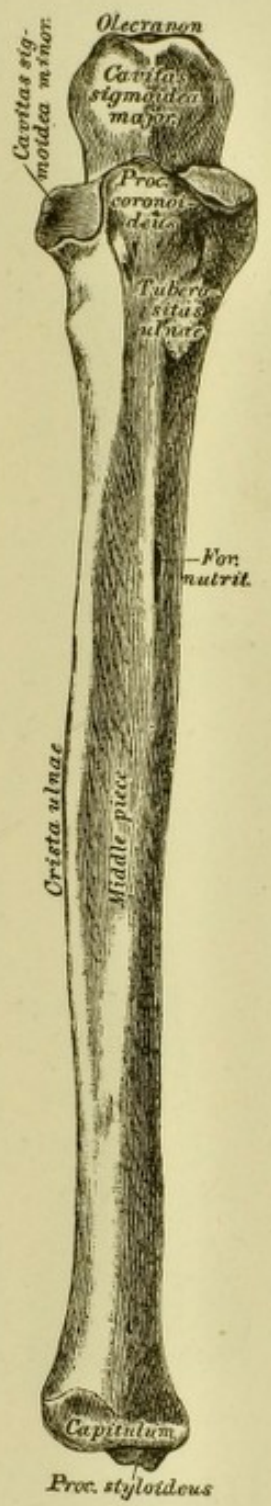
The margin of the glenoid cavity of the scapula is deepened by the *Limbus cartilagineus*. The fibrous and the synovial capsule lining it, bulge outwards as in all articulations, at different places, corresponding to the position of the bones which constitute the articulation. In the bicipital groove, or rather canal, the tendon of the long head of the *M. biceps* runs; the tendon is surrounded up to its origin at the highest point of the *Limbus cartilagineus* by a duplicature of the synovial capsule; this sheath stretches down to the place of insertion of the *M. pectoralis major* (Fig. 109).

The superior extremity of the ulna shows a deep excavation, the greater sigmoid cavity, *Cavitas sigmoidea major*, which is bounded above by the olecranon process (also called *Processus anconaeus*), and below by the coronoid process. On the outer side of the latter is the lesser sigmoid cavity, *Cavitas sigmoidea minor*, for articulation with the head of the radius; below this is the tuberosity, *Tuberositas ulnae* (for the insertion of the *M. brachialis anticus*).

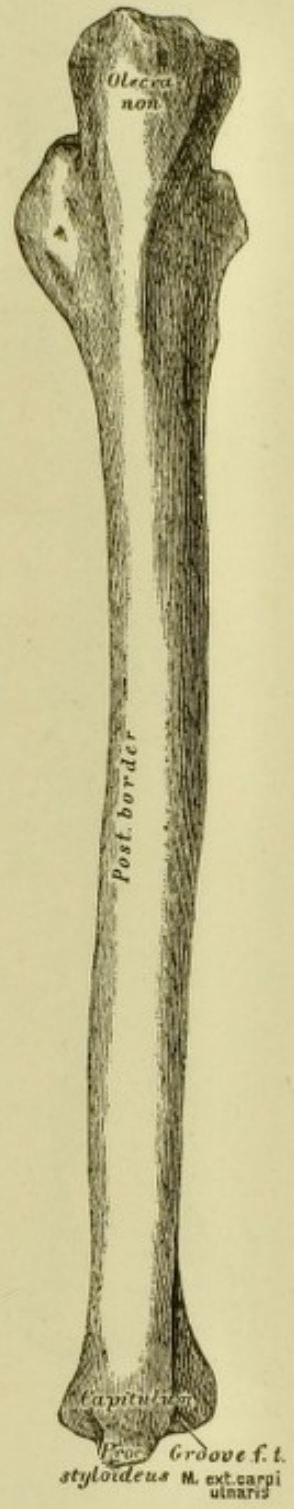
The shaft has three surfaces and three borders, of which latter the one turned toward the radius is called the *Crista ulnae*.

The inferior extremity is called head, *Capitulum;* this has an articular facet, part of which is turned downwards, and part outwards to be received into the sigmoid cavity of the radius. From the back part of the head the styloid process, *Processus styloideus ulnae* projects.

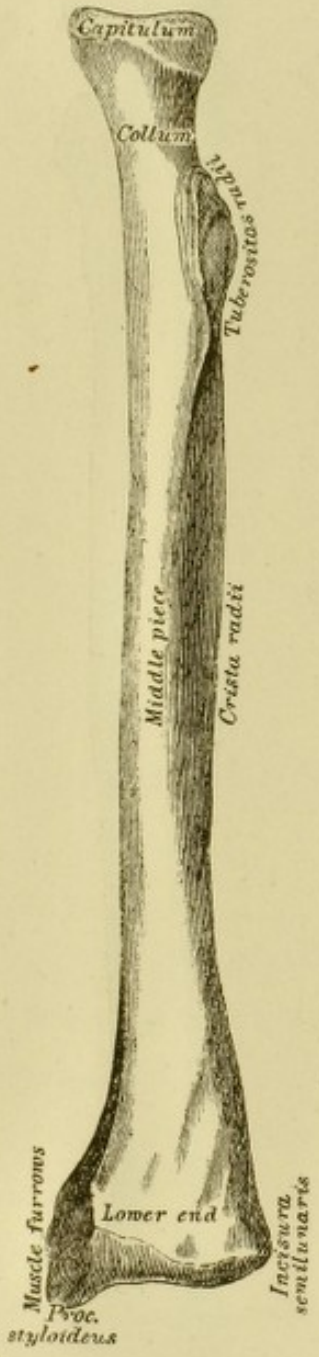
The ulna articulates with the humerus and the radius.



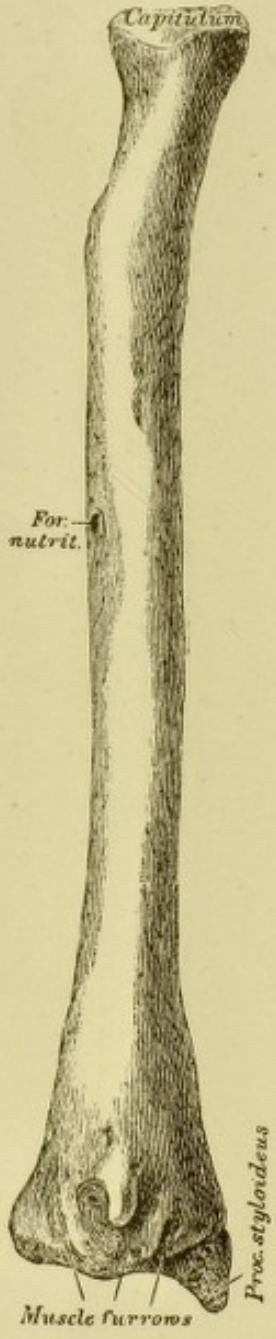
112. The Right Ulna, *Ulna,* from before.



113. The Right Ulna, *Ulna,* from behind.



114. The Right Radius, *Radius,* from before.



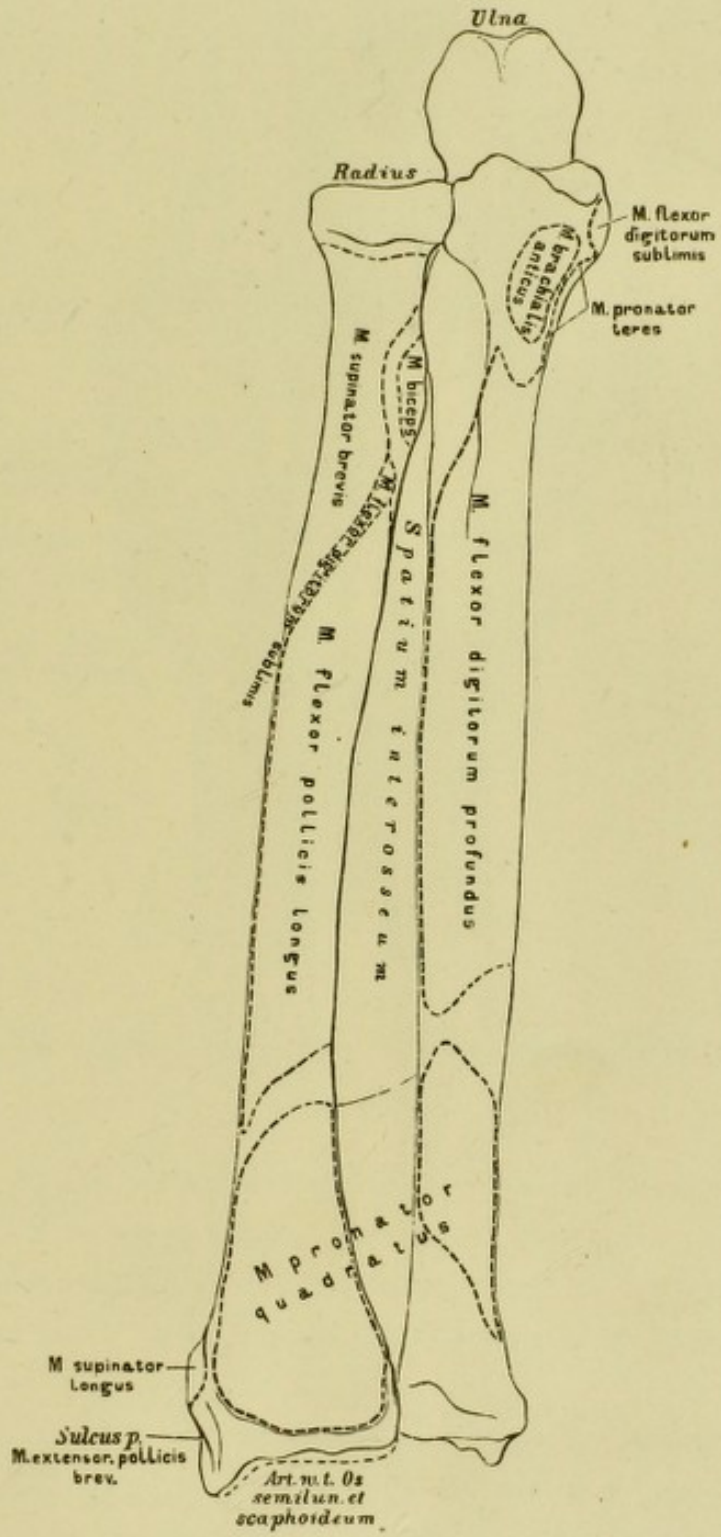
115. The Right Radius, *Radius,* from behind.

The upper extremity of the radius forms the head, *Capitulum radii,* which has a somewhat depressed articular surface; the constricted portion below the head is the neck. Below the latter is the tuberosity, *Tuberositas radii* (for the insertion of the *M. biceps*).

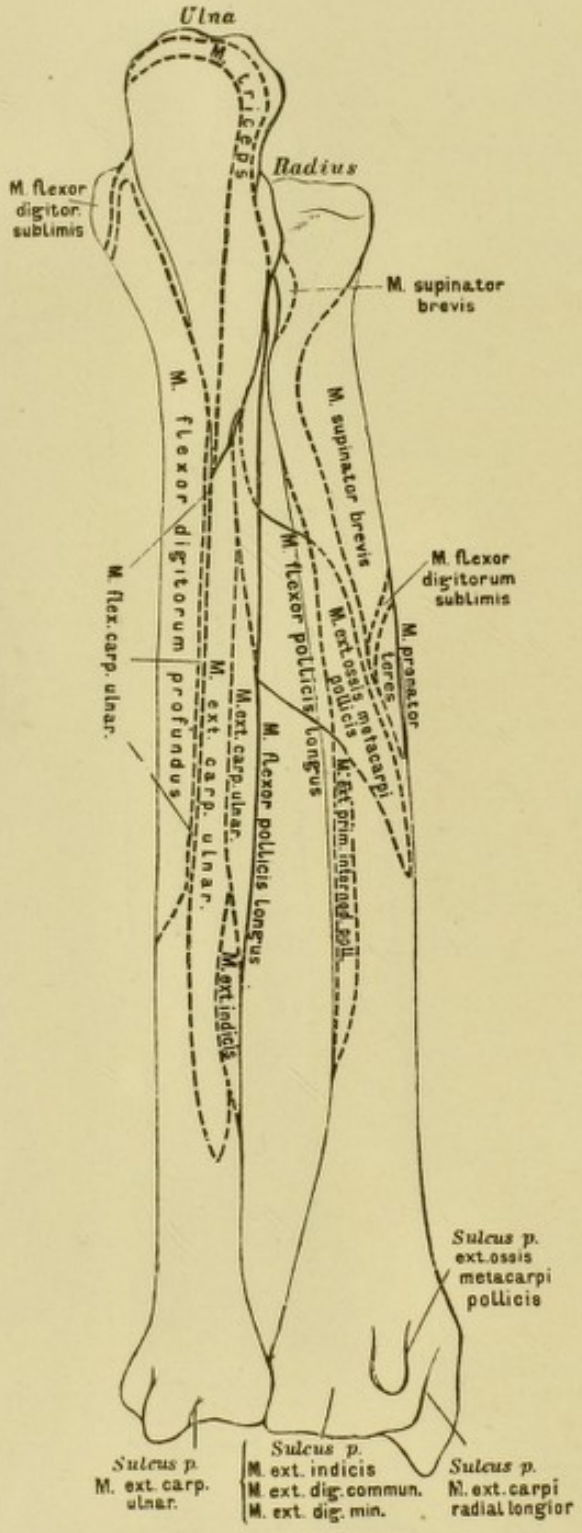
The three sided shaft turns its most marked border, the *Crista radii,* toward the same border of the ulna.

The broad lower extremity has an articular surface inferiorly, and a second smaller, semilunar articular surface, the sigmoid cavity of the radius or *Incisura semilunaris radii,* at the inner side, where it articulates with the *Capitulum ulnae.* From the external surface, the one opposite the sigmoid cavity, the styloid process, *Processus styloideus radii,* projects.

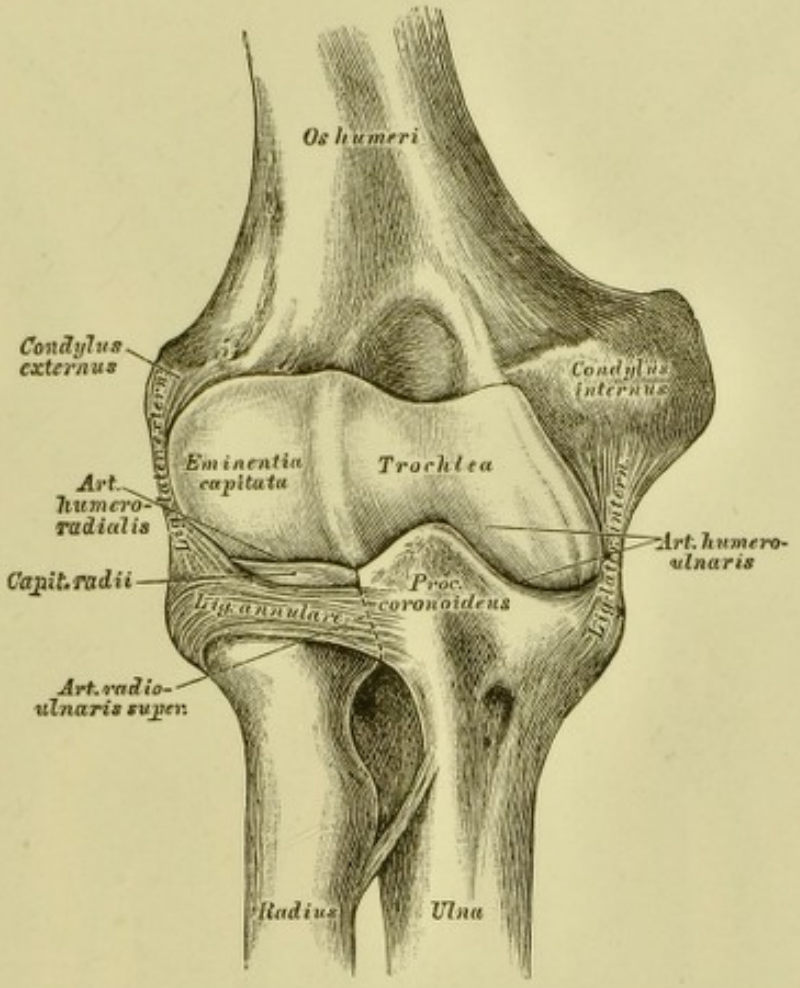
The radius articulates with four bones: the humerus, the ulna, the scaphoid and semilunar bones.



116. The Bones of the Right Forearm, *Radius* and *Ulna,* from before, with the insertions of the muscles, and muscle-furrows.



117. The Bones of the Right Forearm, *Radius* and *Ulna*, from behind, with the insertions of the muscles and muscle-furrows.



118. The Right Elbow-Joint, *Articulatio cubiti,*

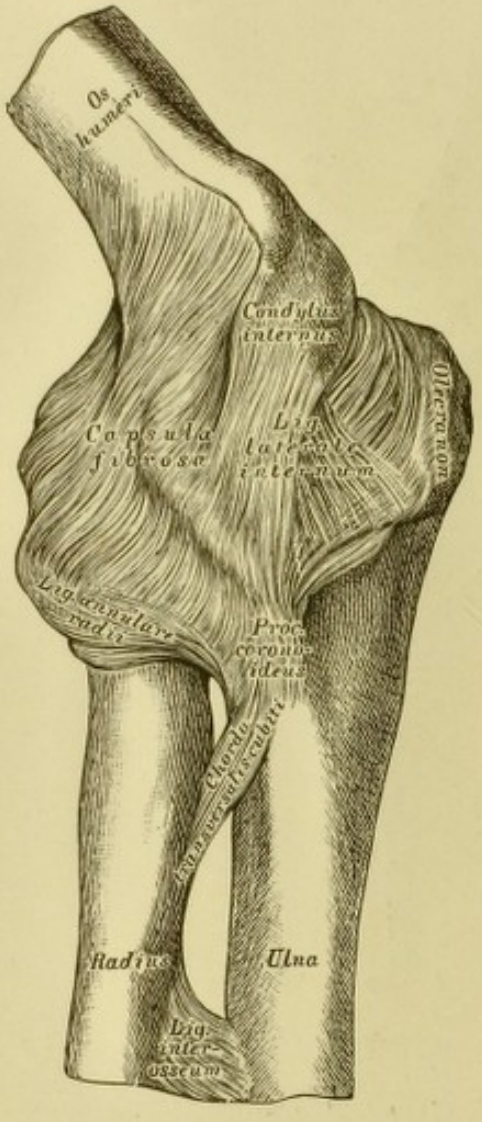
from before.

The elbow-joint is formed by three bones: the humerus, ulna and radius; it consists of three portions, and these are:

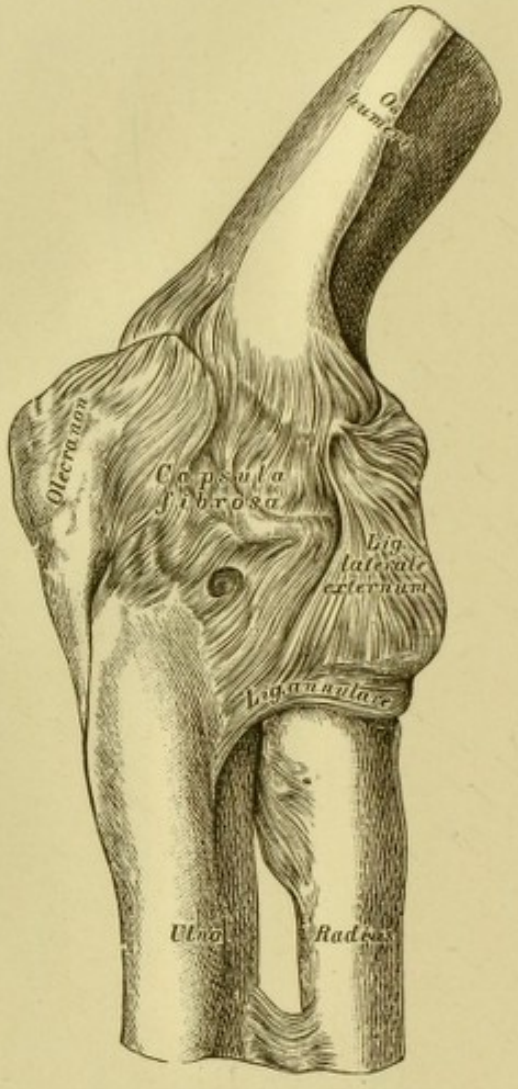
1. the *Articulatio humero-ulnaris,* formed above by the trochlea of the humerus and below by the greater sigmoid cavity of the ulna (flexion — extension);

2. the *Articulatio humero-radialis,* formed above by the lesser or radial head *(Eminentia capitata)* of the humerus, and below by the cup-shaped depression on the head of the radius (flexion — extension);

3. the *Articulatio radio-ulnaris superior,* formed externally by the circumference of the head of the radius, *Capitulum radii,* and internally by the lesser sigmoid cavity of the ulna (pronation — supination).

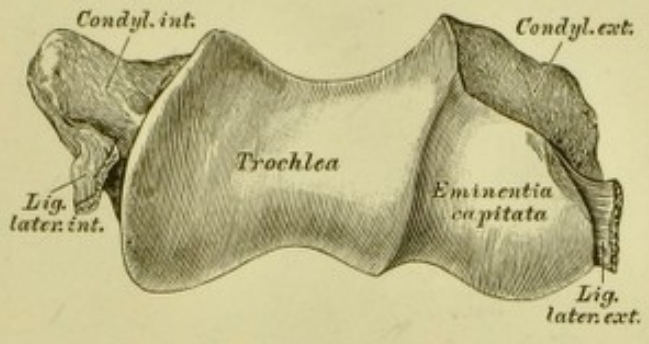


119. The Internal Lateral Ligament of the Right Elbow-Joint, *Lig. laterale internum.*



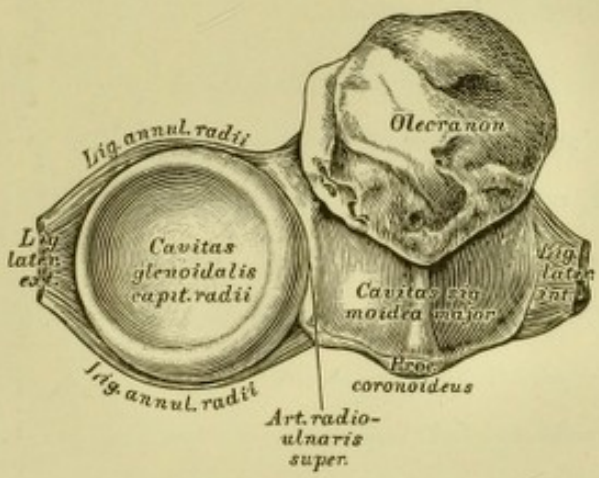
120. The External Lateral Ligament of the Right Elbow-Joint, *Lig. laterale externum.*

The three articulations which form the elbow-joint have a common fibrous capsule, which is inserted superiorly a little above the trochlea and radial head of the humerus, and runs down to the margin of the greater sigmoid cavity of the ulna; it is not directly attached to the radius, but to the annular or orbicular ligament, *Ligamentum annulare*, which surrounds the head of the radius, and is attached by each end to the extremities of the lesser sigmoid cavity of the ulna. Of the two lateral ligaments only the internal is attached directly to the ulna, while the external is attached to the annular ligament.



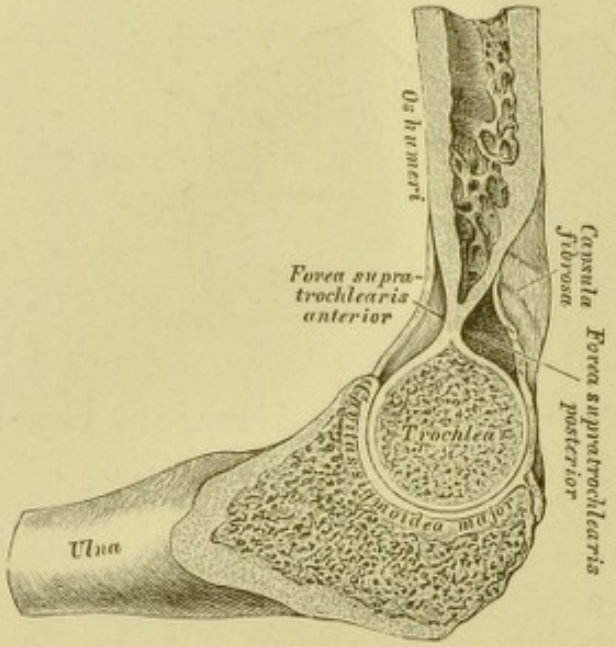
121. The Articular Surfaces of the Humerus constituting the Elbow-Joint, seen from above.

The trochlea serves for articulation with the greater sigmoid cavity of the ulna; the radial head, *Eminentia capitata*, for articulation with the cup-shaped depression on the head of the radius.



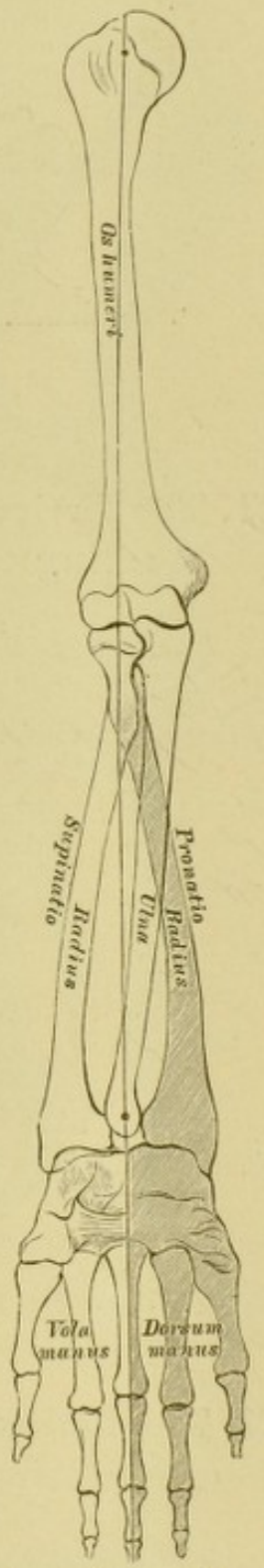
122. The Articular Surfaces of the Radius and Ulna constituting the Elbow-Joint, seen from above.

The greater sigmoid cavity, *Cavitas sigmoidea major ulnae*, receives the trochlea of the humerus; the ridge dividing this cavity into two halves corresponds to the furrow on the trochlea. The cup-shaped depression on the head of the radius, *Cavitas glenoidalis capituli radii*, glides along the *Eminentia capitata* of the humerus, in flexion and extension, as well as in pronation and supination.

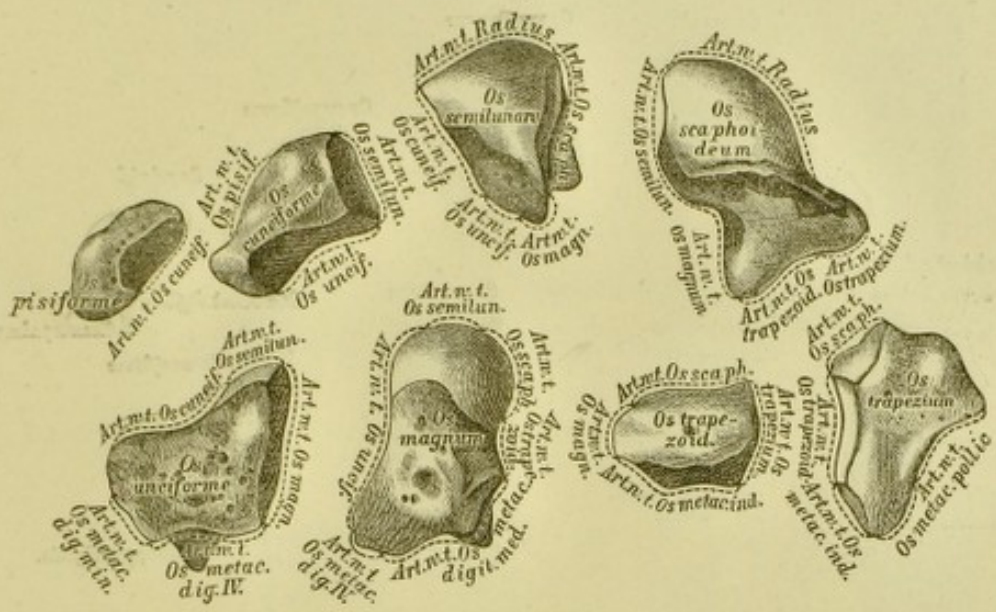


123. The Right *Articulatio humero-ulnaris*, in section.

In the section the forms of the *Trochlea* and *Cavitas sigmoidea major ulnae* are evident; the section is in the median position between flexion and extension. By overflexion the coronoid process of the ulna comes in contact in the coronoid fossa, *Fovea supratrochlearis anterior*, by overextension the olecranon in the olecranon fossa, *Fovea supratrochlearis posterior*, with the bony septum which separates the two fossae from each-other.



124. The Movements of Pronation and Supination of the Radius and the Hand.



125—132. The Bones of the Right Wrist, *Ossa carpi*,

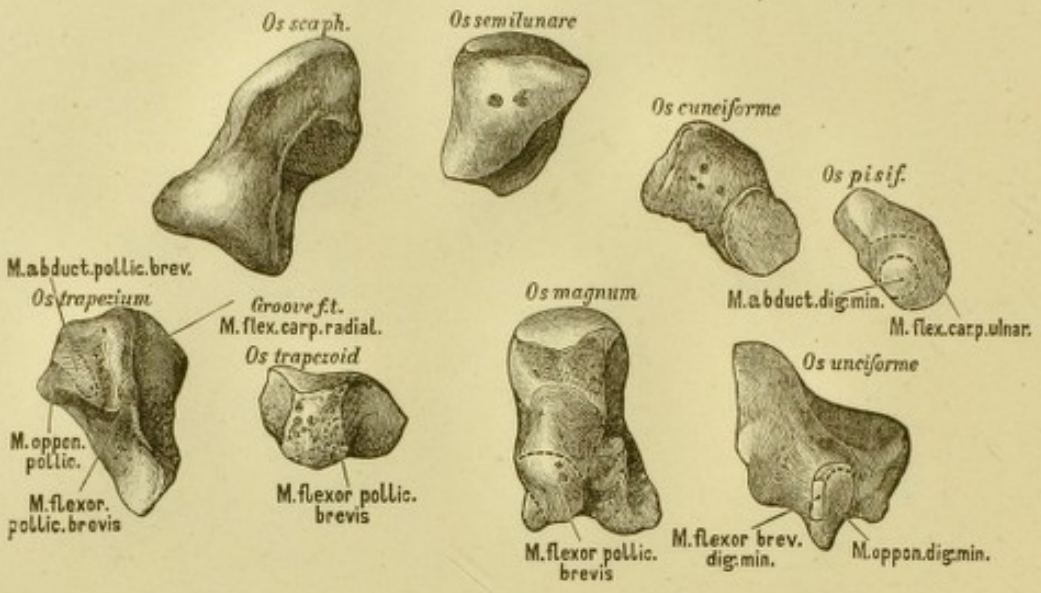
from the dorsal side.

The wrist, *Carpus*, is composed of eight small bones, held together by tense ligaments; they are, enumerated from the radial to the ulnar side:

Upper row: 1. The scaphoid bone, *Os scaphoideum;* 2. the semilunar, *Os semilunare;* 3. the cuneiform, *Os cuneiforme;* 4. the pisiform, *Os pisiforme*, which latter is not articulated with the bones of the forearm.

Lower row: 5. The trapezium, *Os trapezium;* 6. the trapezoid, *Os trapezoides;* 7. the *Os magnum;* 8. the unciform, *Os unciforme.*

The articulations of each bone are evident from the drawing.



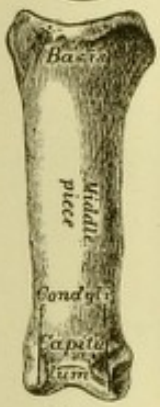
133—140. The Bones of the Right Wrist, *Ossa carpi,*

from the palmar side.

Each bone presents six surfaces: a superior, an inferior, a posterior or dorsal, an anterior or palmar, an internal or ulnar and an external or radial surface. The dorsal surface of all the bones is convex, the palmar surface concave. The concavity of the palmar surface of the carpus is bounded by four prominences, *Eminentiae carpi radiales* and *ulnares*, one at the outer and one at the inner extremity of each row. The tubercle of the scaphoid bone and the ridge on the trapezium form those at the outer, the pisiform bone and the unciform process of the unciform bone those at the inner extremity.

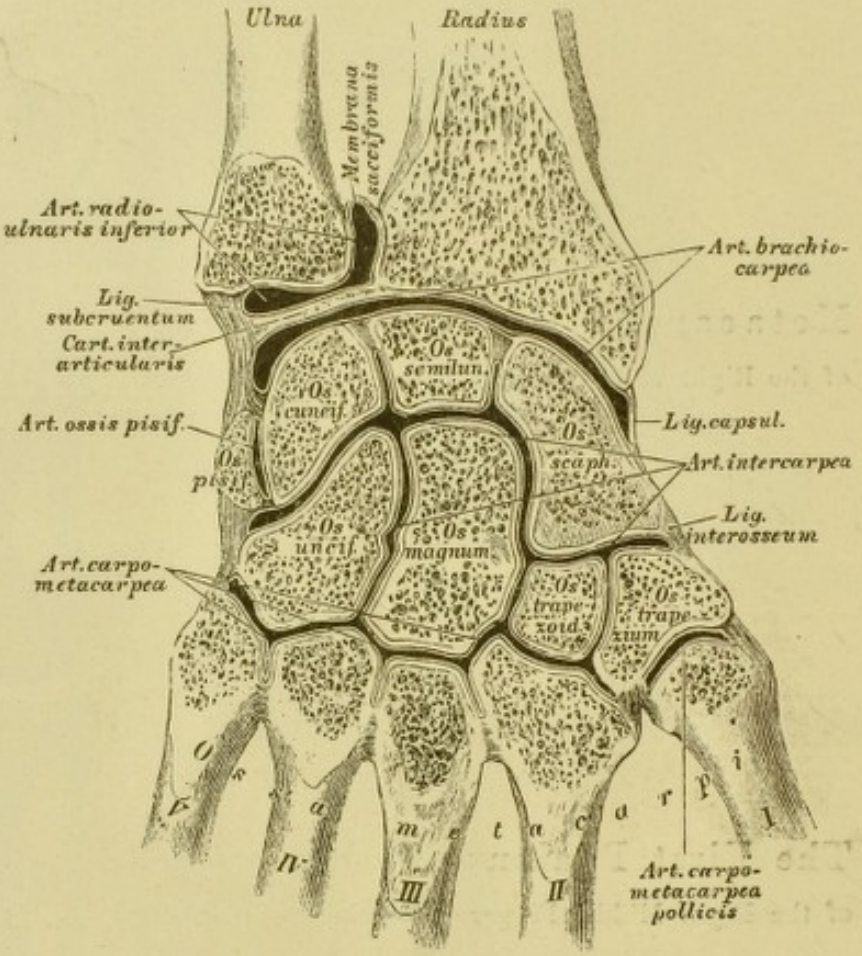
141. Metacarpal Bone, *Os metacarpi,*
of the Right Middle Finger, from the dorsal side.

The First Phalanx, *Phalanx prima,*
of the Right Middle Finger, from the dorsal side.



The Second Phalanx, *Phalanx secunda,*
of the Right Middle Finger, from the dorsal side.

The Third Phalanx, *Phalanx tertia,*
of the Right Middle Finger, from the dorsal side.



142. The Right Carpal- and Metacarpal Articulations, in section.

The articulations around the wrist are:

1. the *Articulatio radio-ulnaris inferior* between the head of the ulna, sigmoid cavity of the radius and upper surface of the *Cartilago interarticularis* (pronation — supination);

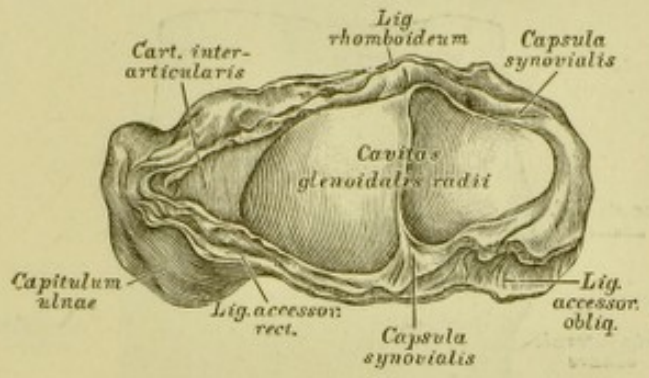
2. the *Articulatio brachio-carpea seu Articulatio carpi* (wrist joint) between the lower end of the radius and under surface of the interarticular cartilage above, and the superior surface of the scaphoid, semilunar and cuneiform bones below (flexion — extension, abduction — adduction of the hand);

3. the *Articulatio intercarpea* between the upper and lower rows of carpal bones (slight flexion and extension);

4. the *Articulatio ossis pisiformis*, isolated;

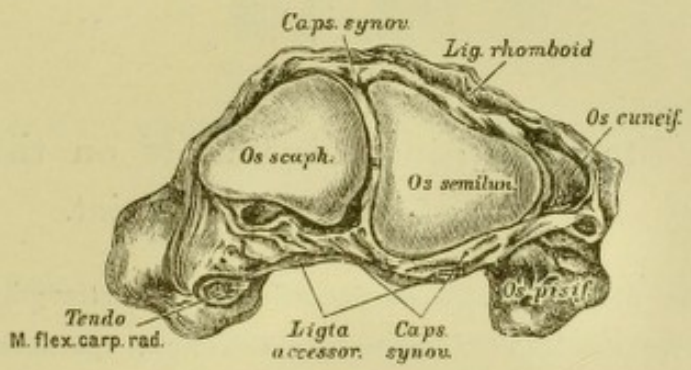
5. the *Articulatio carpo-metacarpea* of the four internal metacarpal bones with the lower row of carpal bones (tense ligaments, very slight movement in every direction);

6. the *Articulatio carpo-metacarpea pollicis*, isolated (flexion — extension, ab- and adduction and circumduction).



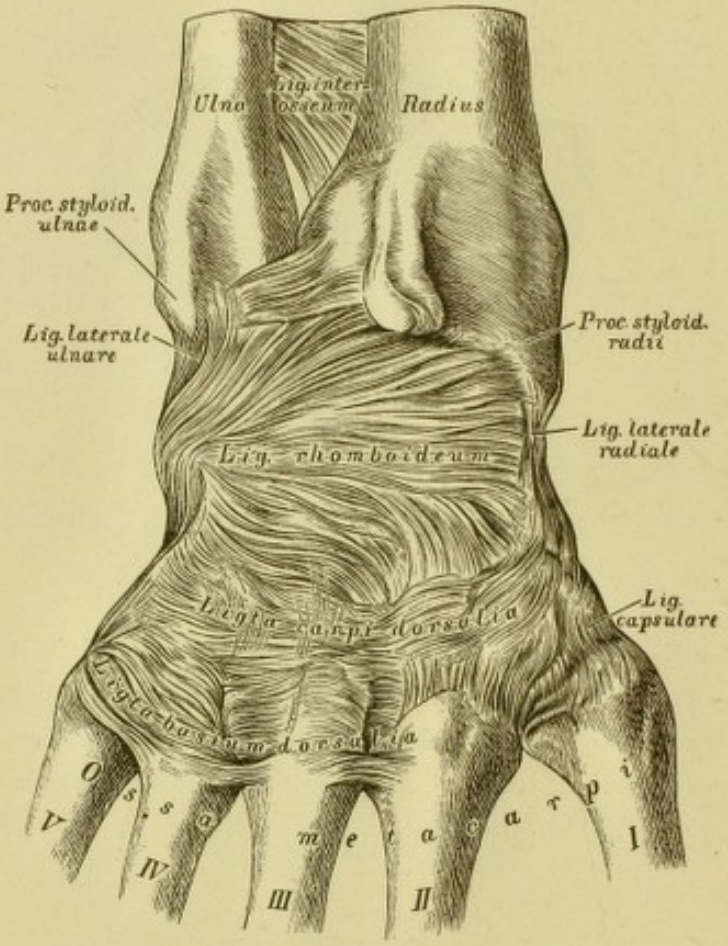
143. The Articular Surfaces of the Radius and Interarticular Cartilage constituting the *Articulatio carpi,* seen from above.

The lower articular surface of the radius is divided by a ridge into two halves, for articulation with the scaphoid and semilunar bones; the under surface of the *Cartilago interarticularis*, which is situated between the head of the ulna and the upper surface of the cuneiform bone, lies in an elongation of this surface.



144. The Articular Surfaces of the Upper Row of Carpal bones constituting the *Articulatio carpi,* seen from above.

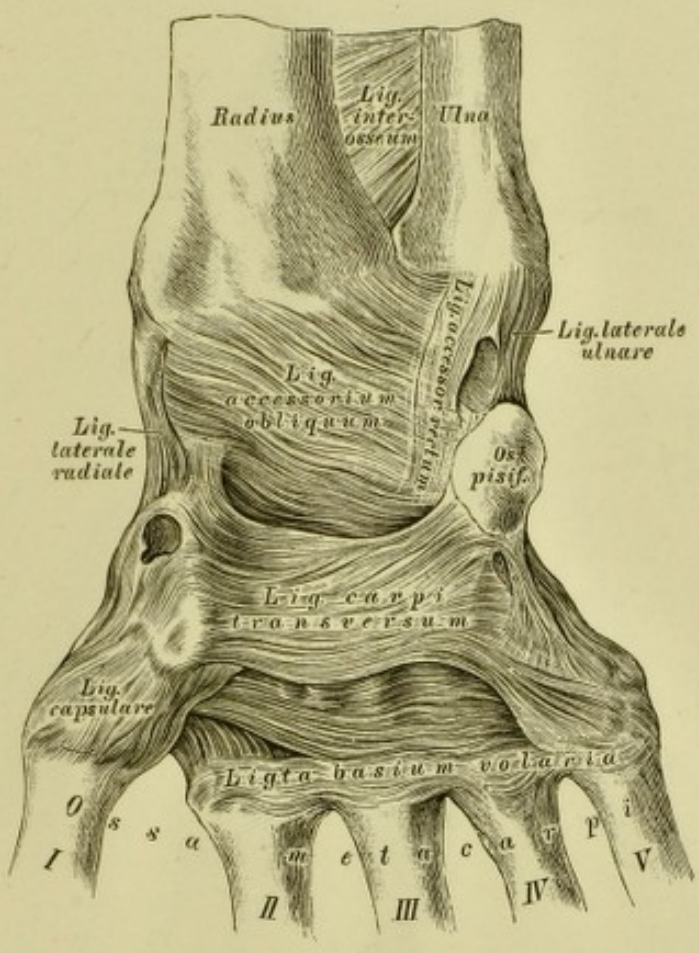
The upper surfaces of the three external of the first row of carpal bones are convex, smooth and covered with cartilage, for articulation with the lower extremities of the bones of the forearm. The articulation between the scaphoid and semilunar bones and the radius is a direct one; between the cuneiform bone and the ulna an indirect one.



145. The Strengthening Ligaments on the Dorsal Surface of the Right Wrist.

The lax fibrous capsule of the wrist joint is strengthened on the dorsal side by the broad *Ligamentum rhomboideum*, (posterior ligament), which runs from the radius to the semilunar and cuneiform bones. Between the styloid process of the radius and the scaphoid bone the external lateral ligament, *Ligamentum laterale radiale*, is attached; between the styloid process of the ulna and cuneiform bone the internal lateral ligament, *Ligamentum laterale ulnare seu Funiculus ligamentosus*. The intercarpal and carpo-metacarpal articulations are strengthened by short, tense ligaments.

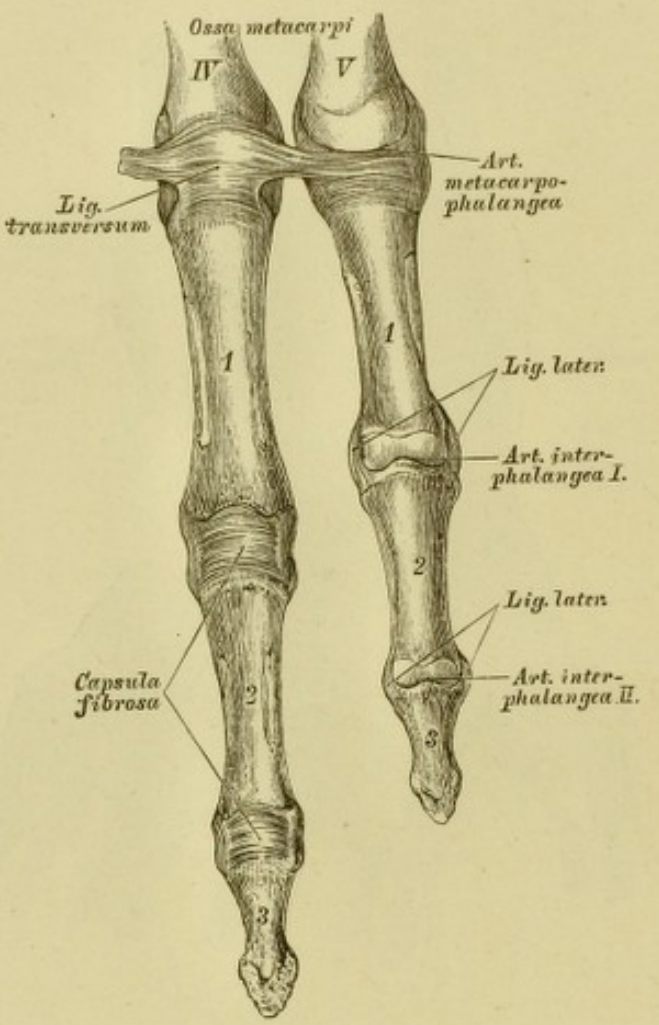
The base of the metacarpal bone of the thumb is articulated to the articular surface of the trapezium by means of a lax fibrous capsule.



146. The Strengthening Ligaments on the Palmar Side of the Right Wrist.

The *Ligamentum accessorium rectum et obliquum* (anterior ligament), attached above to the radius and interarticular cartilage and below to the scaphoid, semilunar and cuneiform bones, serves as strengthening ligament to the fibrous capsule of the wrist joint on the palmar side. Between the *Eminentiae carpi radiales* and *ulnares* the strong *Ligamentum carpi transversum,* (annular ligament), is attached; beneath it the flexor tendons of the fingers pass.

On the palmar side also, short tense ligaments strengthen the intercarpal and carpo-metacarpal articulations.



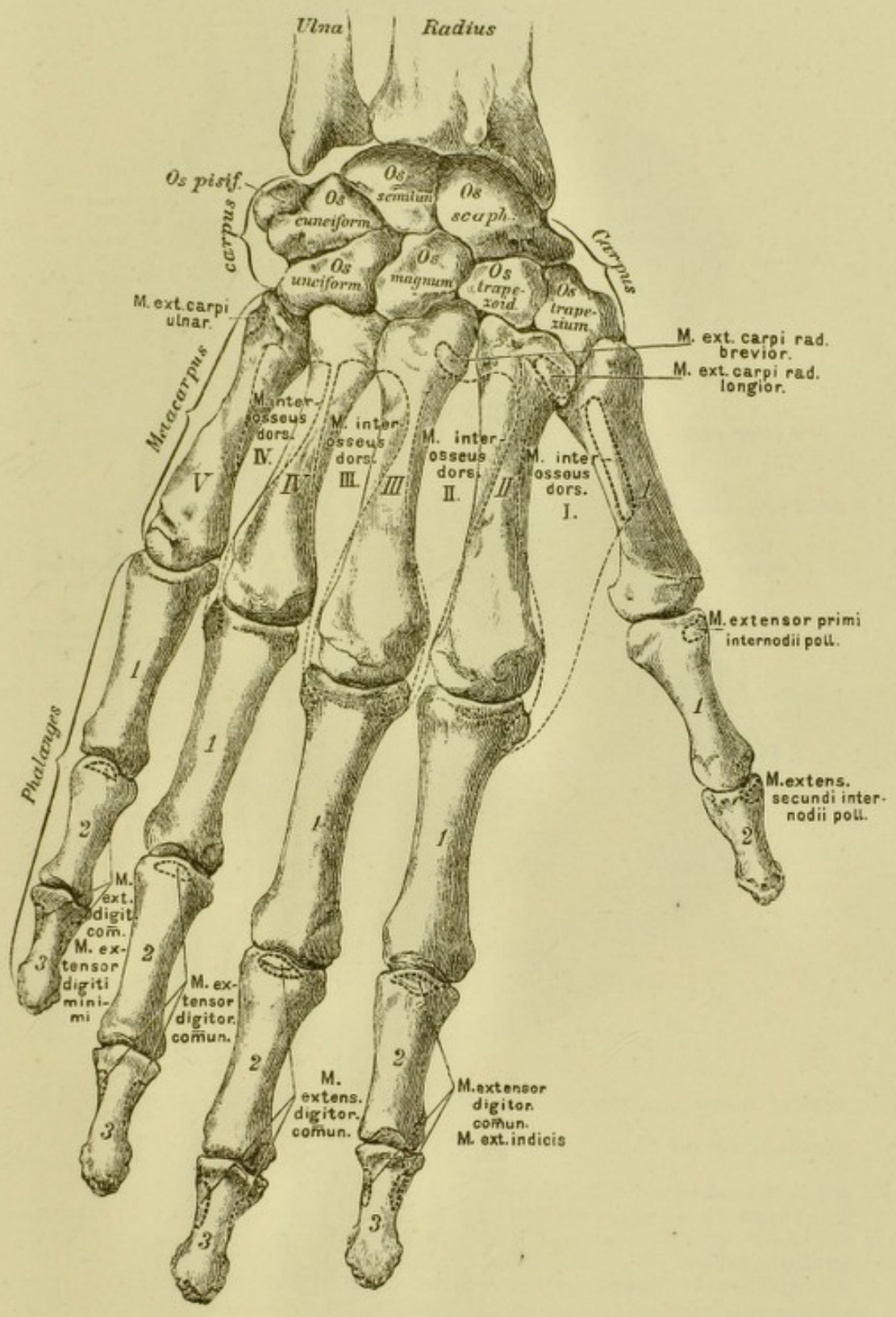
147. The Articulations of the Fourth and Fifth Fingers of the Right Hand, from the palmar side.

On each finger there are:

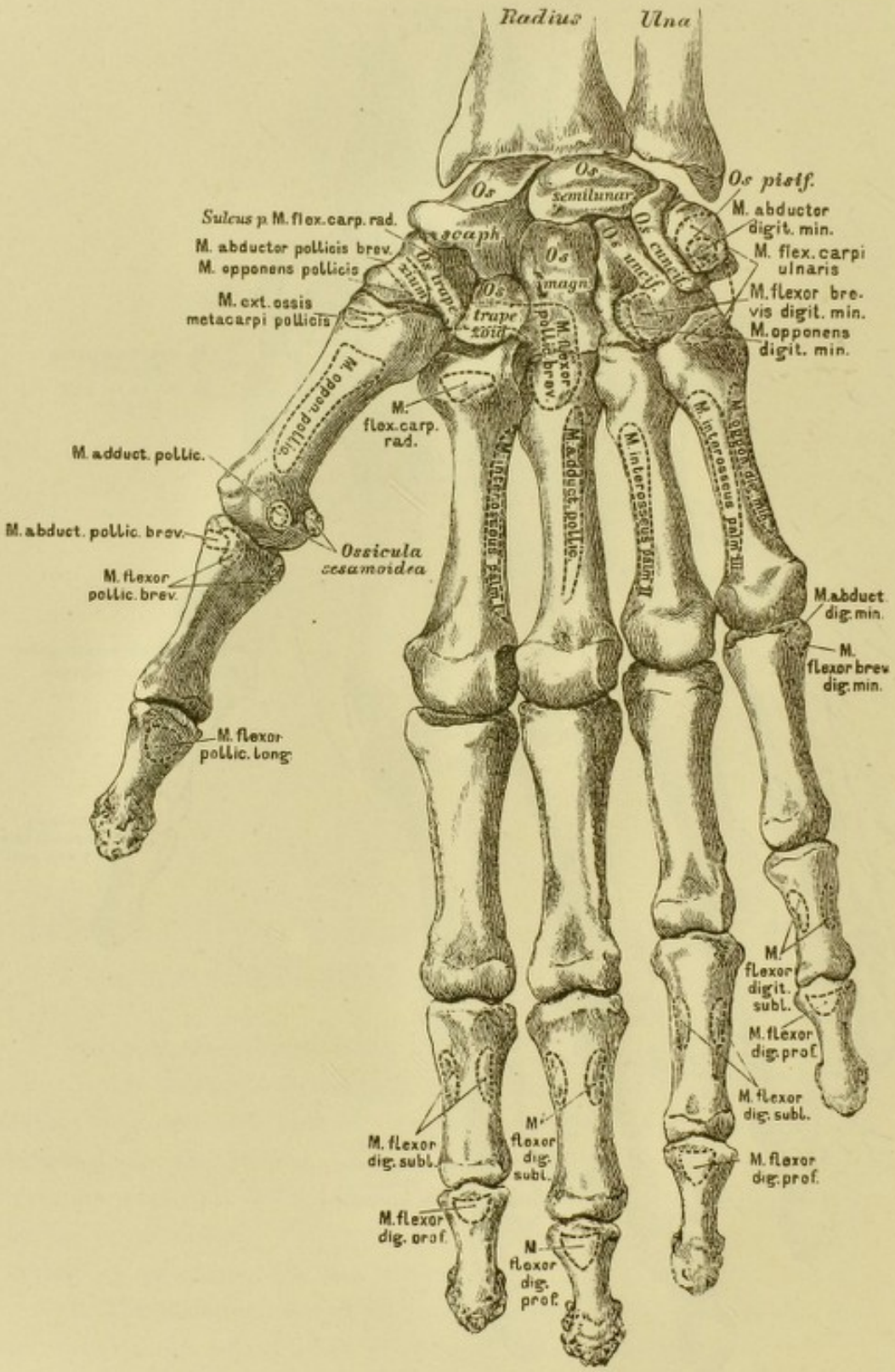
1. The *Articulatio metacarpo-phalangea* between the head of the metacarpal bone and the base of the first phalanx; the fibrous capsule is thickened on the palmar side — *Ligamentum transversum;* the lateral ligaments weak. The *Articulatio metacarpo-phalangea pollicis* is a ginglymus (flexion — extension); the others fingers have here free movements (flexion — extension, ab- and adduction).

2. The *Articulatio interphalangea prima* between the head of the first and base of the second phalanx (flexion — extension).

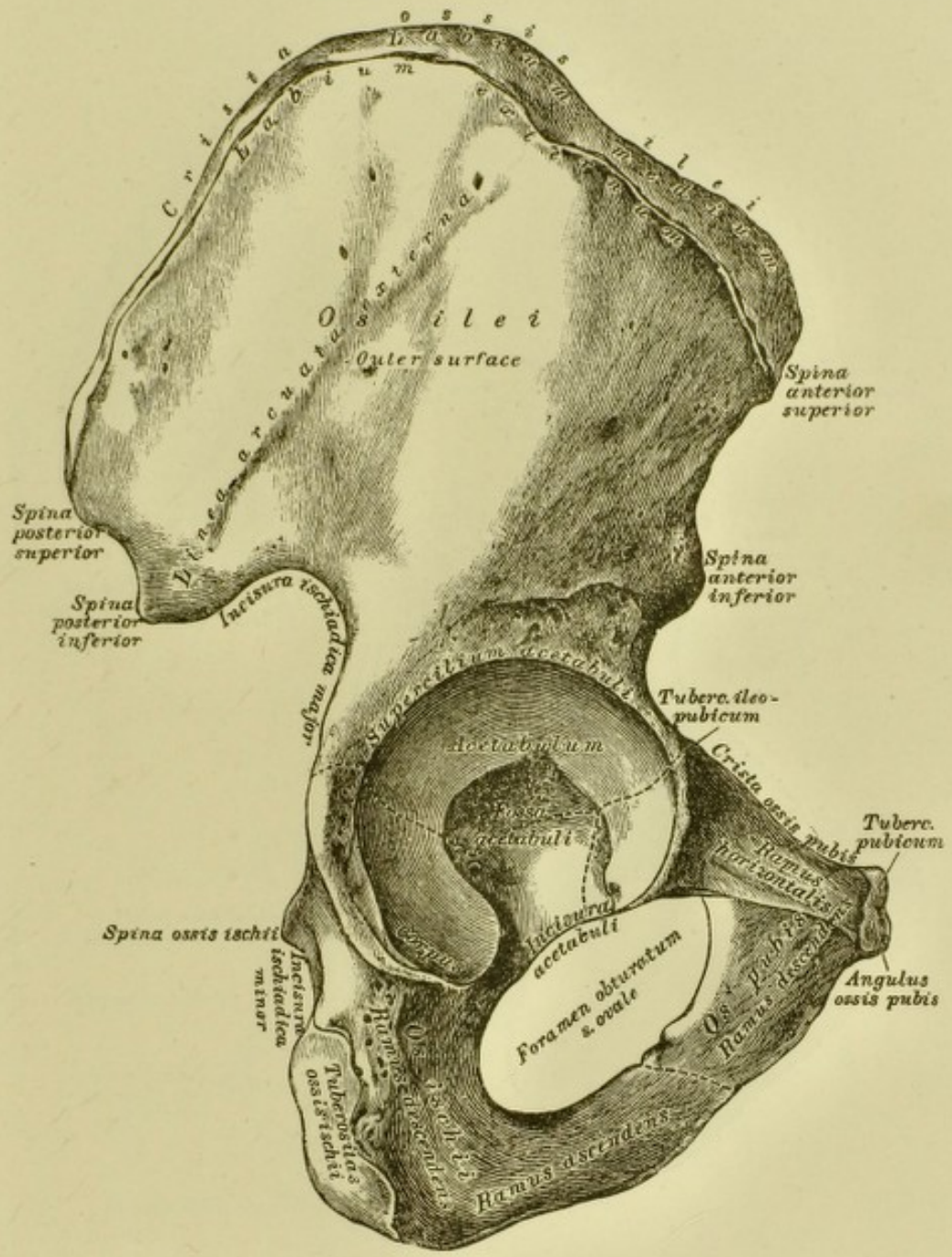
3. The *Articulatio interphalangea secunda* between the head of the second and base of the third phalanx (flexion — extension); 2. and 3. have strong lateral ligaments.



148. The Bones of the Right Hand, from the dorsal side, with the insertions of the muscles.



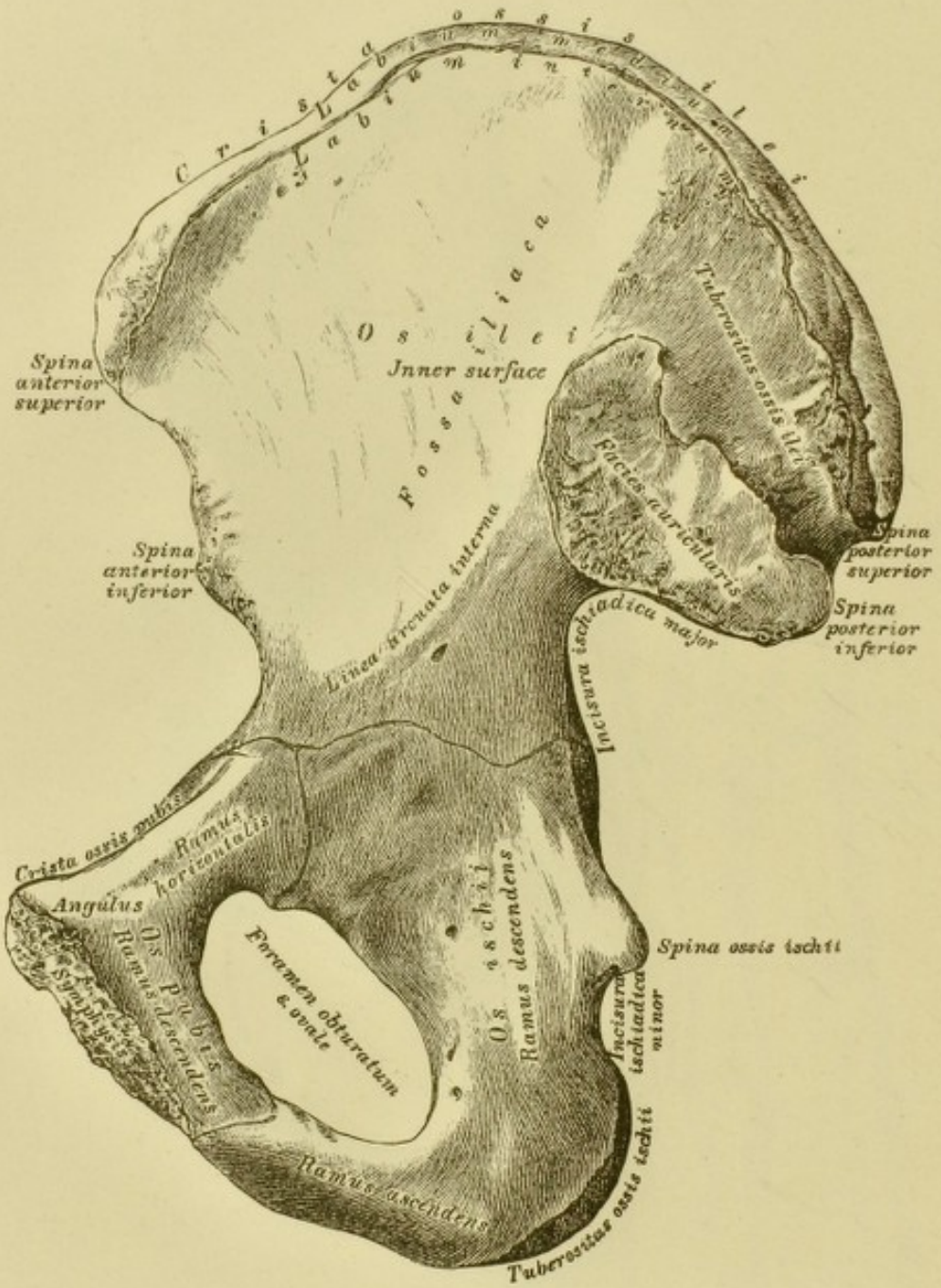
149. The Bones of the Right Hand, from the palmar side, with the insertions of the muscles.



150. The Right Hip Bone, *Os innominatum,* outer surface.

The innominate bone is divided into: the ilium, *Os ilei,* the ischium, *Os ischii,* and the pubes, *Os pubis.*

The ilium shows on its external surface the *Linea arcuata externa.* The superior border or crest of the ilium, *Crista ossis ilei,* has an external, middle and internal lip; (Labium); the anterior and posterior borders are notched and each has two projections, *Spinae;* below the posterior inferior spine is a deep notch, the great sacro-sciatic, *Incisura ischiadica major.* The ischium has a body, a descending and an ascending ramus; the spine of the ischium, *Spina ossis ischii,* limits the great sacro-sciatic notch inferiorly. The descending ramus ends with the tuberosity, *Tuberositas ossis ischii,* between which and the spine of the ischium is the lesser sacro-sciatic notch, *Incisura ischiadica minor.* The ascending ramus ascends from the tuberosity upwards and inwards.

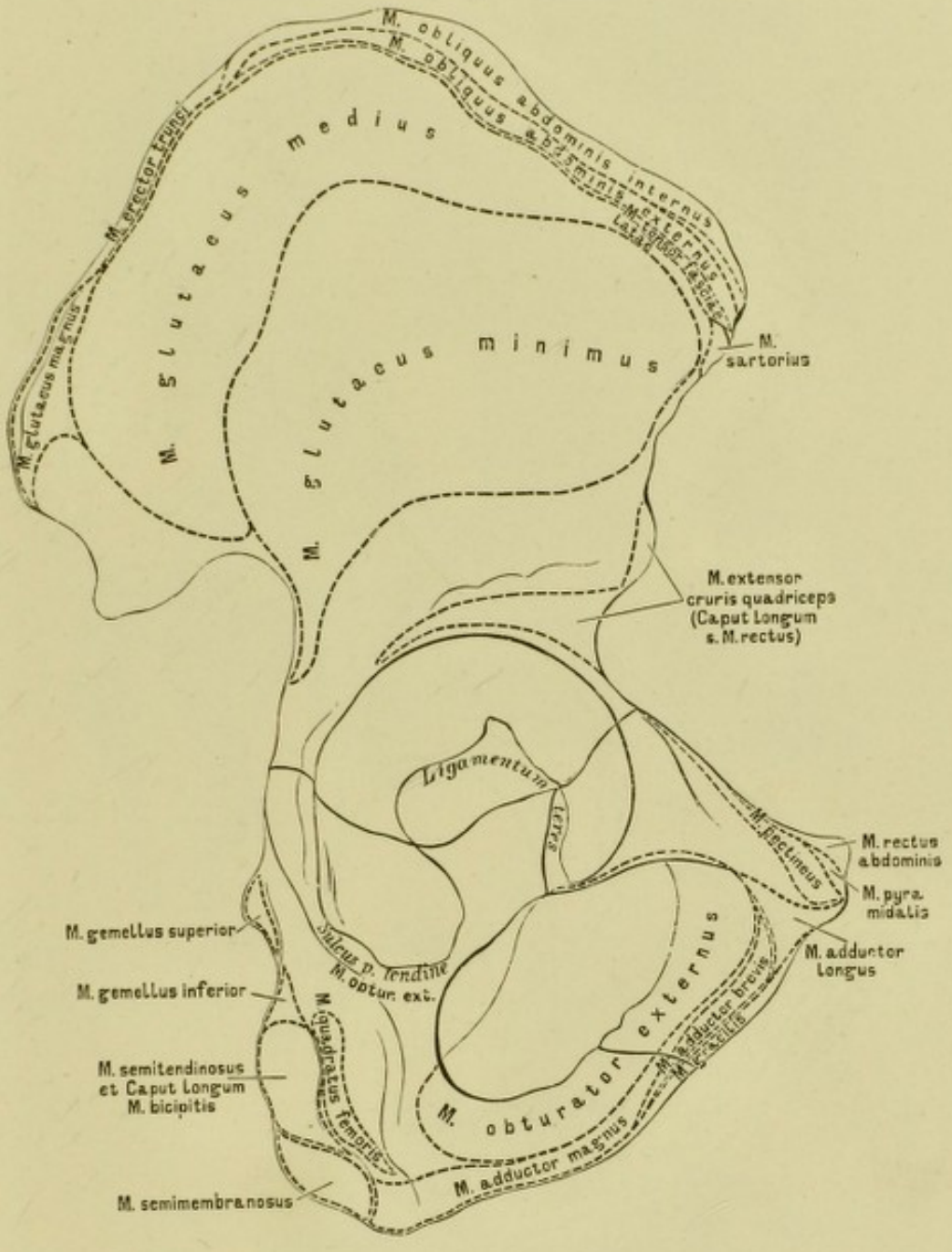


151. The Right Hip Bone, *Os innominatum,* inner surface.

The inner surface of the ilium is divided by the *Linea arcuata interna* into an inferior and a superior half; the superior presents two portions, an anterior, the iliac fossa, *Fossa iliaca,* and a posterior, the auricular surface, *Facies auricularis,* for articulation with the sacrum; above this latter is the rough *Tuberositas ossis ilei.*

The pubes has a horizontal and a descending ramus. The former forms at its outer end, where it joins with the base of the ilium, the rough ileo-pectineal eminence or *Tuberculum ileo-pubicum* (Fig. 150); its upper angle is called crest of the pubes, *Crista ossis pubis;* this crest is continued into the *Linea arcuata interna* and ends internally as *Tuberculum pubicum* (Fig. 150).

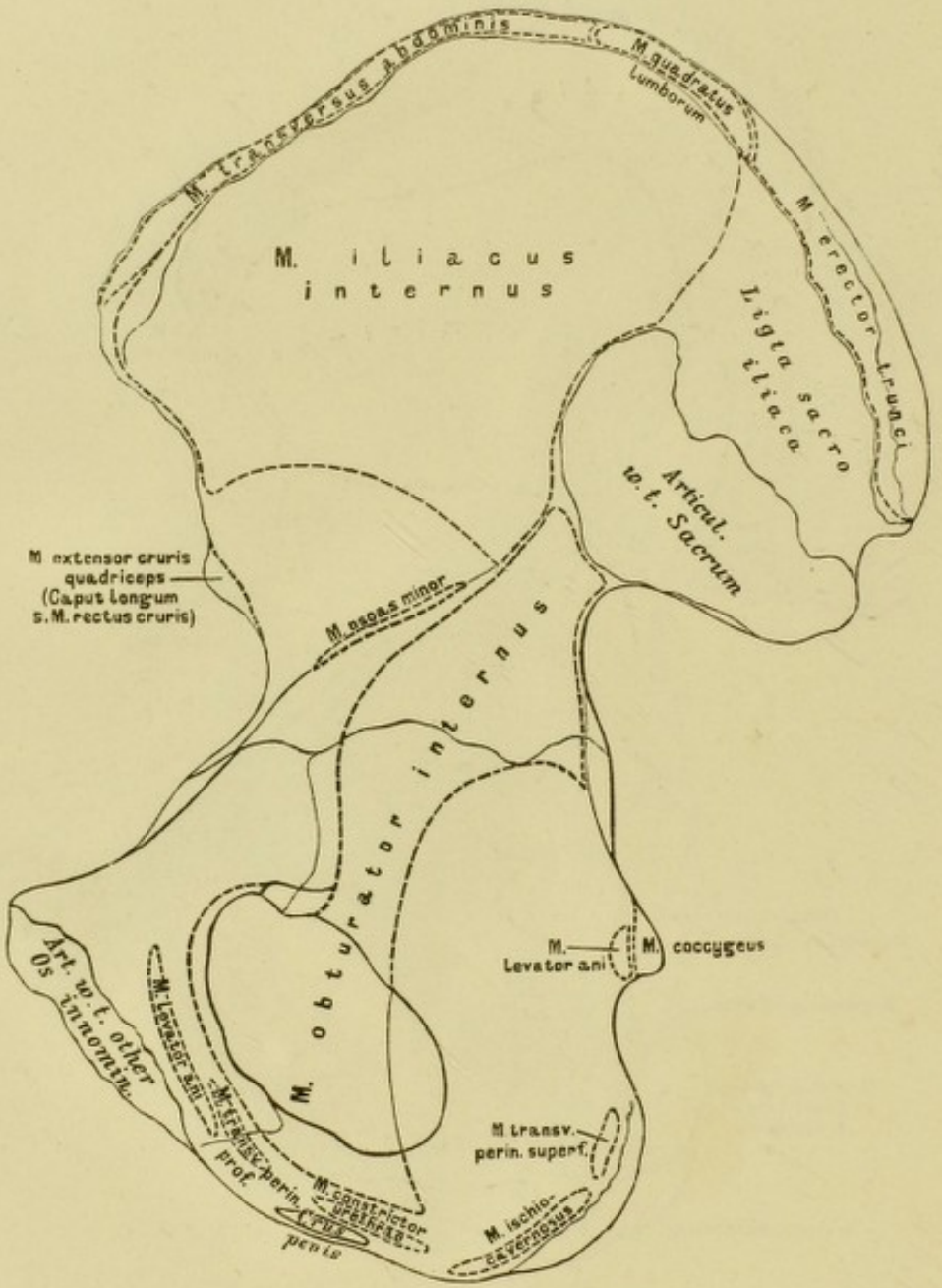
At the angle, *Angulus ossis pubis,* the horizontal and descending rami meet.



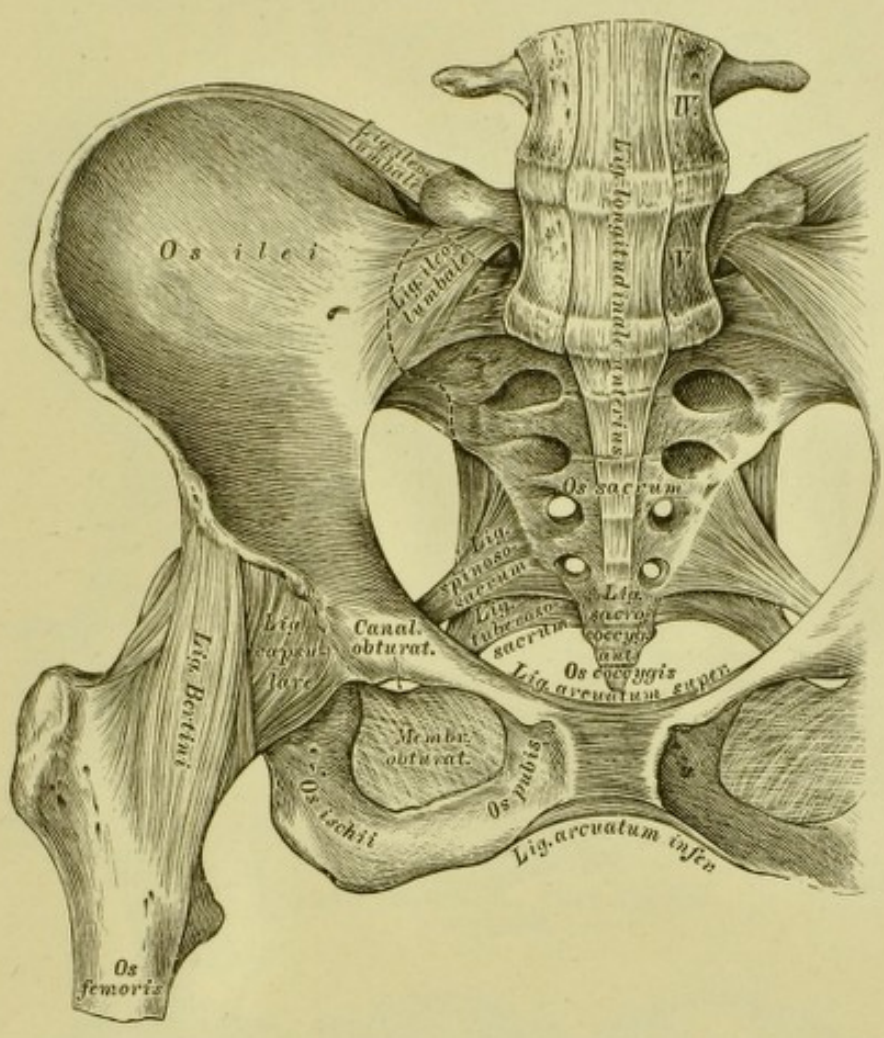
152. The Right Hip Bone, *Os innominatum,* outer surface, with the insertions of the muscles.

At the place where the ilium, ischium and pubes meet, the acetabulum is situated (Fig. 150); its rim, the *Supercilium acetabuli*, is interrupted by a notch, the *Incisura acetabuli*. The bottom of the cavity of the acetabulum has a rough depression, free of cartilage, the *Fossa acetabuli*, which is continuous with the incisura.

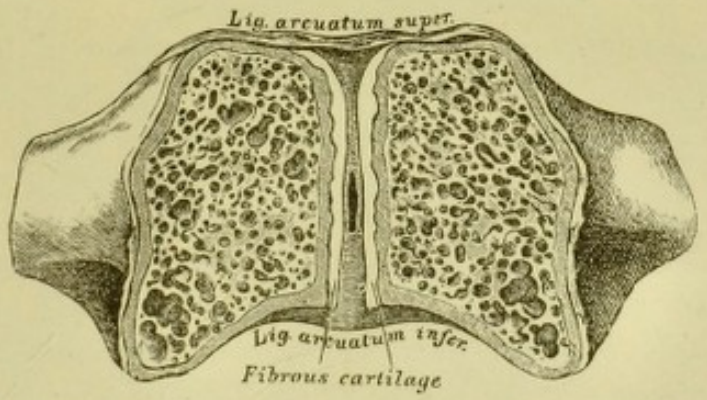
Below the acetabulum is the large obturator foramen, *Foramen obturatum seu ovale.*



153. The Right Hip Bone, *Os innominatum,* inner surface, with the insertions of the muscles.

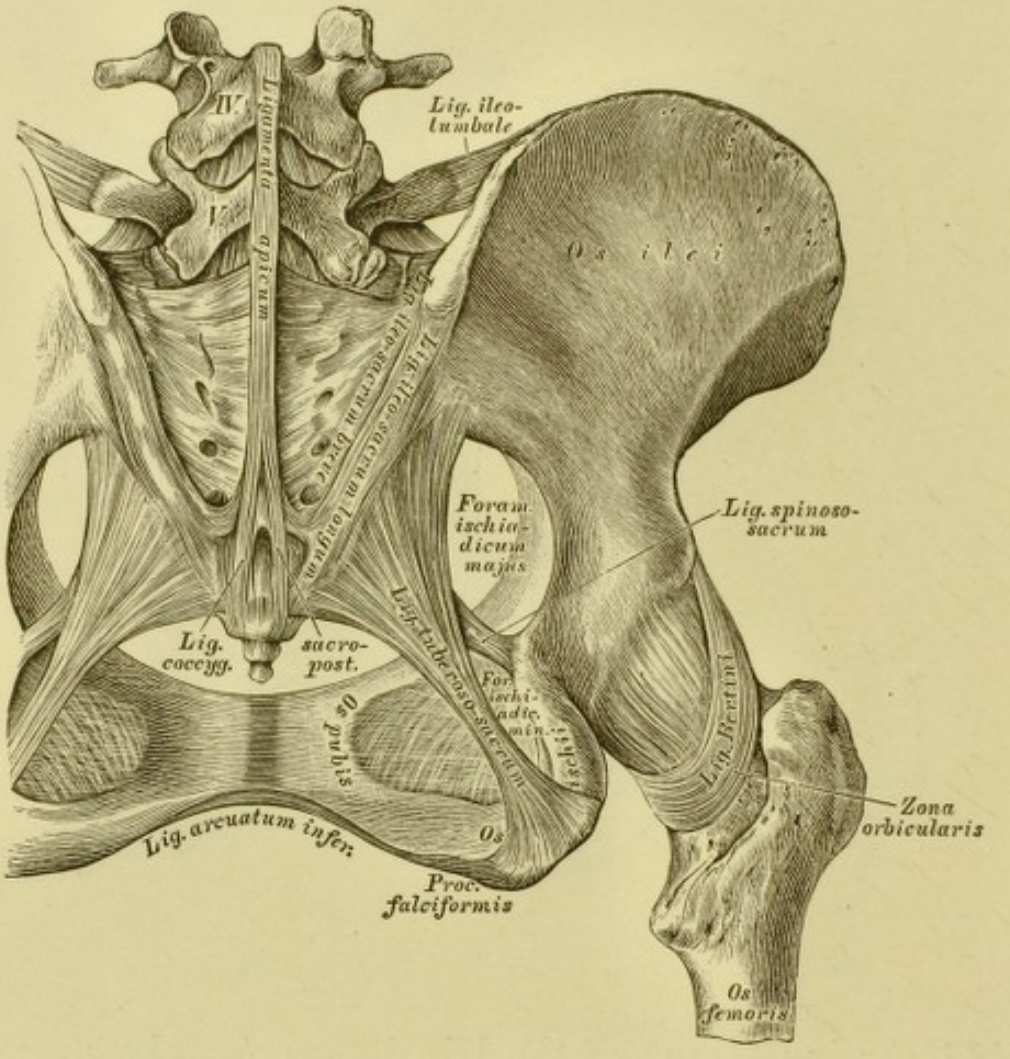


154. Articulations of the Hip Bones, *Symphysis sacro-iliaca* and *Symphysis ossium pubis.* Ligaments on the anterior side of the Pelvis.



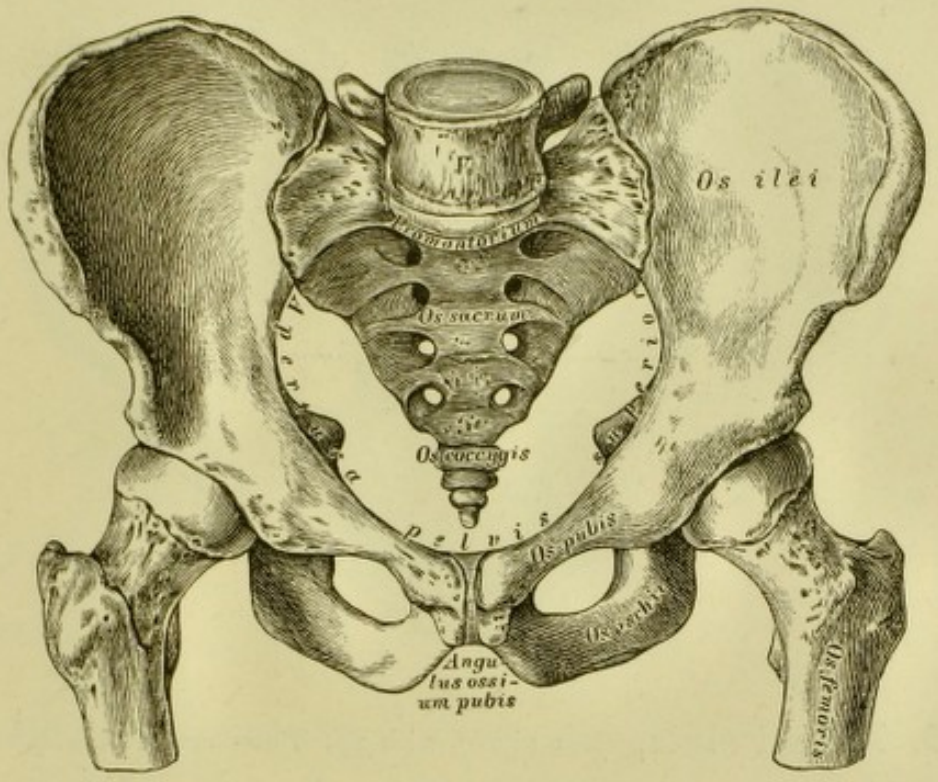
155. The *Symphysis ossium pubis,* in section.

The section is a vertical one through the symphysis, made near its posterior surface, and shows the fibro-cartilage which has a softer nucleus, and a small cavity, interposed between the bones. The *Lig. arcuatum superius* and the *Lig. arcuatum inferius* are strengthening ligaments.

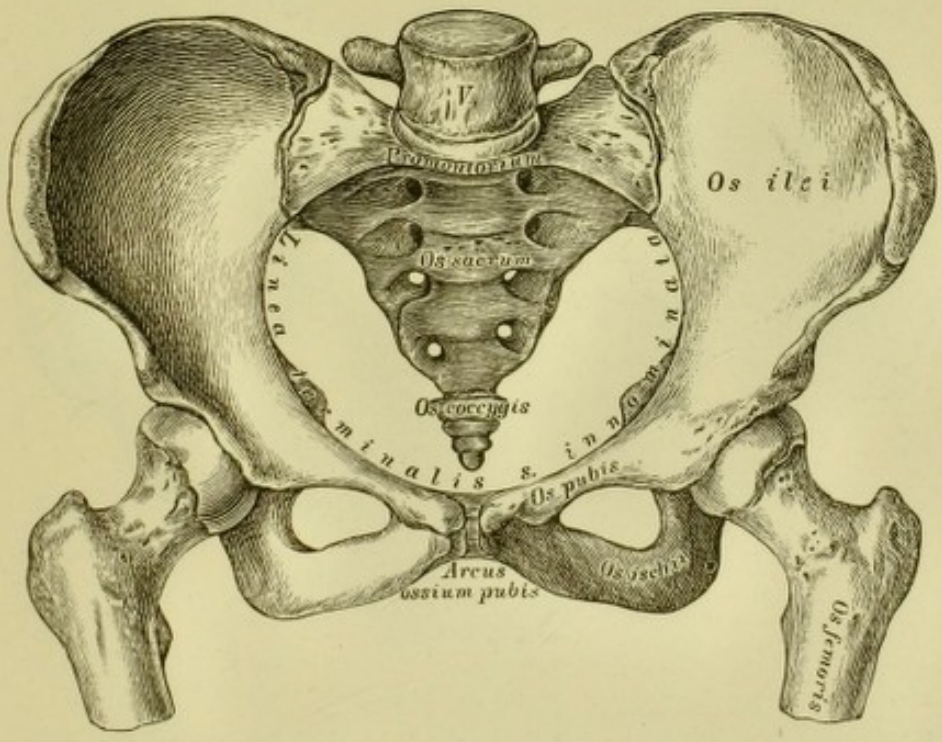


156. Articulations of the Hip Bones. Ligaments at the posterior side of the Pelvis.

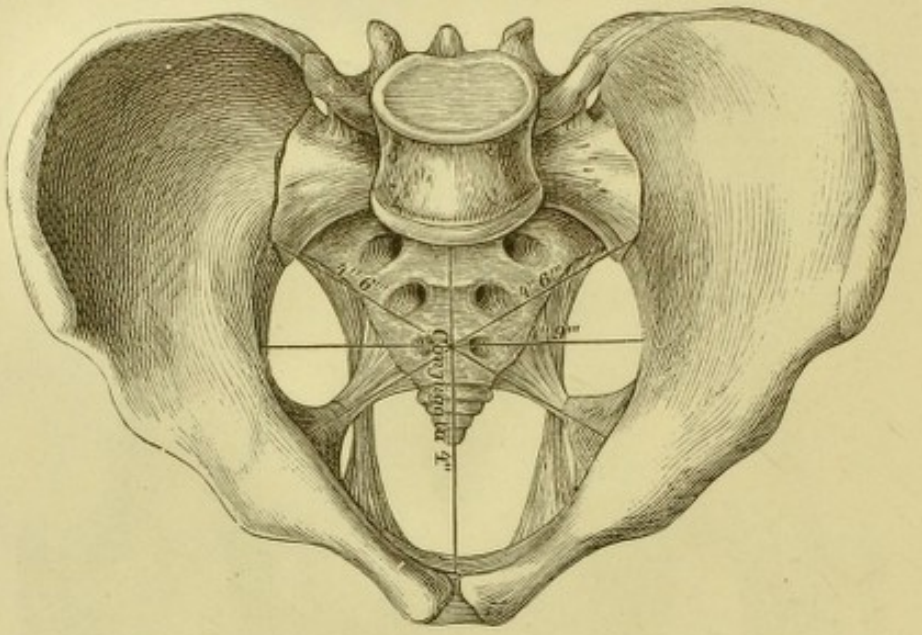
The *Symphysis sacro-iliaca* is covered on the anterior side, (anterior sacro-iliac ligament), by the *Ligamentum ileo-lumbale*, which is divided into two portions, and passes outwards from the transverse process of the fifth lumbar vertebra to the ilium (Fig. 154); on the posterior side the *Ligamentum ileo-sacrum longum et breve* (oblique and horizontal portions of the posterior sacro-iliac ligament) serve as strengthening ligaments. Between the hip bone and sacrum there are further: the posterior or great sacro-sciatic ligament, *Ligamentum tuberoso-sacrum*, running from the tuberosity of the ischium to the posterior inferior spine of the ilium and to the lateral margin of the sacrum and coccyx, and the anterior or lesser sacro-sciatic ligament, *Ligamentum spinoso-sacrum*, running from the spine of the ischium to the lateral margin of the sacrum and coccyx. These two ligaments help to form the great and lesser sacro-sciatic foramina, *Foramen ischiadicum majus* and *Foramen ischiadicum minus*.



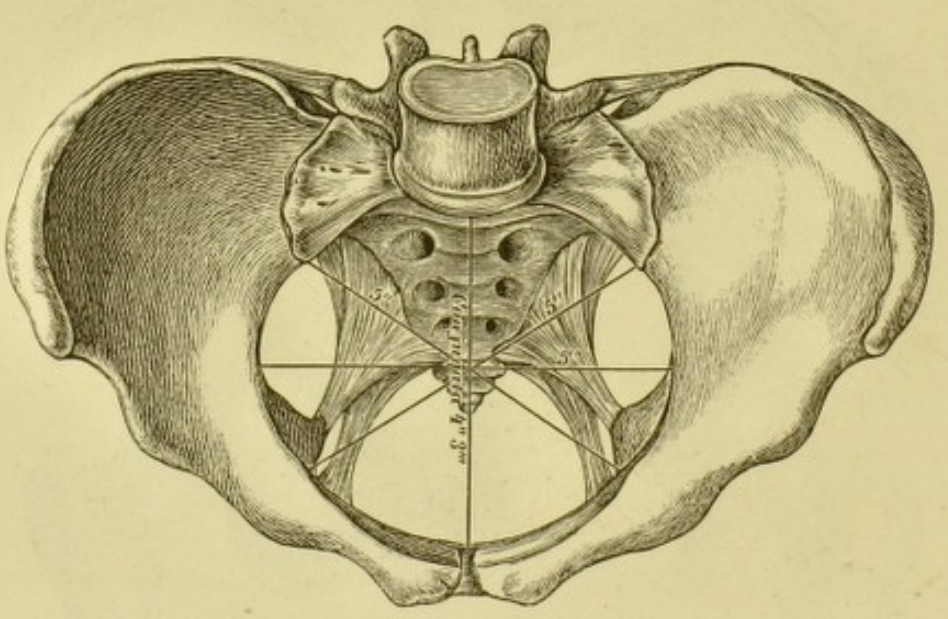
157. Male Pelvis, from before.



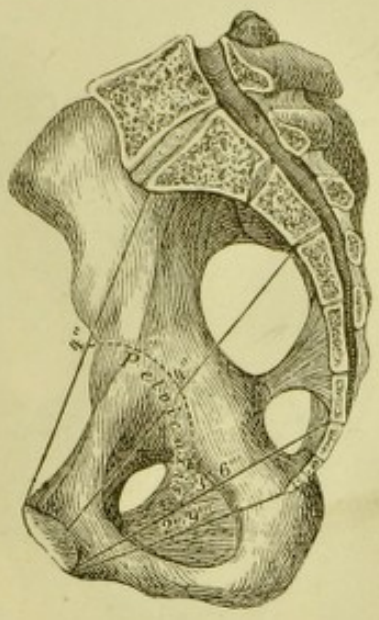
158. Female Pelvis, from before.



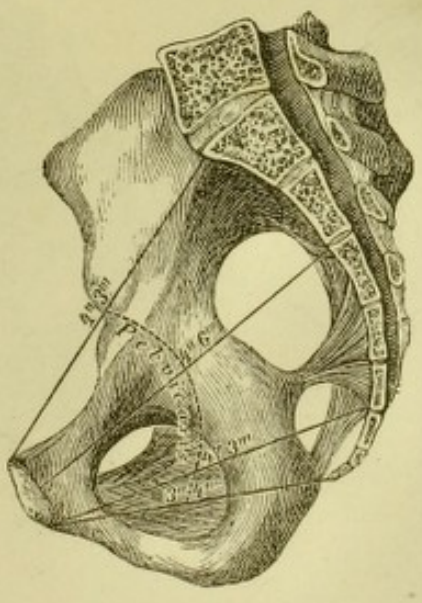
159. Male Pelvis, from above, with the Diameters of the *Apertura pelvis superior.*



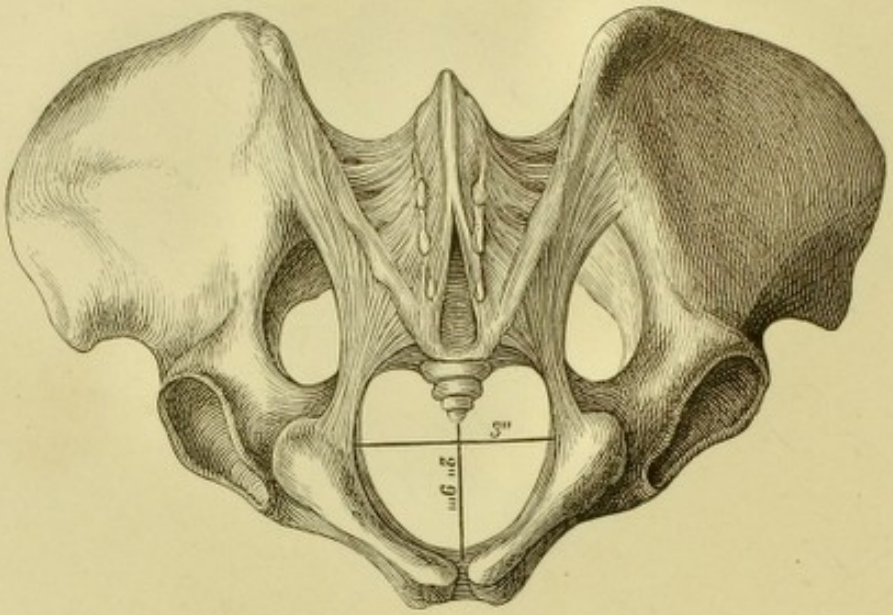
160. Female Pelvis, from above, with the Diameters of the *Apertura pelvis superior.*



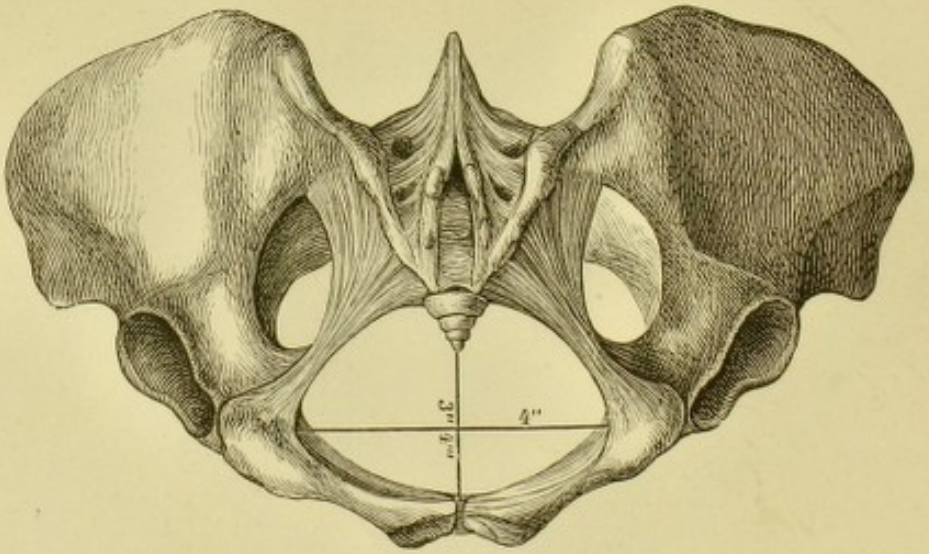
161. Male Pelvis, in section, with the Diameters of the *Cavum pelvis.*



162. Female Pelvis, in section, with the Diameters of the *Cavum pelvis.*



163. Male Pelvis, from below, with the Diameters of the *Apertura pelvis inferior.*



164. Female Pelvis, from below, with the Diameters of the *Apertura pelvis inferior.*

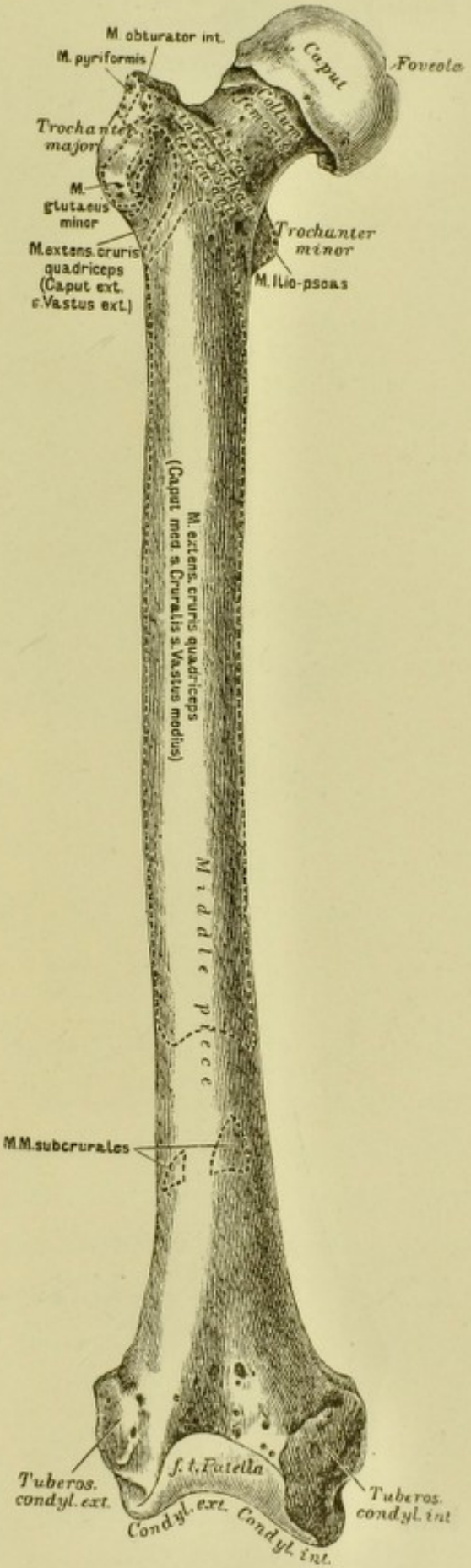
165. The Right Thigh Bone, *Os femoris*, from before.

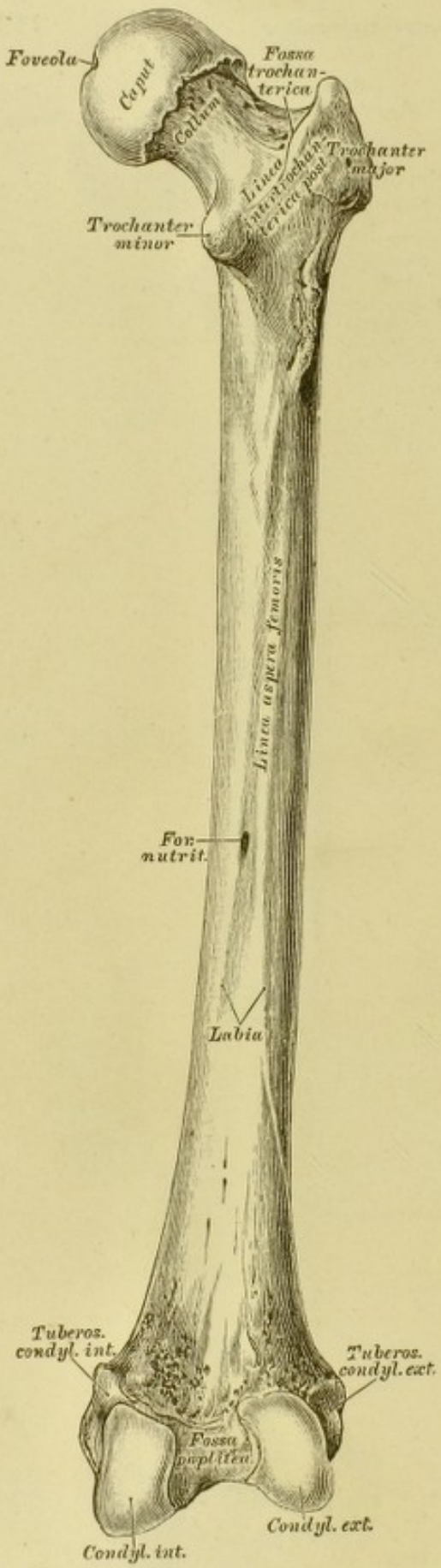
The upper extremity of the femur consists of a head, *Caput femoris*, which is connected to the shaft by means of a neck, and has a small depression, *Foveola*, for the insertion of the *Lig. teres*. At the place where the neck is continued into the shaft, are the two trochanters, the great external, *Trochanter major*, and the lesser internal, *Trochanter minor;* these are connected by the two intertrochanteric lines, the *Linea intertrochanterica anterior* and *posterior*. At the internal surface of the great trochanter lies the digital or trochanteric fossa, *Fossa trochanterica* (Fig. 166).

The *Linea aspera femoris* (Fig. 166) extends along the posterior surface of the shaft; it presents two lips, *Labia*.

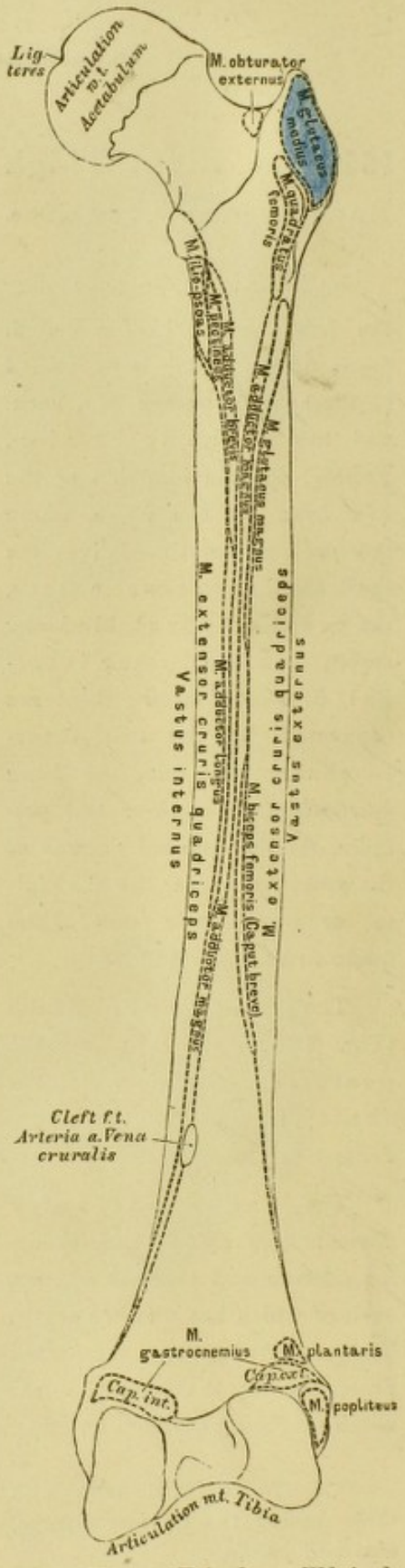
The lower extremity presents two condyles, *Condylus externus* and *Condylus internus*, each of which has a tuberosity. The condyles are separated posteriorly by the intercondyloid notch or *Fossa poplitea* (Fig. 166).

The femur articulates with three bones: the *Os innominatum*, *tibia* and *patella*.

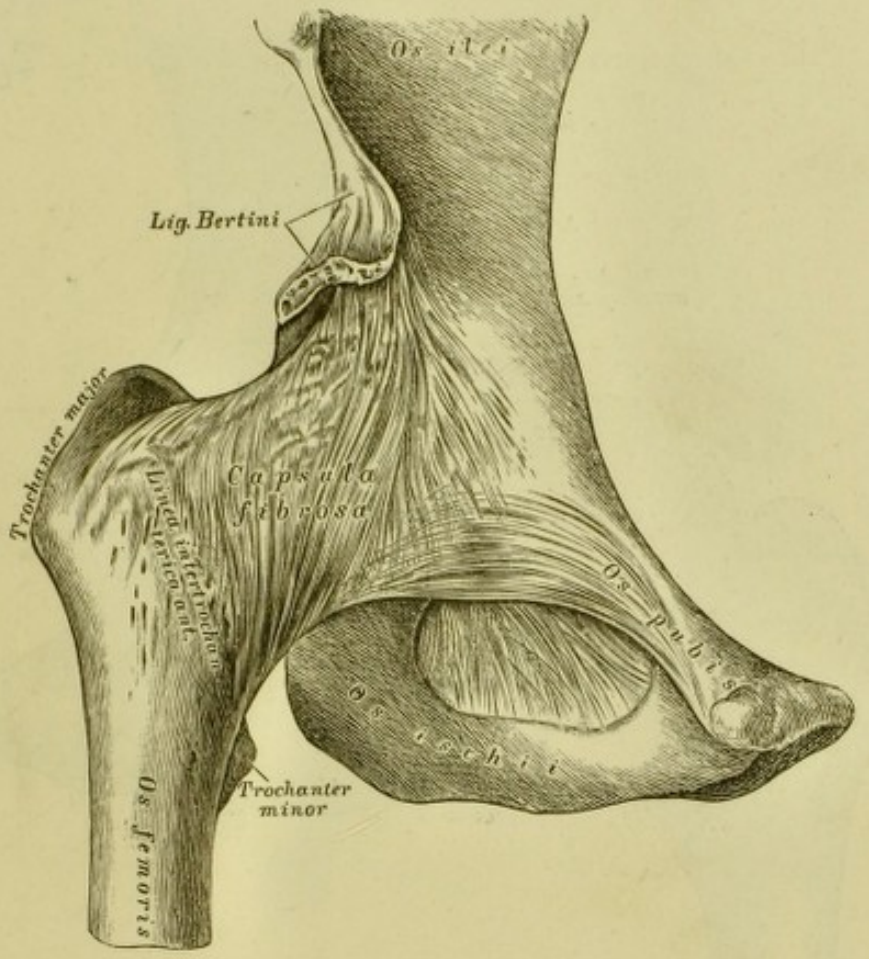




166. The Right Thigh Bone, *Os femoris,* from behind.



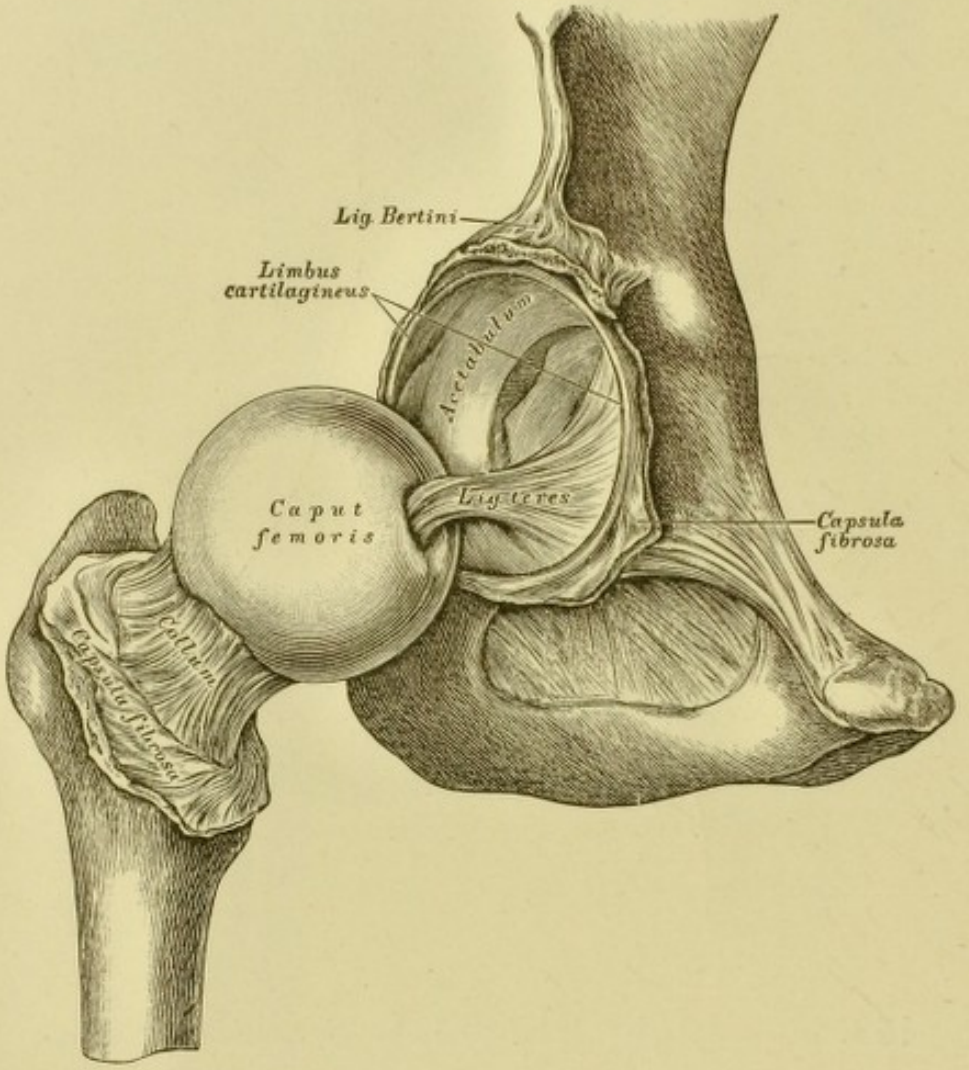
167. The Right Thigh Bone, *Os femoris,* from behind, with the insertions of the muscles.



168. The Right Hip-Joint, *Articulatio coxae,*
from before.

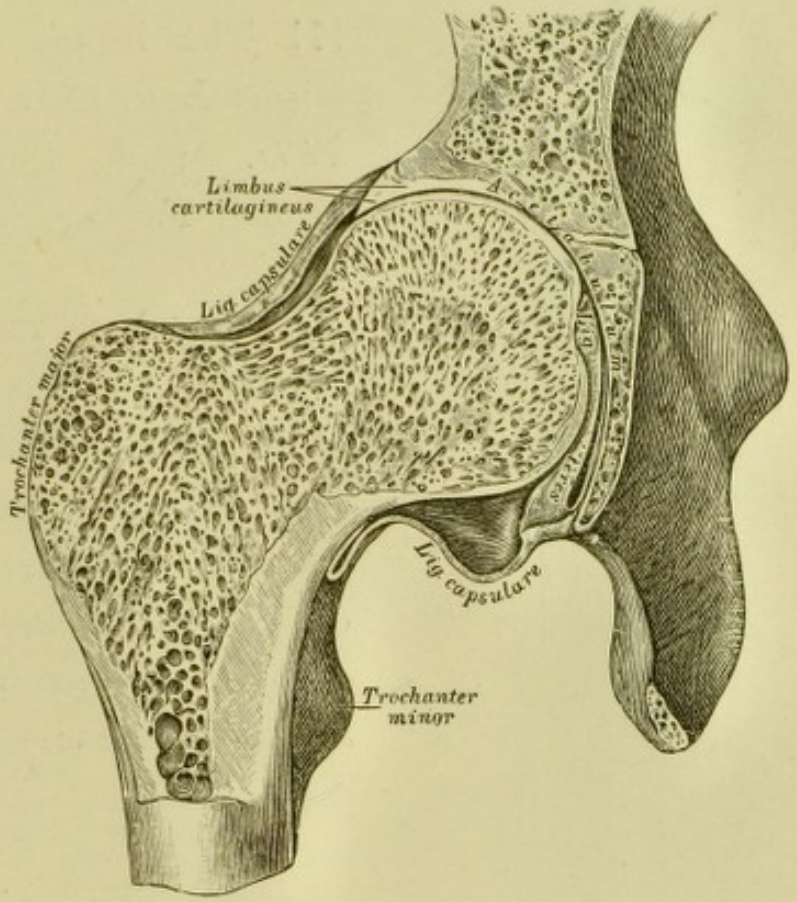
The fibrous capsule of the hip-joint is attached above to the bony margin of the acetabulum and below at the anterior surface of the femur, to the *Linea intertrochanterica anterior*. The strong *Ligamentum Bertini* (ileo-femoral ligament) serves to strengthen the anterior capsular wall; it is attached above to the anterior inferior spine of the ilium, below partly to the anterior intertrochanteric line (Fig. 154), and partly surrounds the neck of the femur by two bands as *Zona orbicularis Weberi* (Fig. 156).*

* This is frequently designated the Y-ligament of Bigelow.



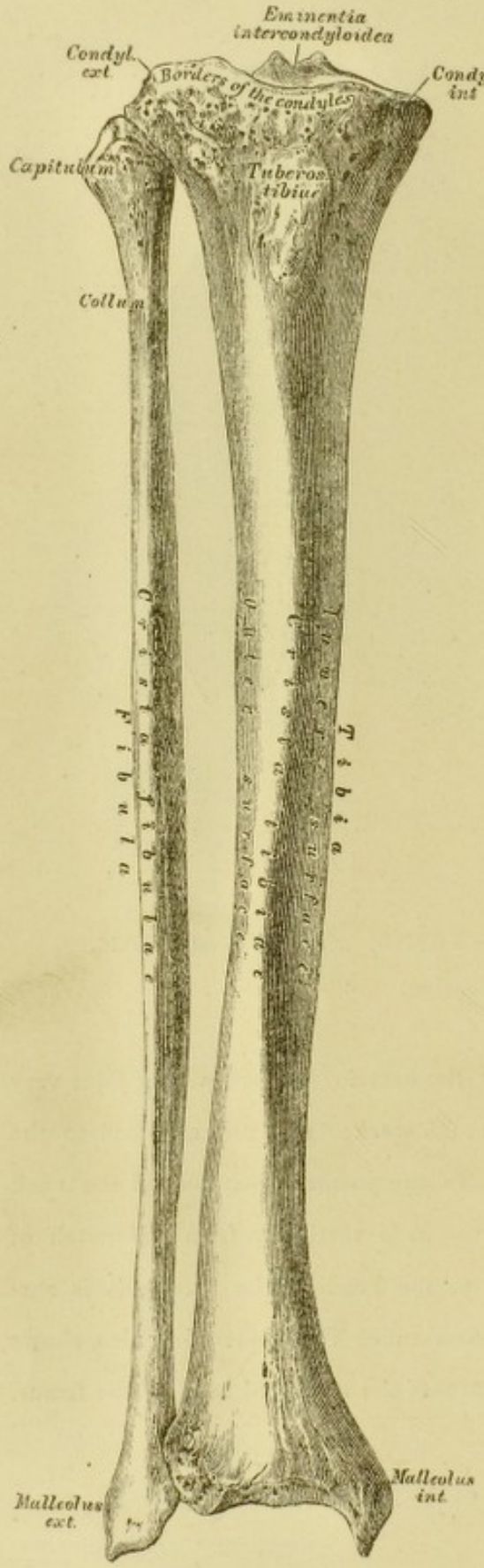
169. The Right Hip-Joint, *Articulatio coxae,* laid open.

To the margin of the acetabulum a fibro-cartilaginous ring, *Limbus cartilagineus acetabuli* (cotyloid ligament), is attached; it bridges over the *Incisura acetabuli.* The round ligament, *Ligamentum teres,* is attached by one extremity to the depression on the head of the femur, by the other to the margins of the notch of the acetabulum. The fibrous capsule of the hip-joint is shown in the figure cut open and folded backwards; it is seen that on the anterior surface the neck of the femur is entirely surrounded by the capsule.



170. The Right Hip-Joint, *Articulatio coxae,*
in section.

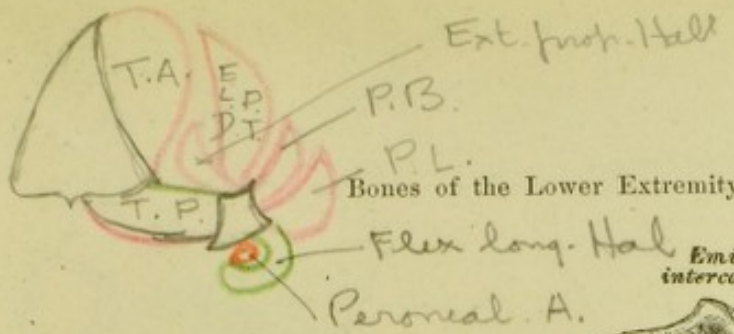
The fibrous capsule, at the anterior surface of the joint very strong, is at its posterior portion much weaker and not attached to the posterior intertrochanteric line, but to the posterior surface of the neck of the femur. The *Ligamentum teres* ascends vertically from the notch of the acetabulum to the depression on the head of the femur; it is surrounded by a sheath of a synovial membrane. The illustration also shows the peculiarly arranged bony structure of the neck and head of the femur.



171. The Bones of the Right Leg, Shin Bone, *Tibia,* and Peroneal Bone, *Fibula,* from before.

Shin Bone, *Tibia.* The shaft has anteriorly the crest of the tibia, *Crista tibiae.* The upper extremity is thickened, and has two tuberosities or condyles, *Condyli tibiae,* between whose articular surfaces is the spine or *Eminentia intercondyloidea.* Below the borders of the condyles, on the anterior side, is the tubercle, *Tuberositas tibiae.* The lower extremity is prolonged downwards into the strong internal malleolus, *Malleolus internus.*

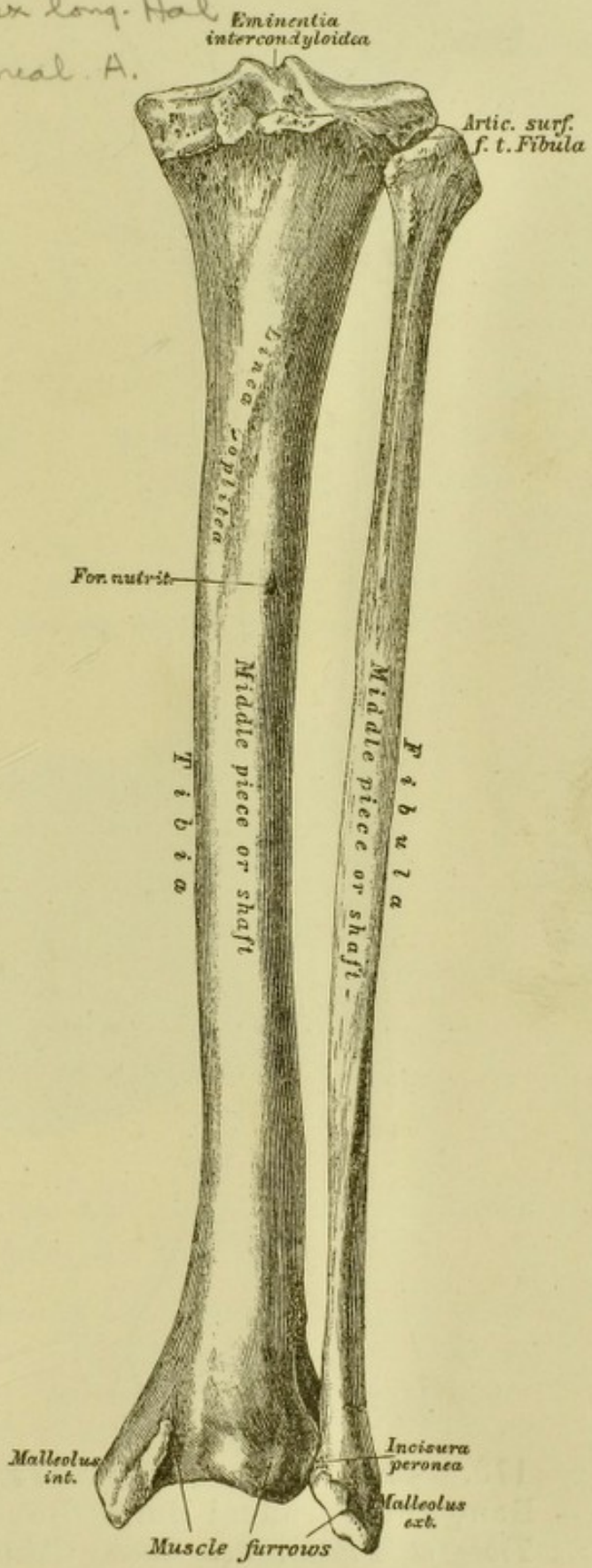
Peroneal Bone, *Fibula.* The anterior most prominent border of the shaft is called *Crista fibulae;* the upper extremity forms the head, *Capitulum,* the lower extremity, the external malleolus, *Malleolus externus.*

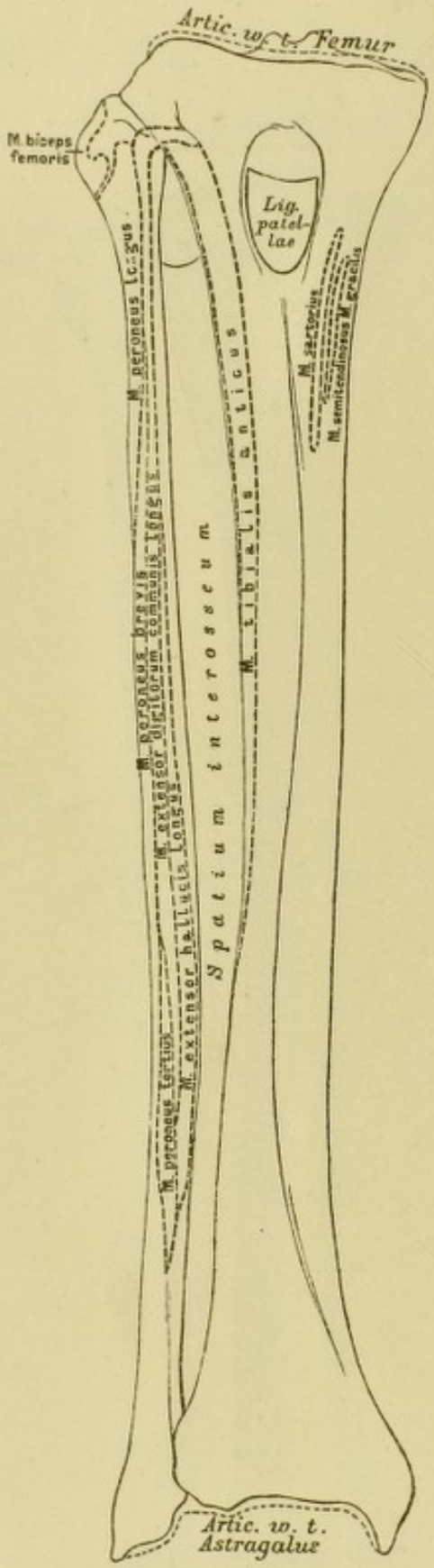


172. The Bones of the Right Leg, Shin Bone, *Tibia,* and Peroneal Bone, *Fibula,* from behind.

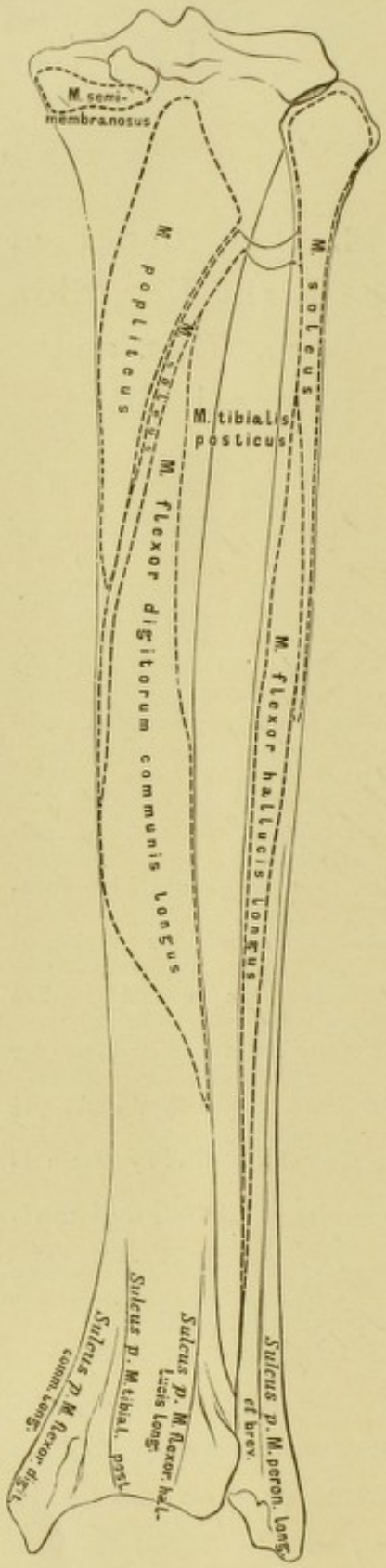
Shin Bone, *Tibia.* The shaft has at the upper part of its posterior border the oblique line or *Linea poplitea;* near the lower end of this line is a large nutritive foramen. The posterior portion of the external condyle has laterally an articular facet for the head of the fibula. At the lower extremity there is opposite the internal malleolus a depression, *Incisura peronea,* for the fibula.

The tibia articulates with three bones: the femur, the fibula and the astragalus; the fibula only with two bones: the tibia and the astragalus.

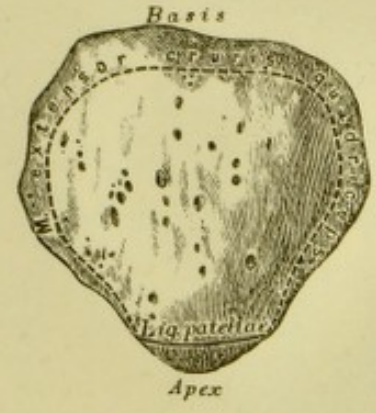




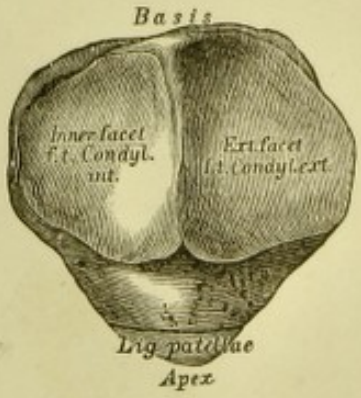
173. The Right Shin Bone and Peroneal Bone, *Tibia et Fibula,* from before, with the insertions of the muscles.



174. The Right Shin Bone and Peroneal Bone, *Tibia et Fibula,* from behind, with the insertions of the muscles.

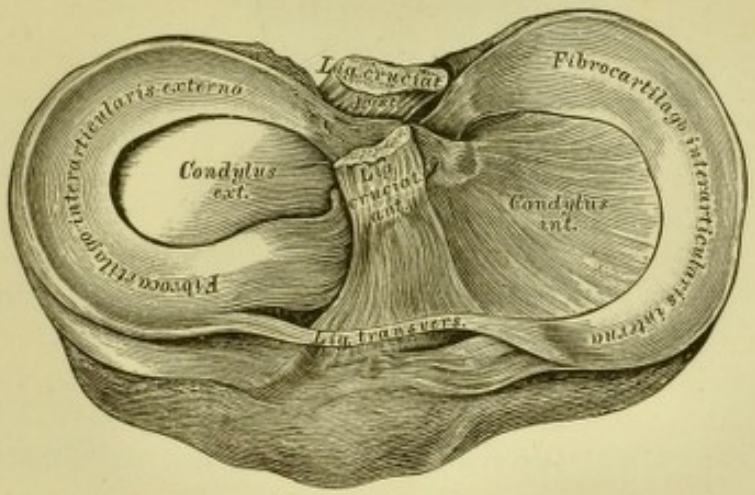


175. The Right Knee-Pan, *Patella,* from before.



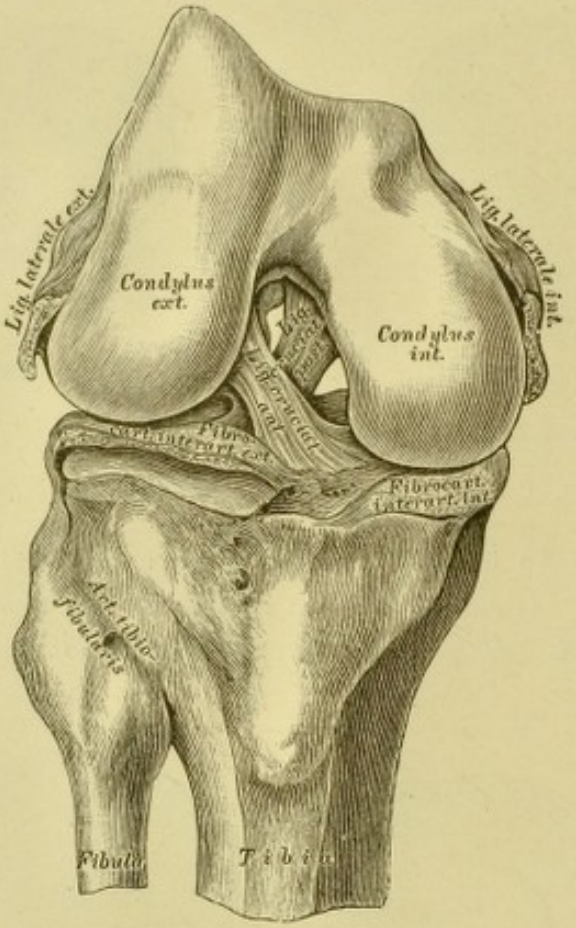
176. The Right Knee-Pan, *Patella,* from behind.

The patella has a base, an apex, an anterior rough, and a posterior surface, which latter is divided into two articular facets, and moves along the groove between the two condyles of the femur.



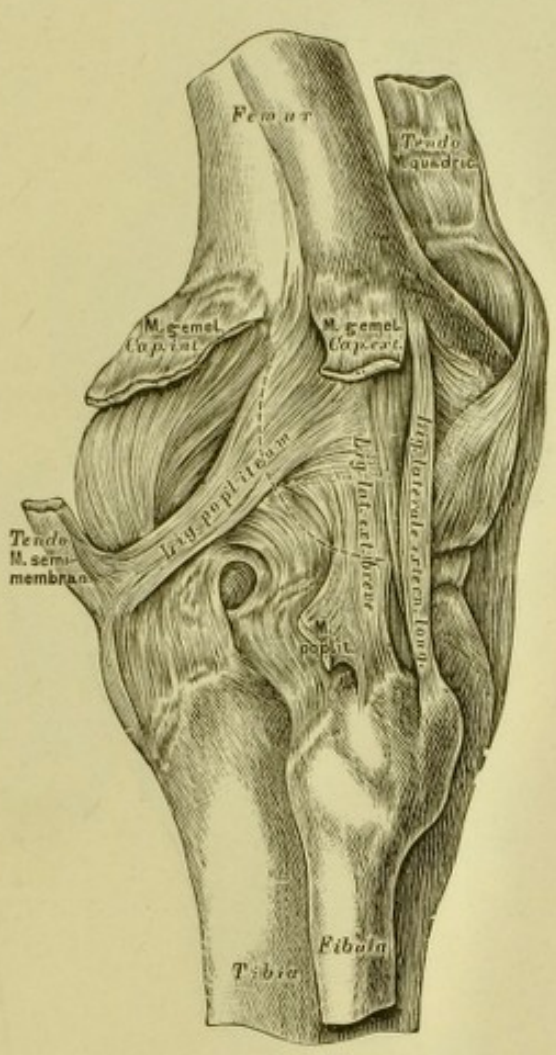
177. The Semilunar Fibro-Cartilages, *Fibrocartilagines interarticulares,* seen from above.

The convex thickened border of each semilunar cartilage is turned toward the capsule, the concave thinned border toward the *Eminentia intercondyloidea* of the tuberosities of the tibia. The internal semilunar fibro-cartilage is less curved, and at its convex border thicker than the external (Fig. 178); the anterior extremities of these cartilages are connected by means of a transverse ligament; these extremities are inserted in front, the posterior behind the *Eminentia intercondyloidea.*



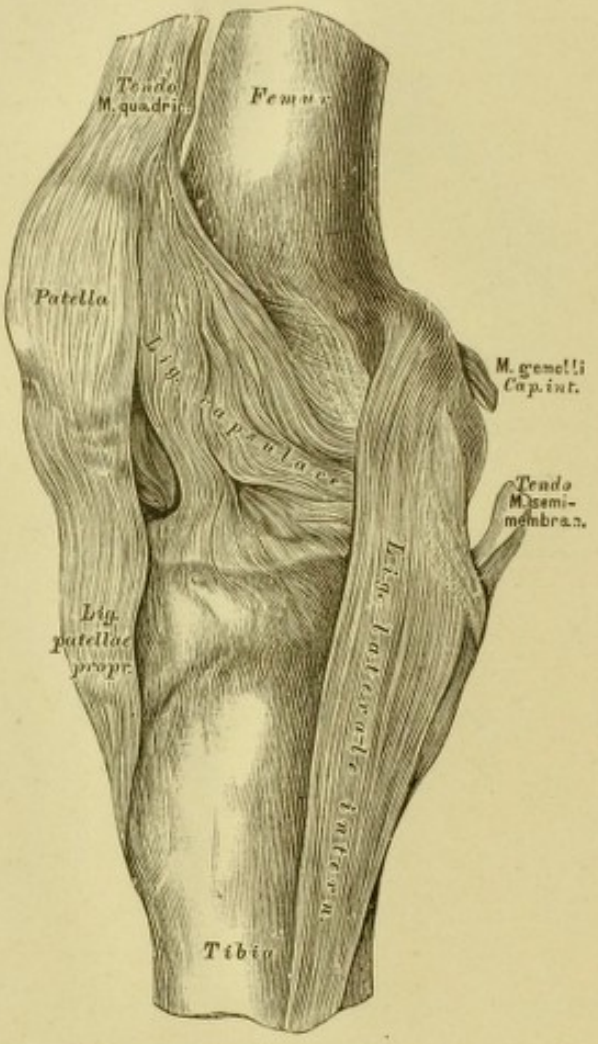
178. The Crucial Ligaments, *Ligamenta cruciata*, of the Right Knee-Joint.

The crucial ligaments pass from the rough inner surfaces of the condyles of the femur to the spaces in front of and behind the spine of the tibia. The anterior or external crucial ligament, *Ligamentum cruciatum anterius*, passes from the inner surface of the external condyle to the depression in front of the spine of the tibia; the posterior or internal crucial ligament, *Ligamentum cruciatum posterius*, from the outer surface of the internal condyle to the depression behind the spine of the tibia.



179. The External Lateral Ligament, *Ligamentum laterale externum,* of the Right Knee-Joint.

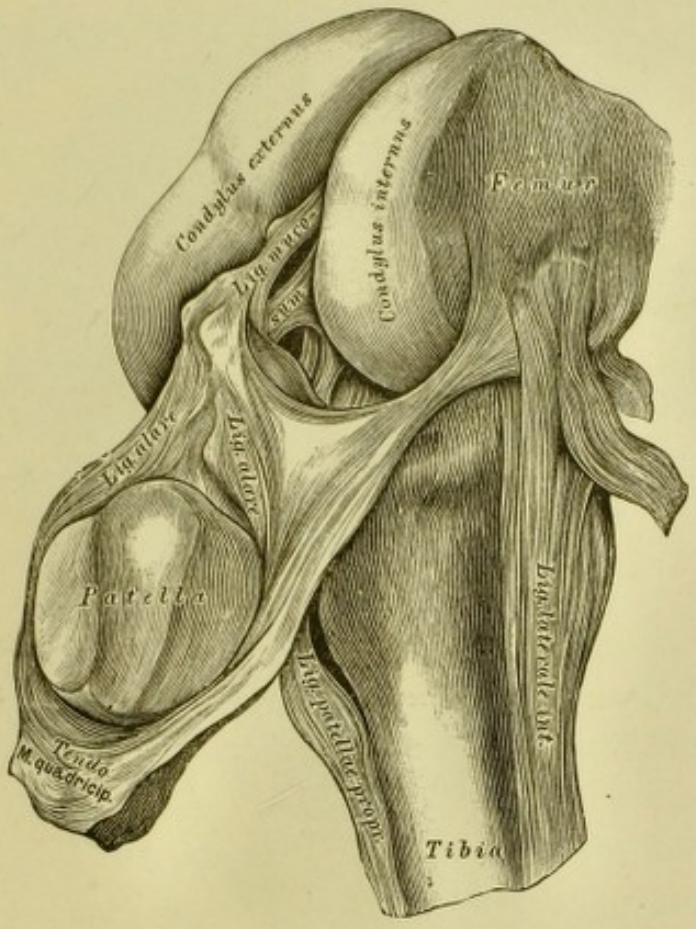
The rounded external lateral ligament passes from the tuberosity on the external condyle of the femur to the head of the fibula. It lies outside of the thin fibrous capsule, which is strengthened by fibrous expansions on the posterior and external surface of the joint. The stronger band of fibres lying in the popliteal space is described as popliteal ligament, *Ligamentum popliteum,* those fibres lying externally as short external lateral ligament, *Ligamentum laterale externum breve.* The relation of these fibres with the muscle insertions is seen in the drawing.



180. The Internal Lateral Ligament, *Ligamentum laterale internum,* of the Right Knee-Joint.

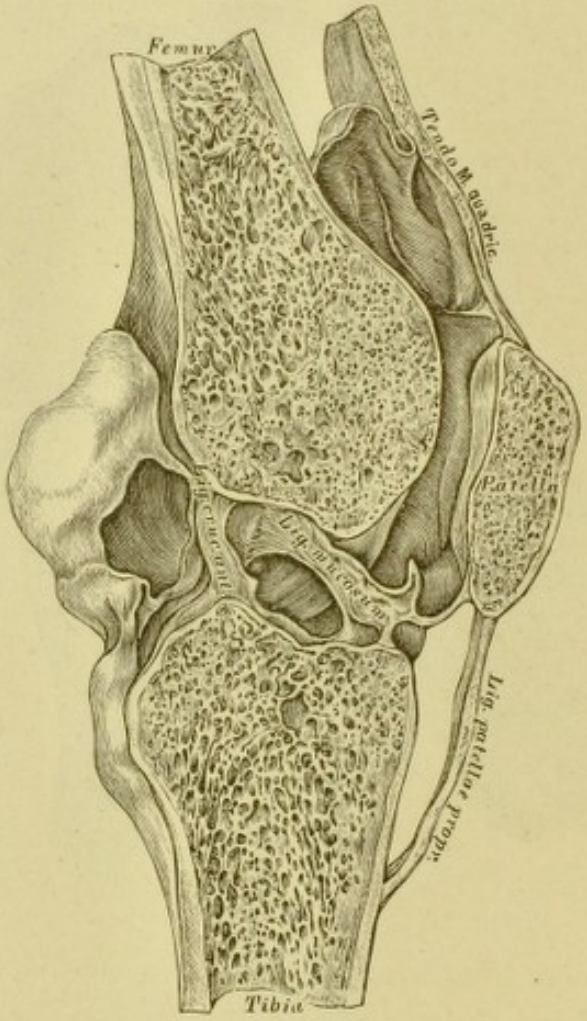
The broad and strong internal lateral ligament is attached above to inner tuberosity of the femur and reaches 2—3″ down below the inner condyle of the tibia, being attached to its internal border.

In the figure the fibrous capsule, which is very thin toward the inner side, its relation to the tendon of the quadriceps extensor muscle, its origin above the condyles of the femur, and its insertion at the rough margin of the condyles of the tibia, are represented.



181. The Alar Ligaments, *Ligamenta alaria*, of the Right Knee-Joint.

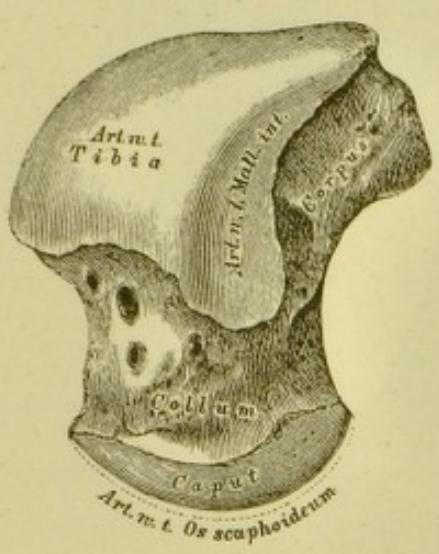
The synovial membrane of the knee-joint sends off, on each side of the patella, two folds *(Ligamenta alaria)*, which are well supplied with fat, and end in a thin ligamentous band, which runs from the place of insertion of the anterior crucial ligament to the intercondylar fossa of the femur — *Ligamentum mucosum*. The alar ligaments divide (after Hyrtl) the space in front of the crucial ligaments into three entirely separate ligamentous cavities.



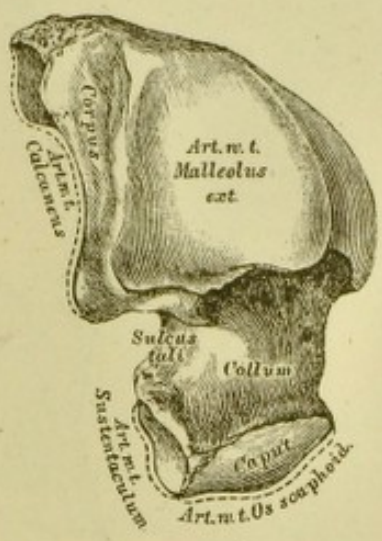
182. The Knee-Joint, *Articulatio genu,*

in section.

The knee-joint was sawed through, after injection of a hardening mass through an aperture made in the patella; after the sawing the mass used for injection was removed. In this way the sac-like diverticula of the synovial capsule become visible, and it can be seen how high up the insertion of the synovial capsule on the anterior and posterior side of the knee-joint reaches.



183. The Right Astragalus, *s. Talus,*
from before and the inner side.

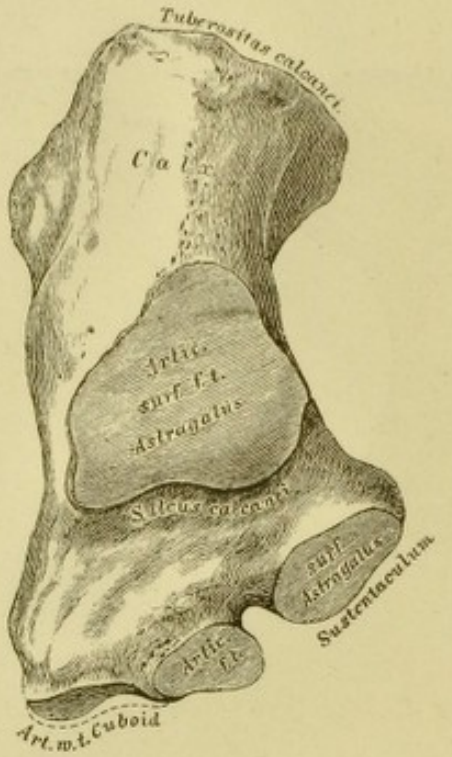


184. The Right Astragalus, *s. Talus,*
from the outside.

The astragalus or talus has a body, neck and head. The superior surface of the body is covered with cartilage and serves for articulation with the tibia; the internal surface is also covered with cartilage for articulation with the inner malleolus of the tibia, while the larger external surface articulates with the external malleolus of the fibula. The inferior concave surface articulates with the *Os calcis.*

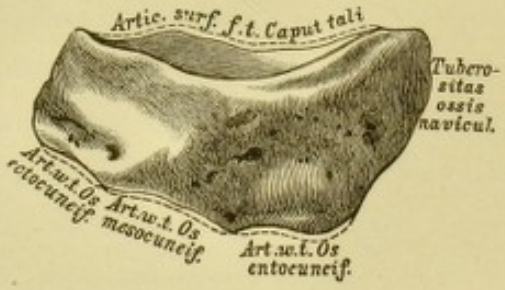
The anterior surface of the body is continued into the neck, and that into the head; the former is covered with cartilage on the inferior surface for articulation with the sustentaculum of the *Os calcis,* the latter covered with cartilage for articulation with the scaphoid bone. From within and behind a groove, the *Sulcus tali,* runs externally and anteriorly.

The astragalus is therefore in articulation with four bones: with the tibia, the fibula, the *Os calcis* and the scaphoid.



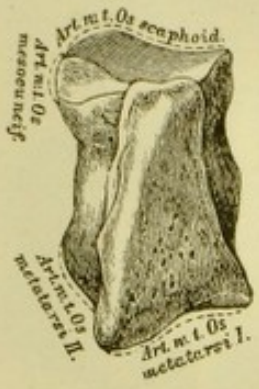
185. The Right *Os calcis, s. Calcaneus,* from above.

The calcaneum, situated below the astragalus, is elongated posteriorly, forming the *Calx,* which ends in the tuberosity, *Tuberositas calcanei.* On the superior surface is the articular facet covered with cartilage, for articulation with the body of the astragalus; in front of it is the *Sulcus calcanei,* which, with the similar *Sulcus tali* forms the *Sinus tarsi.* Internally to the articular facet a process, the *Sustentaculum,* covered with cartilage on its upper surface, projects; a second similar facet is sometimes found at the inner anterior angle of the calcaneum. The anterior articular facet serves for articulation with the cuboid bone, articulates therefore with two bones: the astragalus and cuboid.



186. The Right Scaphoid Bone, *Os scaphoideum seu naviculare,* from above.

The posterior surface of the scaphoid bone serves for articulation with the head of the astragalus; the anterior surface is divided into three facets for articulation with the three cuneiform bones; the internal border presents the tuberosity, *Tuberositas ossis navicularis.* The scaphoid bone articulates with four bones: the astragalus and the three cuneiform, sometimes also with the cuboid.



187. The Right Internal Cuneiform Bone, *Os entocuneiforme,* from above.

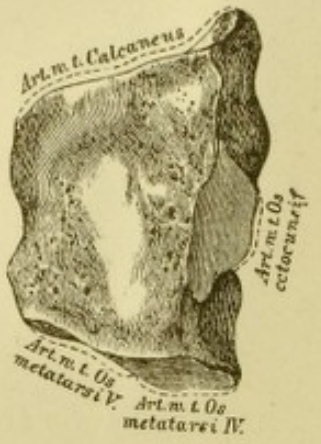
189. The Right External Cuneiform Bone, *Os ectocuneiforme,* from above.

188. The Right Middle Cuneiform Bone, *Os mesocuneiforme,* from above.

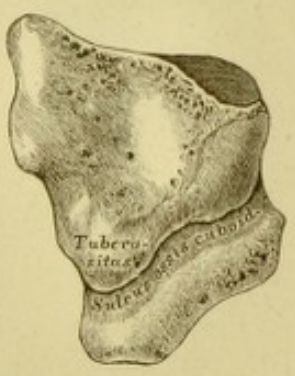
The three cuneiform bones, *Ossa cuneiformia,* are situated in front of the scaphoid bone. The largest first or internal cuneiform bone has its sharp border directed upwards; it articulates with four bones: with the scaphoid, the middle cuneiform, the first and second metatarsal bones.

The smallest second or middle cuneiform bone has its sharp edge directed downward towards the sole; it articulates with four bones: the scaphoid, the internal and external cuneiform and the second metatarsal.

The third or external cuneiform bone is wedged in between five bones, with which it articulates: the scaphoid, middle cuneiform, cuboid, the second and third metatarsal bones.

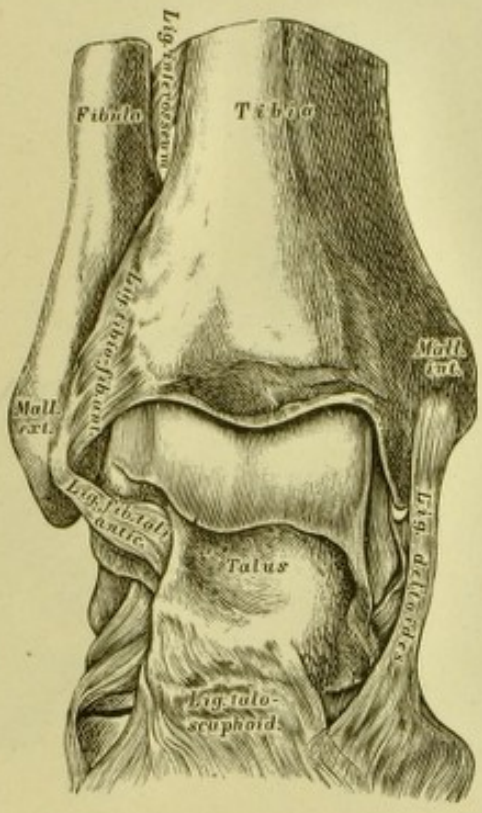


190. The Right Cuboid Bone, *Os cuboideum*, from above.

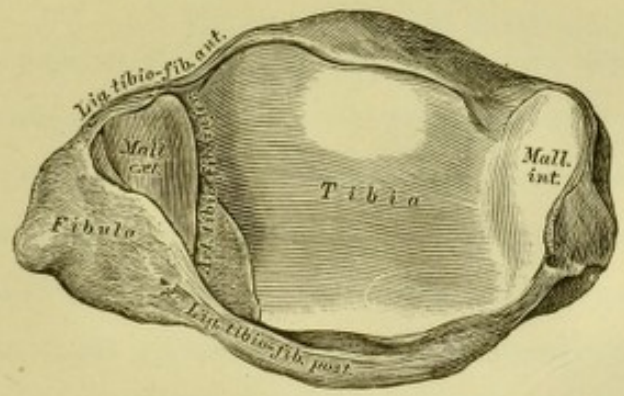


191. The Right Cuboid Bone, *Os cuboideum*, from below.

The cuboid bone is situated in front of the *Os calcis* at the outer side of the foot. The inferior surface presents a tuberosity, *Tuberositas ossis cuboidei*, in front of which is a groove, *Sulcus ossis cuboidei*, running inwards and forwards; it lodges the tendon of the *M. peroneus longus*. The articular surfaces of the cuboid bone are: a posterior for articulation with the *Os calcis;* an internal for the external cuneiform bone; two anterior for the bases of the fourth and fifth metatarsal bones. Sometimes a fifth very small articular facet is present on the internal surface of the bone, for articulation with the scaphoid bone.

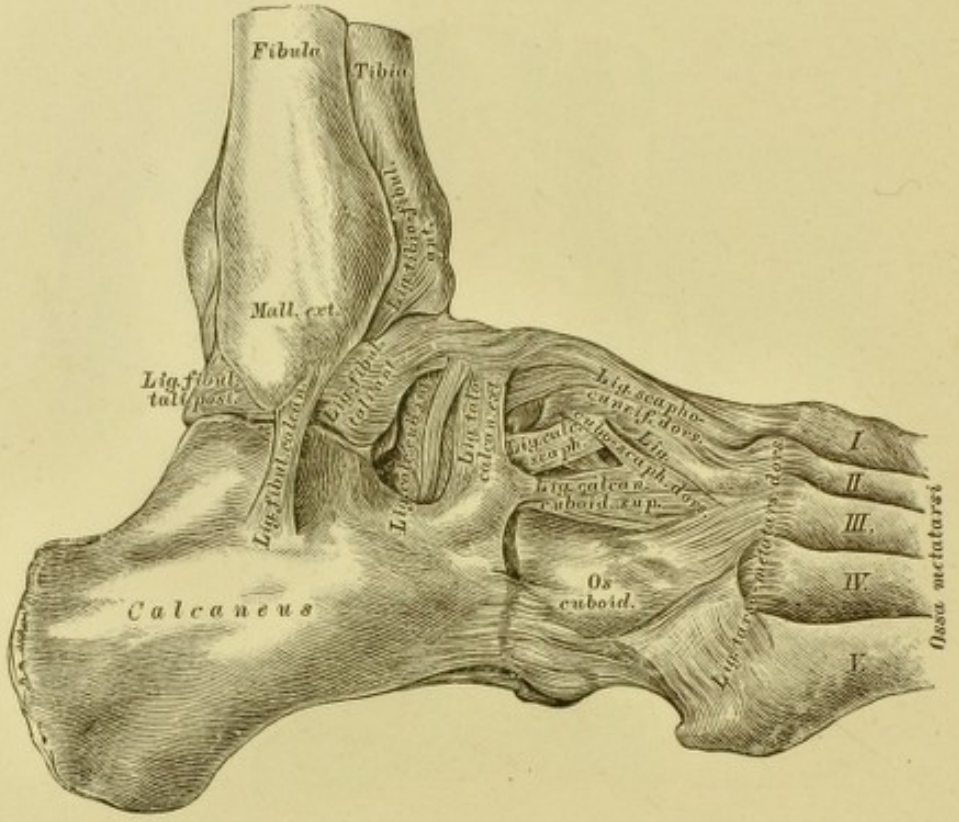


192. The Right Ankle-Joint, *Articulatio pedis,*
from before, after removal of the anterior capsular wall.



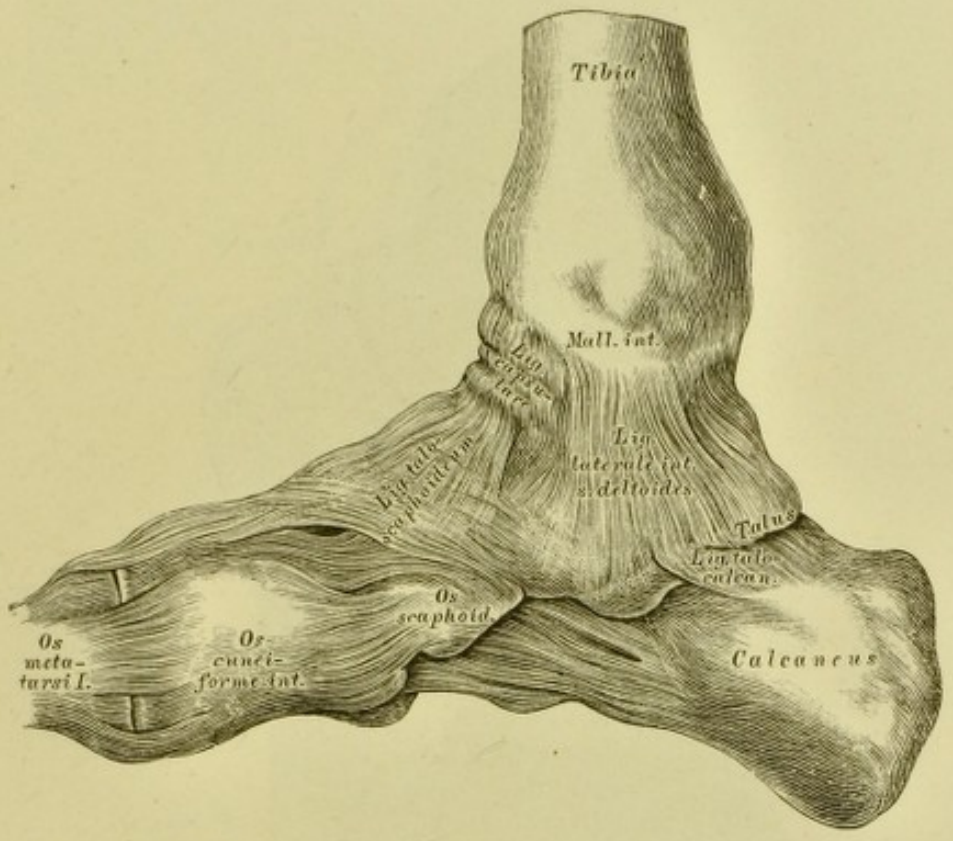
193. The Articular Surfaces of the Right Tibia and Fibula, constituting the Ankle-Joint,
seen from above.

On account of the size of the articular surface on the body of the astragalus, a part of the anterior and posterior articular surfaces of that bone is, even in the median position of the joint, between flexion and extension, free from contact with the articular surface of the tibia. The tibia and fibula are articulated below by means of the anterior and posterior tibio-fibular ligaments, *Ligamentum tibio-fibulare anterius* and *posterius;* between these are sac-like diverticula of the synovial membrane of the ankle-joint.



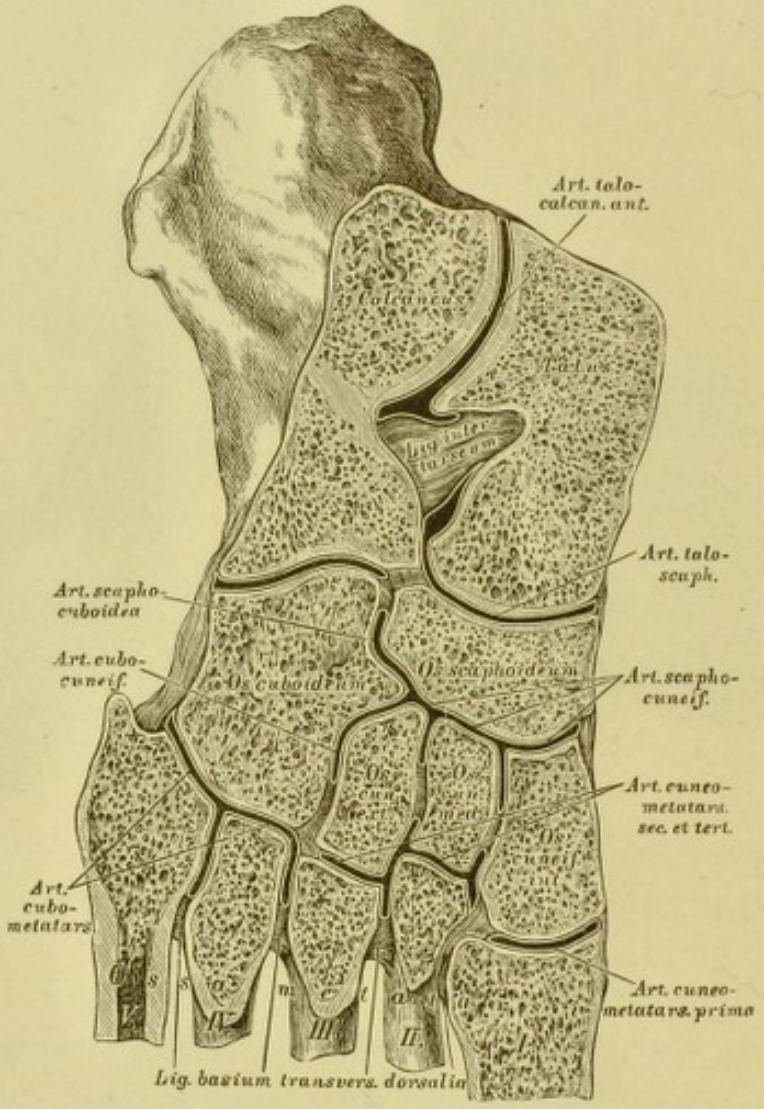
194. The Ligaments of the Ankle-Joint and the Tarsal Bones, from the outside.

The fibrous capsule of the ankle-joint is strengthened externally by three lateral ligaments; these are: 1. the *Ligamentum fibulare tali anticum*, 2. the *Lig. fibulare tali posticum* and 3. the middle *Lig. fibulare calcanei* (anterior, posterior and middle fasciculi of the external lateral ligament). Of the ligaments of the tarsus those visible on the outer side of the foot are: between astragalus and calcaneus the *Lig. talo-calcaneum externum;* between calcaneus and cuboid bones the *Lig. calcaneo-cuboideum superius* and *internum;* between calcaneus and scaphoid bones the *Lig. calcaneo-scaphoideum dorsale;* between scaphoid and cuboid bones the *Lig. cubu-scaphoideum dorsale;* between the scaphoid and three cuneiform bones the three *Ligamenta scapho-cuneiformia dorsalia*, between the cuboid and third cuneiform the *Lig. cubo-cuneiforme.* Between the tarsus and the bases of the five metatarsal bones the *Ligamenta tarso-metatarsea dorsalia* are attached.



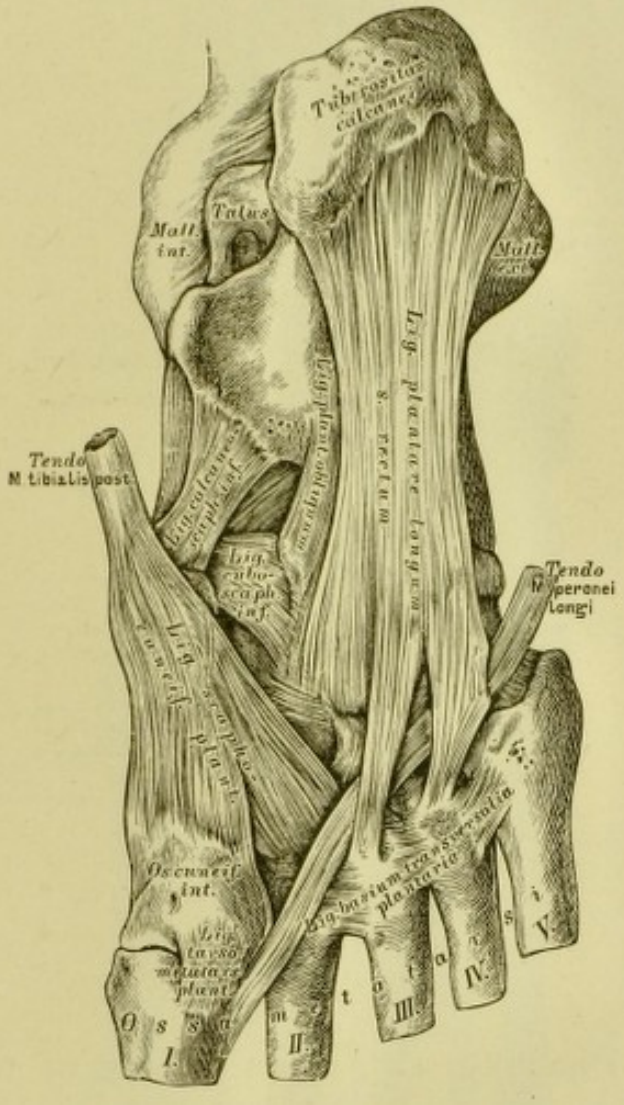
195. The Ligaments of the Ankle-Joint and the Tarsal Bones, from the inner side.

On the inner side of the capsule of the ankle-joint there is only one lateral ligament: the internal lateral, *Ligamentum laterale internum seu deltoides*, attached above to the internal malleolus, and below to the inner surface of the astragalus and to the sustentaculum of the *Os calcis*. On the inner side of the tarsus the following ligaments can be seen: between astragalus and calcaneus the *Lig. talo-calcaneum posticum;* between astragalus and scaphoid the broad *Lig. talo-scaphoideum;* between the scaphoid and first and second cuneiform bones the *Ligamenta scapho-cuneiformia dorsalia;* between the cuneiform bones the *Ligamenta cuneiformia dorsalia*. In Fig. 196 the short *Ligamenta basium transversalia dorsalia*, four in number, attached between the bases of the five metatarsal bones, can be seen; the three similar plantar ligaments are seen in Fig. 197.



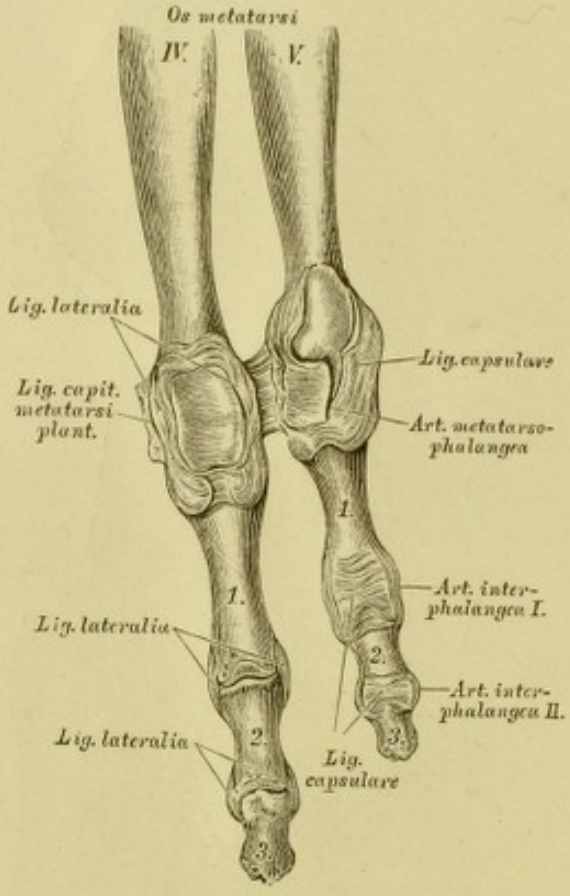
196. The Articulations of the Tarsal Bones, *Articulationes intertarseae et tarso-metatarseae,* in section.

The following articulations of the tarsus have common synovial membranes: 1. the *Articulatio talo-scaphoidea* with the *Art. talo-calcanea anterior;* 2. the three *Articulationes scapho-cuneiformes* with the *Art. scapho-cuboidea* and the *Art. cubo-cuneiformis;* 3. the *Articulatio cuneo-metatarsea secunda et tertia;* 4. the two *Articulationes cubo-metatarsea.* Isolated are: 5. the *Articulatio calcaneo-cuboidea* and 6. the *Articulatio cuneo-metatarsea prima.*



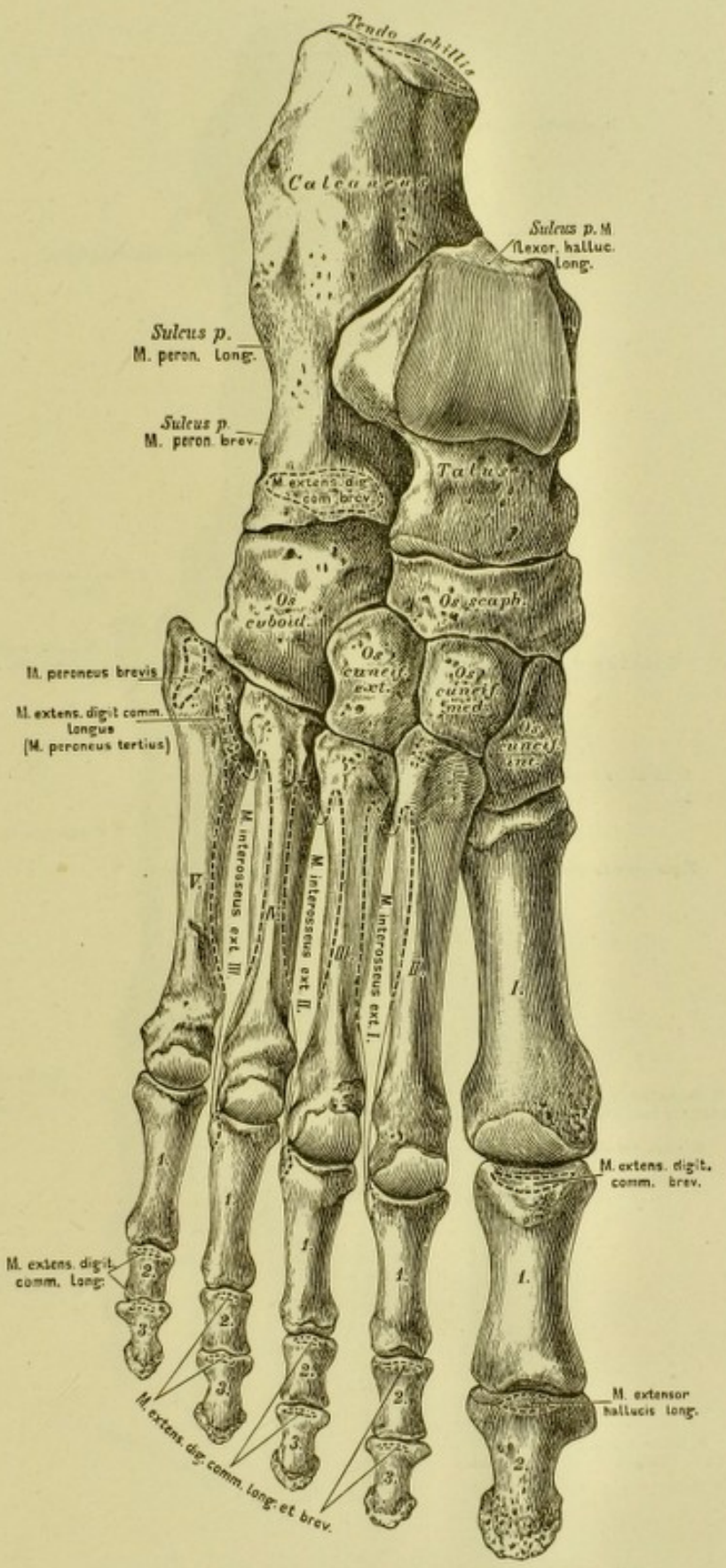
197. The Plantar Strengthening Ligaments of the Tarsal Articulations.

The following ligaments are seen: between calcaneum and cuboid bones the strong *Lig. calcaneo-cuboideum plantare longum s. rectum*, and, partially hidden by this, the *Lig. plantare obliquum* or short calcaneo cuboid ligament; from the former two bands, which strengthen the sheath of the *M. peroneus longus*, run to the bases of the third and fourth metatarsal bones. Further the following ligaments: the *Lig. calcaneo-scaphoideum inferius;* the *Lig. cubo-scaphoideum inferius;* the *Ligamenta scapho-cuneiformia plantaria* in relation with the tendon of the *M. tibialis posticus;* the weak *Lig. cubo-cuneiforme* and *intercuneiforme plantare.*

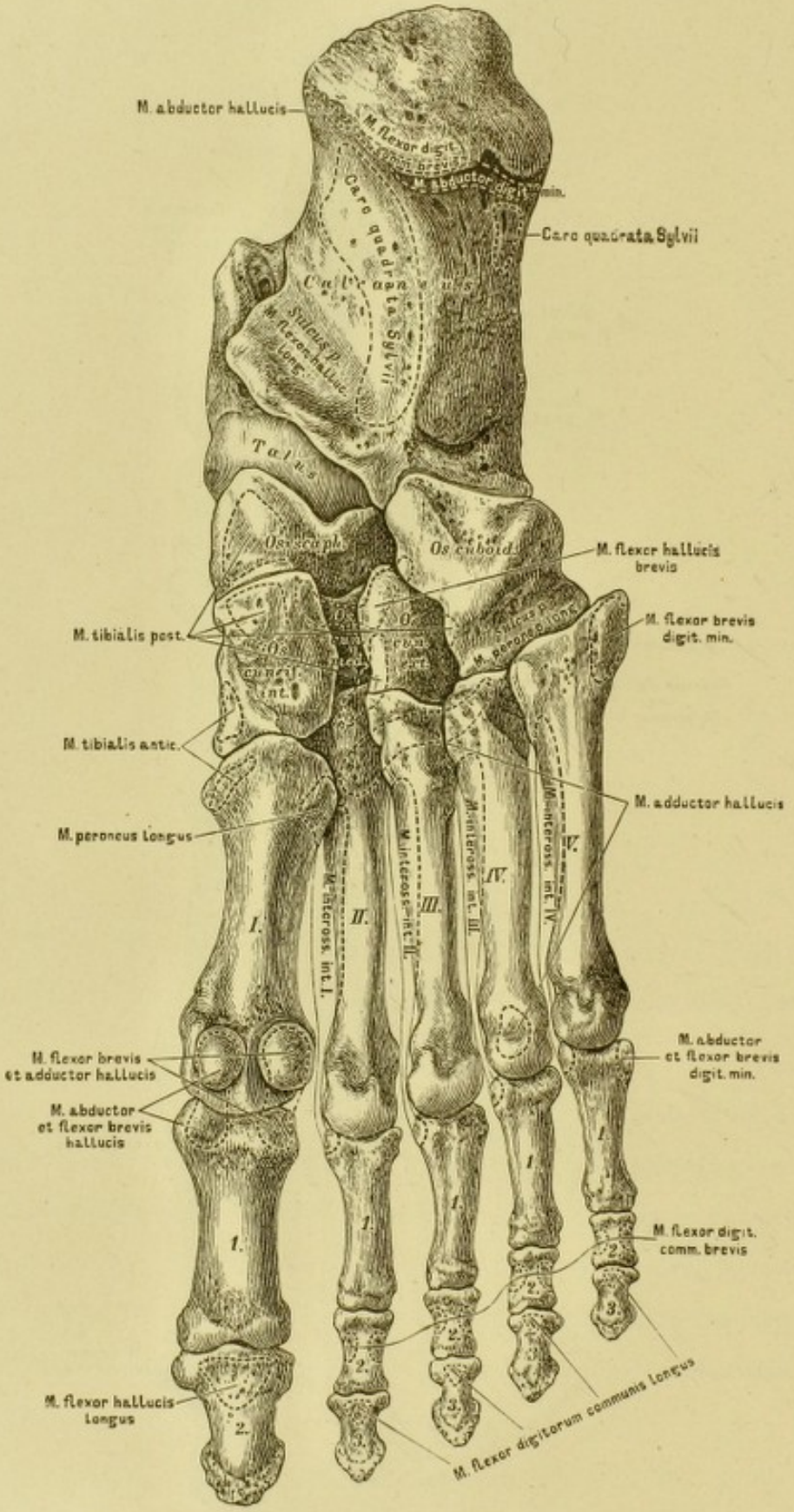


198. The Phalangeal Articulations of the Fourth and Fifth Toes of the Right Foot, from the Plantar Side.

As at the fingers, the following articulations are seen at the toes: 1. the *Articulatio metatarso-phalangea;* 2. the *Art. interphalangea prima;* 3. the *Art. interphalangea secunda.* Each of these articulations has two *Ligamenta lateralia;* the *Art. metatarso-phalangea* has besides these ligaments, thickenings of the capsule. This thickening is in relation at the capsule of the big toe with two sesamoid bones, which are represented in Fig. 200.



199. The Bones of the Right Foot,
from the Dorsal Side, with the insertions of the muscles.

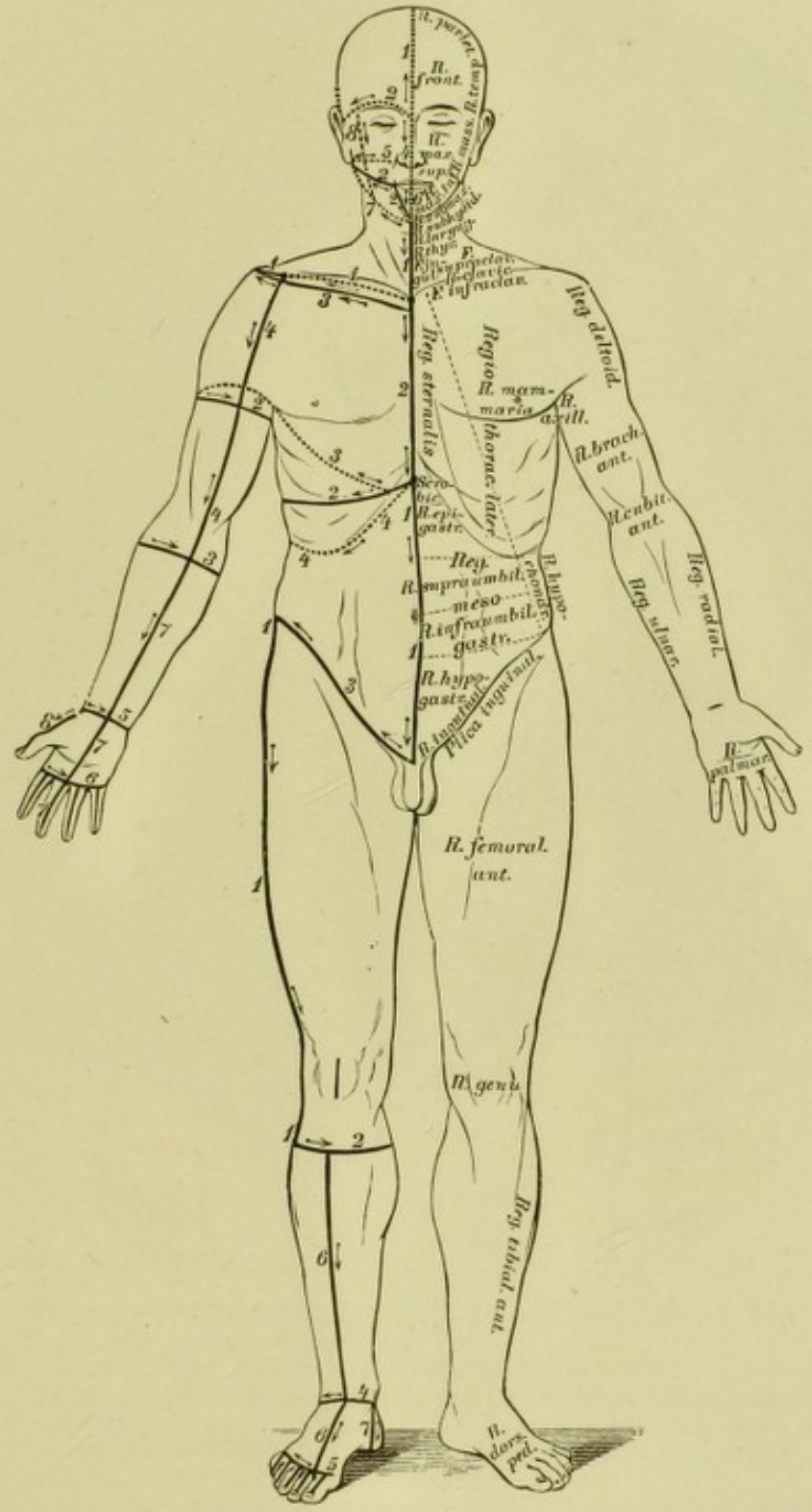


200. The Bones of the Right Foot,
from the Plantar Side, with the insertions of the muscles.

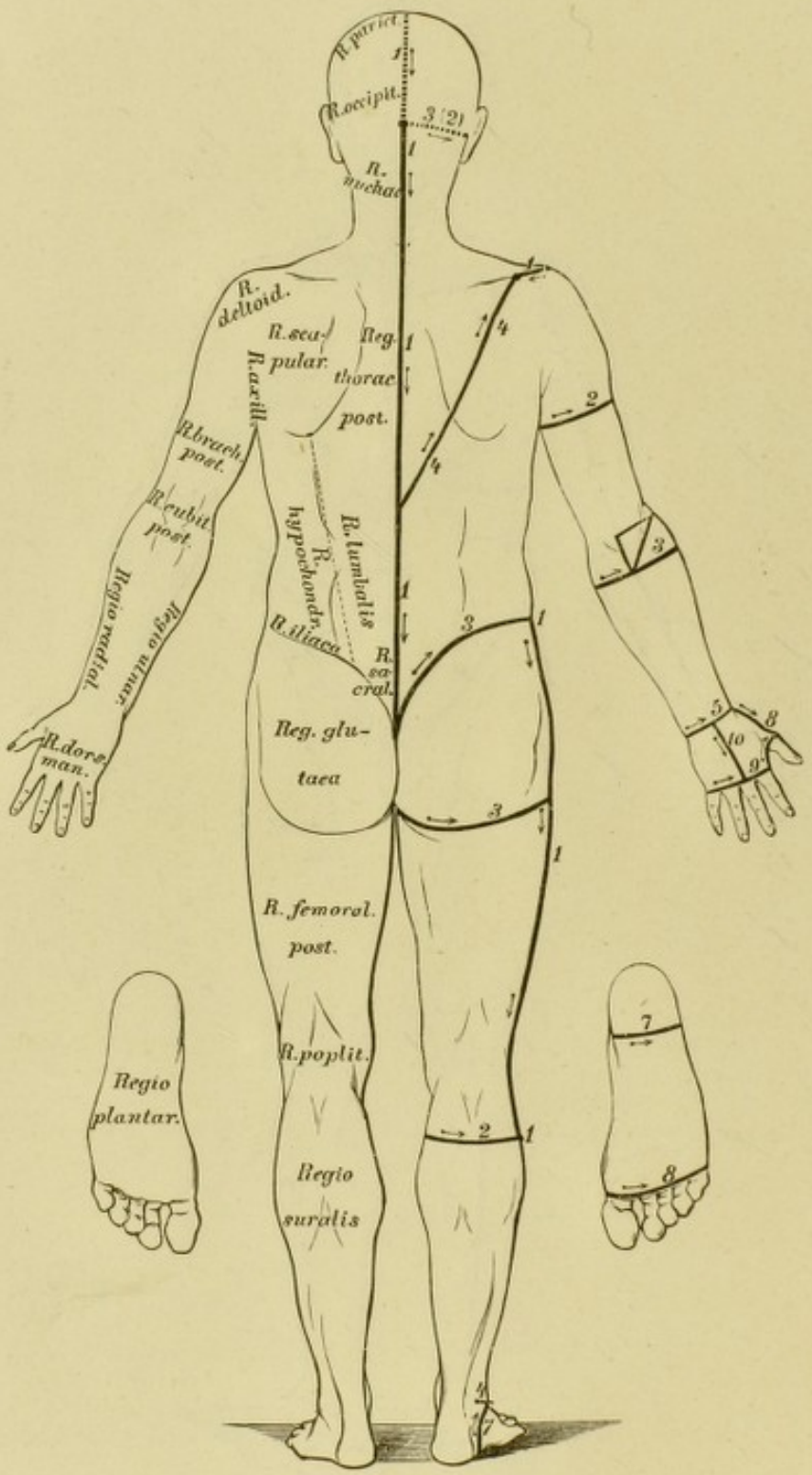
II.

MUSCLES. FASCIAE.

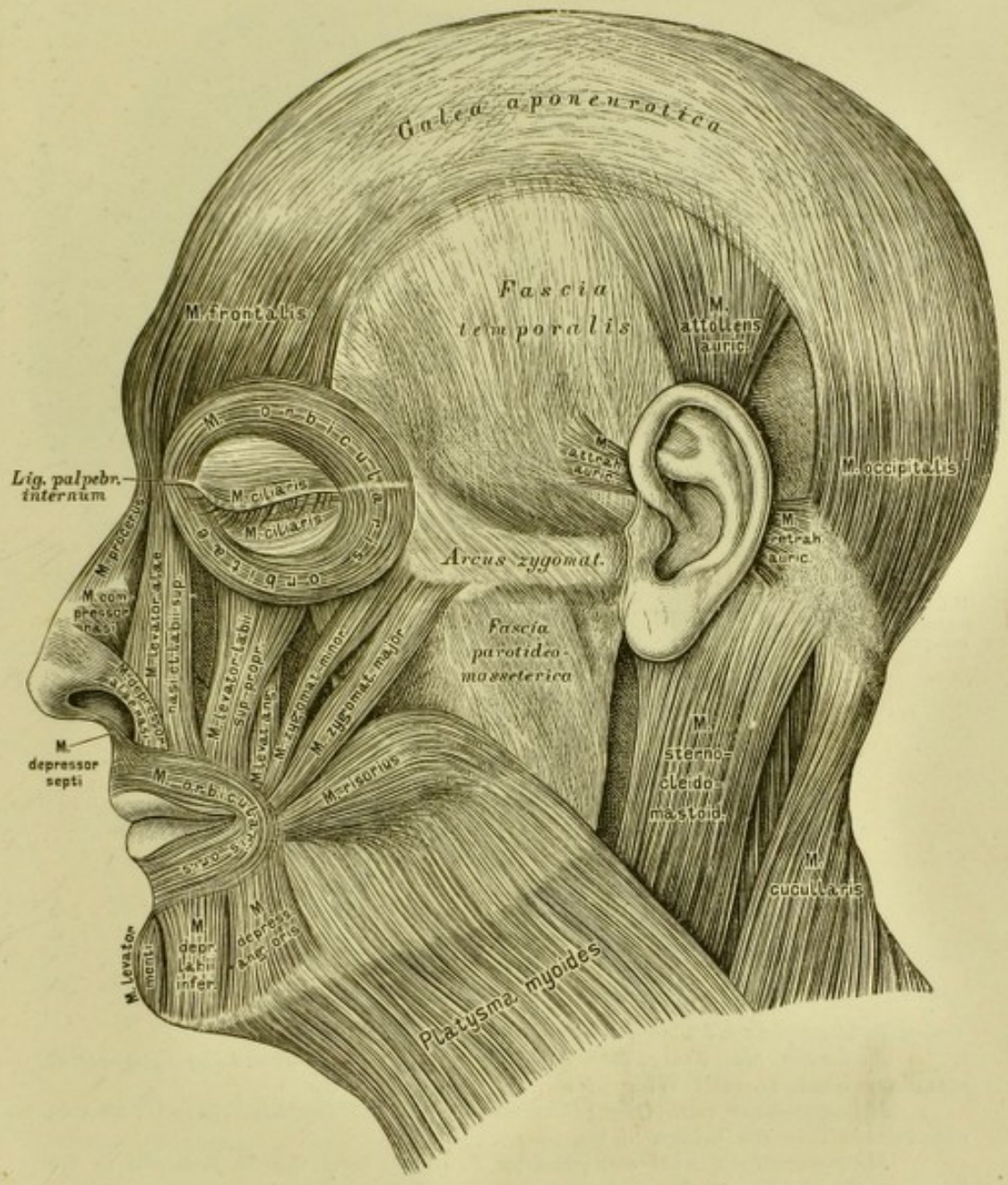
TOPOGRAPHY.



201. The Incisions through the Skin for Dissections. The Regions of the Body, anterior view.



202. The Incisions through the Skin for Dissections. The Regions of the Body, posterior view.



203. Muscles and Fasciae of the Head and Face.

1. Muscles of the Epicranial region: *M. occipito-frontalis* divided into the *M. frontalis* and *M. occipitalis.*

M. frontalis. Origin: Glabella and superciliary ridge of frontal bone. Insertion: *Galea aponeurotica* (Tendinous aponeurosis of occipito-frontalis).

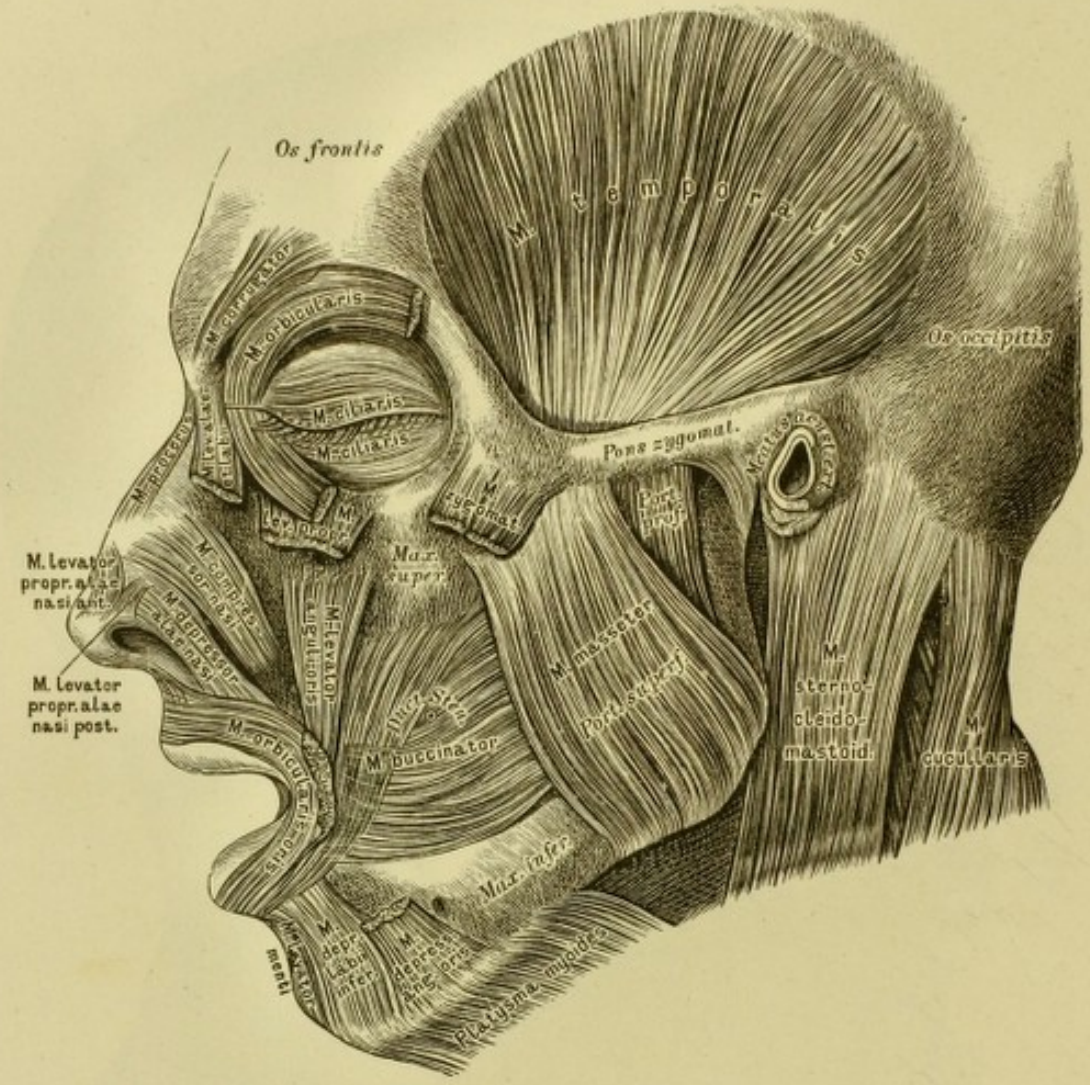
M. occipitalis. Orig.: Superior curved line of the occipital bone, mastoid portion of the temporal bone. Insert.: *Galea aponeurotica.*

2. Muscles of the Eyelids and Eyebrows:

M. orbicularis palpebrarum (orbitae). Orig.: *Lig. palpebrarum internum,* nasal process of the superior maxillary bone. Insert.: *Lig. palpebr. int., Margo infraorbitalis* of the sup. max.

M. ciliaris on the eyelids close to the margins. (Closes the lids.)

M. corrugator supercilii (Fig. 204). Orig.: Beneath the *M. frontalis* and *orbicularis palpebrarum* from the *Glabella;* is inserted into the two muscles covering it.



204. Muscles of the Face.

3. Muscles of the Nose:

M. levator alae nasi et labii superioris. Orig.: Nasal process of the superior maxillary bone. Insert.: Wing of the nose and upper lip.

M. compressor nasi. Orig.: Canine fossa of the sup. max. Insert.: as thin aponeurosis into the bridge of the nose.

M. pyramidalis nasi seu procerus Santorini from the *M. frontalis* to the fascia at the bridge of the nose.

M. depressor alae nasi. Orig.: Alveolus of the canine and external incisor tooth. Insert.: Cartilage of the wing of the nose.

MM. levator proprius alae nasi anterior et posterior (Dilatator naris ant. et post.) at the cartilage of the nose.

M. depressor septi mobilis narium (Fig. 203); from the *M. orbicularis oris* to the *Septum narium.*

4. Muscles of the Lips and Mouth:

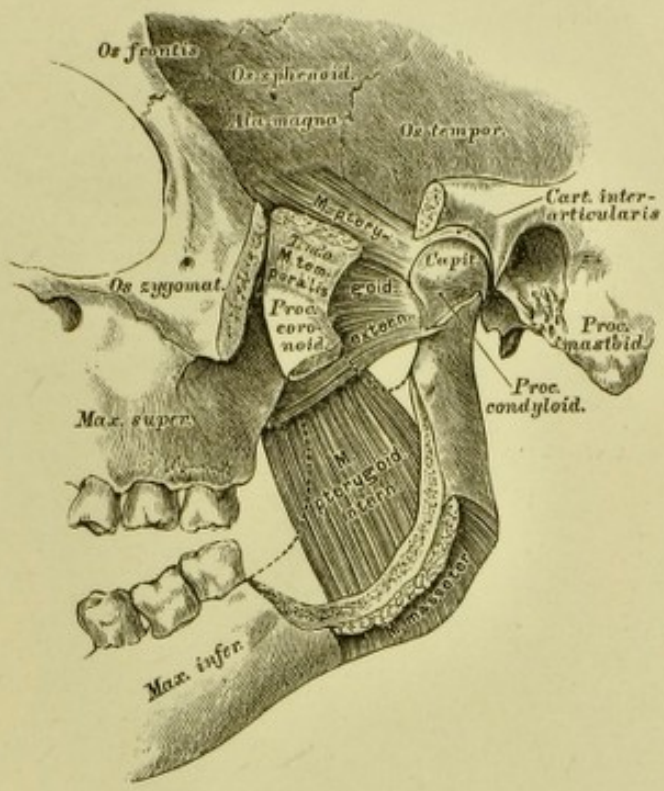
M. levator labii superioris proprius; from the *Margo infraorbitalis* to the upper lip.

M. levator anguli oris; from the canine fossa to the angle of the mouth.

MM. zygomaticus major et minor. Orig.: Facial surface of the malar bone. Insert.: From the angle of the mouth, into the upper and lower lips.

M. risorius Santorini (Fig. 203); from the *Fascia parotideo-masseterica* to the angle of the mouth.

M. depressor anguli oris (Triangularis); from the inferior border of the lower jaw to the angle of the mouth.



205. Muscles of the Lower Jaw, from outside.

Muscles of the Lips and Mouth (Fig. 203 and 204):

M. depressor labii inferioris (Quadratus menti). Orig.: External oblique line of the lower jaw. Insert.: Lower lip and integument of the chin.

M. levator menti (Levator labii inferioris); runs from the incisive fossa of the lower jaw down to the integument of the chin.

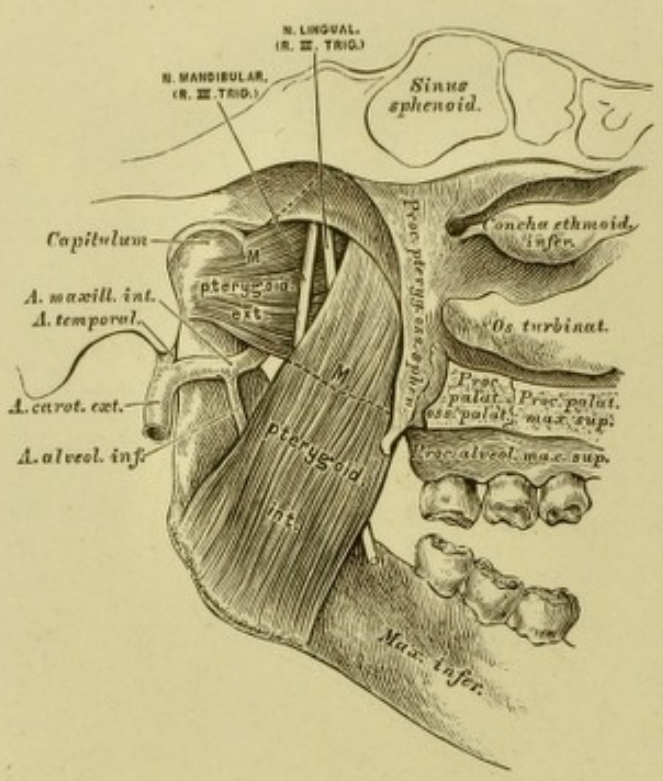
MM. incisivi Cowperi; two upper and two lower, arise from the alveolar processes of the incisor teeth (not illustrated).

M. buccinator. Orig.: Alveolar processes of both maxillary bones and *Hamulus pterygoid.* of the sphenoid bone. Insert.: Into the upper and lower lips, the central fibres intersecting each other.

M. orbicularis seu Sphincter oris; elliptic muscle closing the lips, formed by the muscles that converge to the mouth; besides, origins at the cartilage of the *Septum narium (M. depressor septi)* and in the region of the alveoli of the canine teeth *(MM. incisivi Cowperi).*

5. Muscles of the Ear (Fig. 203):

M. attolens auriculae, raises the ear
M. attrahens auriculae, draws the ear forwards } *Epicranius temporalis.*
MM. retrahentes auriculae, draw the ear backwards.



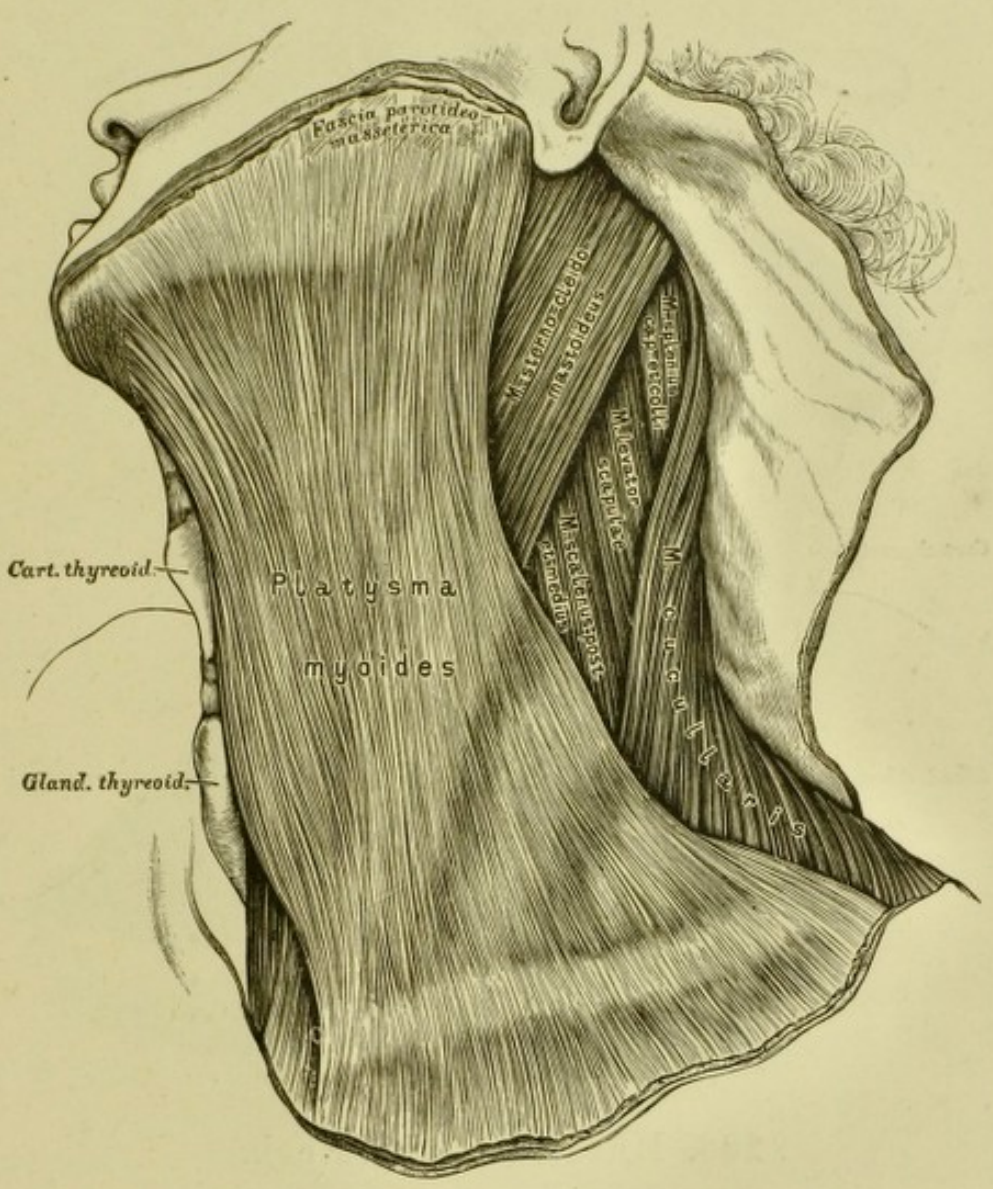
206. Muscles of the Lower Jaw (the Pterygoid Muscles), from inside.

M. temporalis, (Fig. 204). Orig.: From the whole of the temporal fossa and from the inner surface of the temporal fascia. Insert.: Below the zygomatic arch at the coronoid process of the lower jaw. (Elevator and retractor of the lower jaw.)

M. masseter (Fig. 204) has two portions, superficial and deep. Orig.: Zygomatic arch. Insert.: Outer surface of the ramus of the lower jaw as far as the angle. (Elevates the lower jaw and draws it forwards.)

M. pterygoideus internus. Orig.: Pterygoid fossa of the sphenoid bone. Insert.: Lower half of the inner side of the ramus of the lower jaw. (Elevates the lower jaw and draws it forwards and somewhat laterally.)

M. pterygoideus externus. Orig.: Outer surface of the external pterygoid plate and great wing of the sphenoid bone, tuberosity of the superior maxillary bone. Insert.: By a strong tendon at the neck of the condyle of the lower jaw, at the inner wall of the capsule and of the interarticular fibro-cartilage of the temporo-maxillary articulation. (Acting on both sides it draws the lower jaw forwards; acting on one side it draws it laterally.)



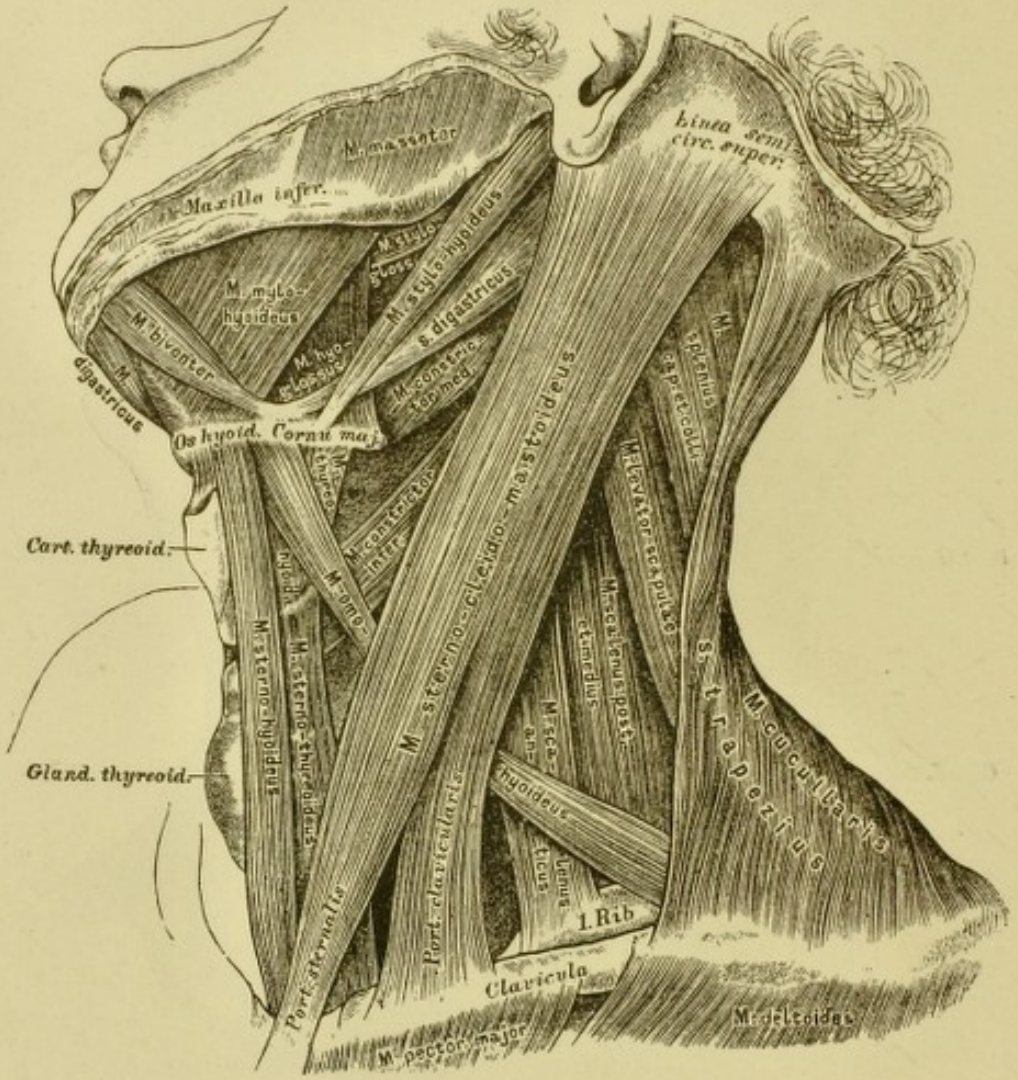
207. The Subcutaneous Muscle of the Neck.

Muscles of the Neck, which move the Head and Lower Jaw:

Platysma myoides (M. subcutaneus colli). Orig.: Subcutaneous connective tissue of the chest and *Fascia pectoralis* in the region of the second rib. Insert. of the inner bundles which cross each other: At the lower margin of the inferior maxillary bone; of the others: Into the *Panniculus adiposus* of the face and into the *Fascia parotideo-masseterica.* (Depresses the lower jaw, and raises the skin.)

M. sterno-cleido-mastoideus (Fig. 208). Orig. by two heads: From the *Manubrium sterni* and the sternal extremity of the clavicle. Insert.: Into the mastoid process and into the superior curved line of the occipital bone. (Each acting singly rotates and flexes the head; both acting together and taking their fixed point at the head, elevate the thorax; they also bend forwards the head and neck towards the sternum.)

M. biventer seu digastricus maxillae inferioris (Fig. 208). Orig. of the posterior belly: From the digastric groove at the mastoid process of the temporal bone; of the anterior belly: from the lower border of the lower jaw, the intervening tendon being attached to the hyoid bone. (Depressor of the lower jaw.)



208. Muscles of the Neck.

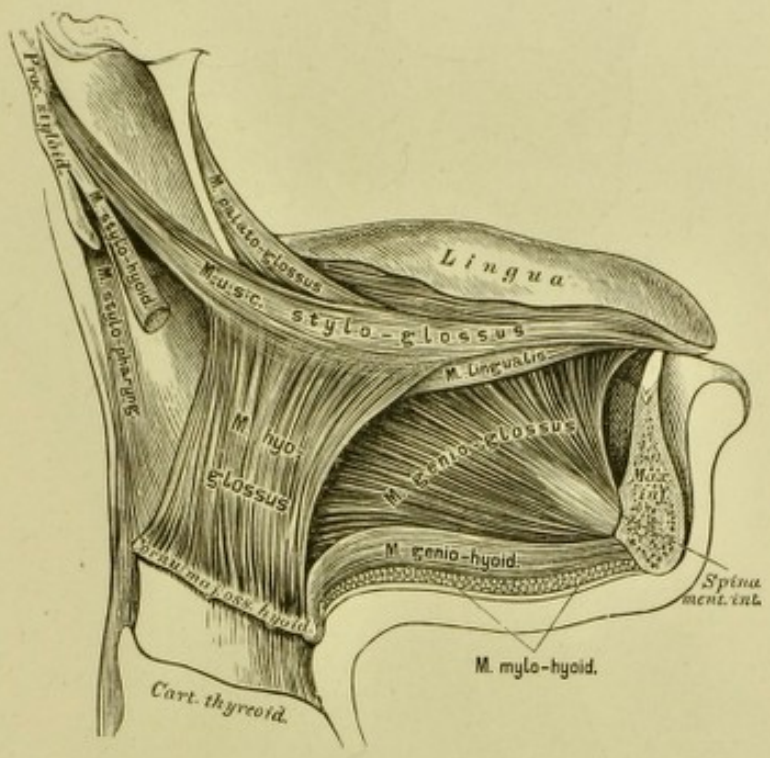
Muscles of the Hyoid Bone (Depressors of the Hyoid Bone):

M. omo-hyoideus. Orig.: From the upper border of the scapula near the suprascapular notch, or from the ligament which crosses the notch; it is a long ribbon-shaped muscle consisting of two bellies. Insert.: Into the body of the hyoid bone (Tensor of the cervical fascia).

M. sterno-hyoideus arises from the posterior surface of the *Manubrium sterni*, and is inserted into the body of the hyoid bone. Beneath this:

M. sterno-thyreoideus which arises from the posterior surface of the *Manubrium sterni* and the upper edge of the cartilage of the first rib, and is inserted at the side of the ala of the thyroid cartilage *(Inscriptio tendinea)*.

M. thyreo-hyoideus arises from the ala of the thyroid cartilage, and is inserted into the lower border of the hyoid bone (body and greater cornu).



209. The Muscles of the Tongue.

Muscles of the Hyoid Bone (Elevators of the Hyoid Bone):

M. stylo-hyoideus. Orig.: Base of the styloid process. Insert.: Into the upper border of the hyoid bone.

M. mylo-hyoideus (Fig. 208). Orig.: *Linea mylo-hyoidea* of the lower jaw. Insert. of the external fibres: Into the anterior surface of the body of the hyoid bone; of the internal: Into a median tendinous raphé.

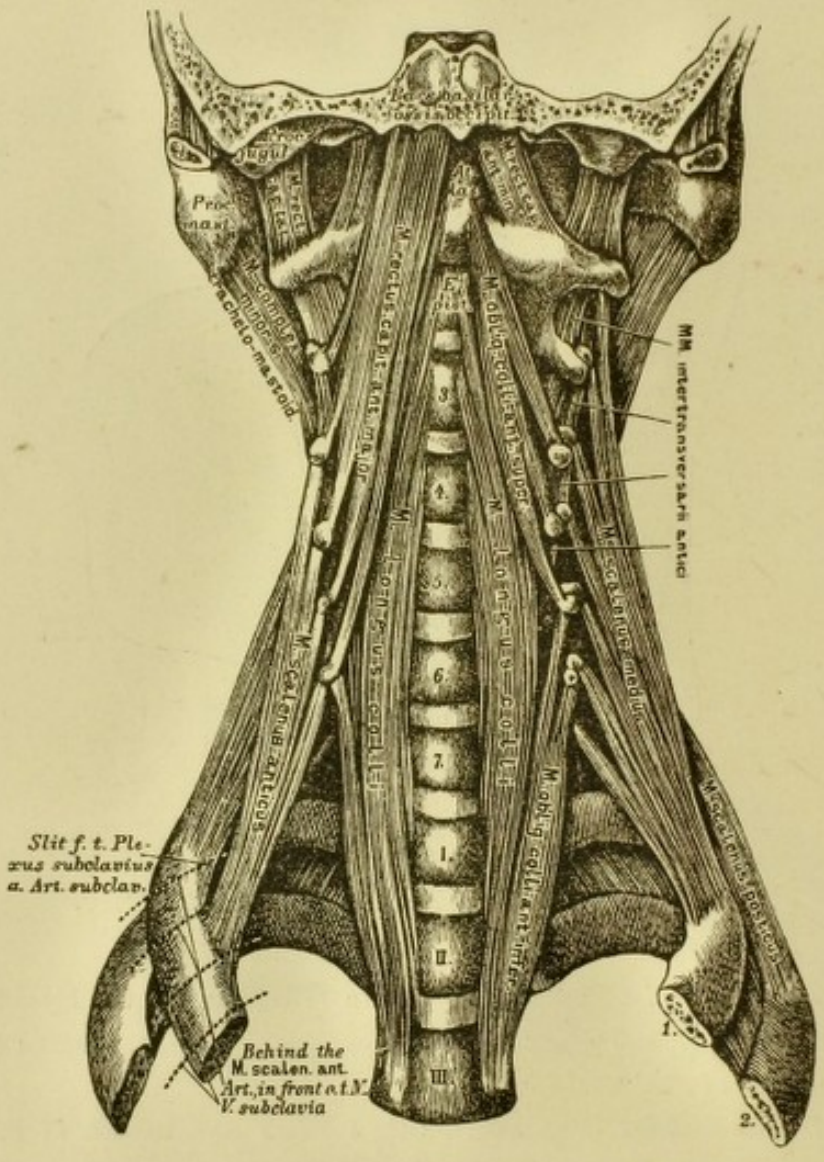
M. genio-hyoideus arises from the *Spina mentalis interna* (genial tubercle), and is inserted into the body of the hyoid bone.

Muscles of the Tongue:

M. genio-glossus seu genio-hyo-glossus. It arises from the *Spina mentalis interna* and is attached to the tongue and hyoid bone. (Depresses and protrudes the tongue.)

M. hyo-glossus. Orig.: From the upper border of the body, and of the greater and lesser cornua of the hyoid bone. Insert.: Into the posterior lateral border of the tongue. (Depresses the tongue.)

M. stylo-glossus. Orig.: Styloid process and stylo-maxillary ligament. Insert.: Into the side of the tongue. (Acting singly it draws the tongue laterally, acting on both sides it draws it backwards.)



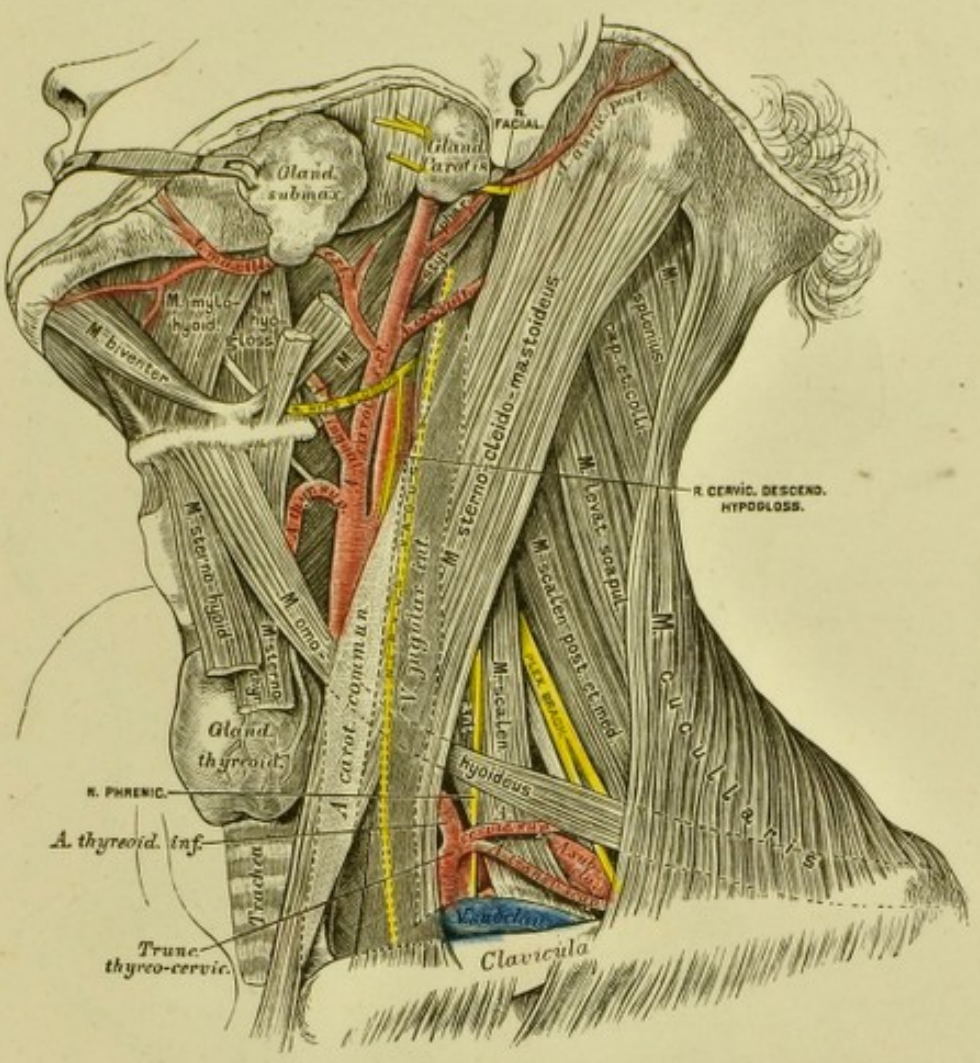
210. The Deep Muscles of the Neck.

Muscles of the Lateral Vertebral Region (taking their fixed point at the neck, they elevate the first and second ribs; taking their fixed point at the ribs, they act as lateral flexors of the neck and bend the neck forwards):

M. scalenus anticus arises from the transverse processes of the third to the sixth cervical vertebrae, and is inserted into the upper border of the first rib, at the *Tuberculum Lisfrancii.*

M. scalenus medius arises from the transverse processes of all seven cervical vertebrae, and is inserted into the upper border and external surface of the first rib.

M. scalenus posticus arises from the transverse processes of the fifth to the seventh cervical vertebrae and is inserted into the outer surface of the second rib.



211. Topographical Anatomy of the Neck.

Contents of the two triangles of the neck, the *Trigonum inframaxillare* and the *Trigonum supraclaviculare,* which are formed by the crossing of the *M. sterno-cleido-mastoideus* with the *M. omo-hyoideus.*

The deep anterior vertebral muscles of the neck (Fig. 210):

M. rectus capitis anticus major. Orig.: Transverse processes of the third to the sixth cervical vertebrae. Insert.: Inferior surface of the basilar process of the occipital bone.

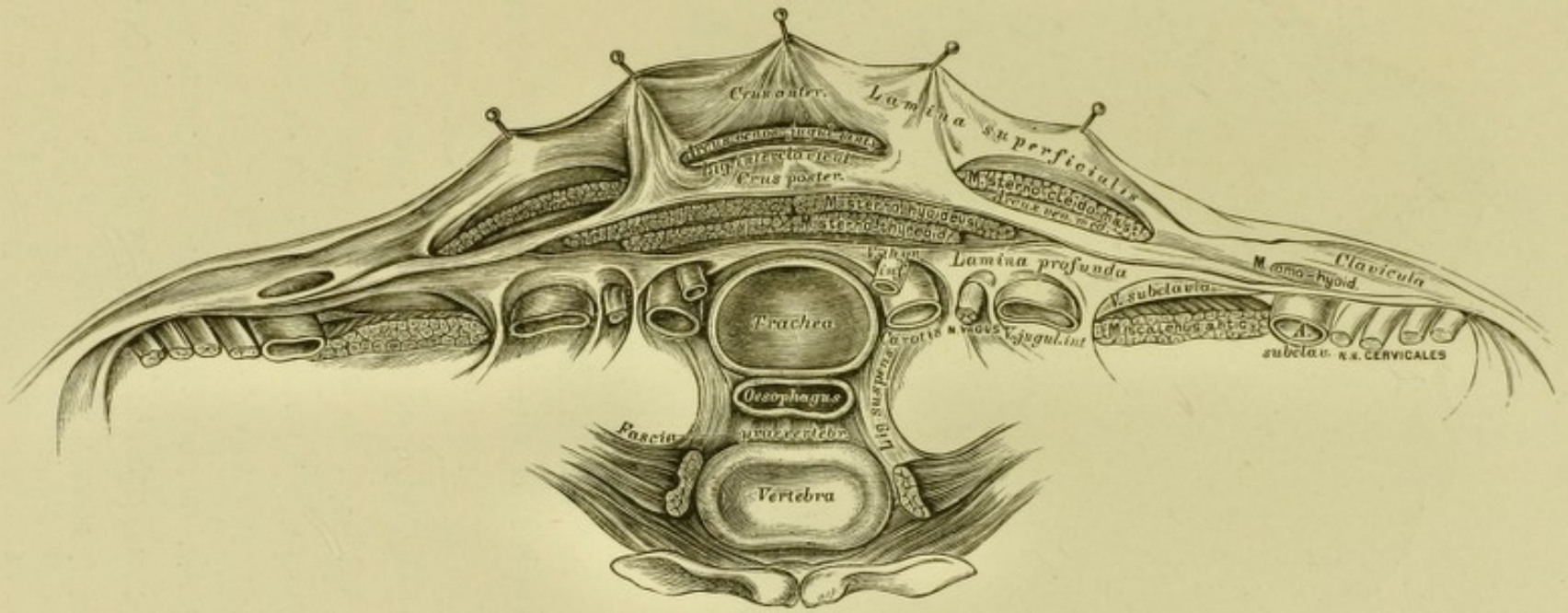
M. rectus capitis anticus minor. Orig.: Front of the root of the transverse process of the atlas. Insert.: Inferior surface of the basilar process. (Both flex the head.)

M. rectus capitis lateralis. Orig.: Transverse process of the atlas. Insert.: Jugular process of the occipital bone.

M. longus colli consists of three separate muscles: a) *M. longus colli rectus* which extends from the body of the third dorsal vertebra up to the body of the axis (flexor); b) *M. obliquus colli (anticus) inferior* which arises from the bodies of the second and third dorsal vertebrae, and is inserted into the transverse processes of the fifth to the seventh cervical vertebrae (rotator); c) *M. obliquus colli (anticus) superior* which arises from the transverse processes of the third and fourth cervical vertebrae and is inserted into the anterior tubercle of the atlas (rotator).

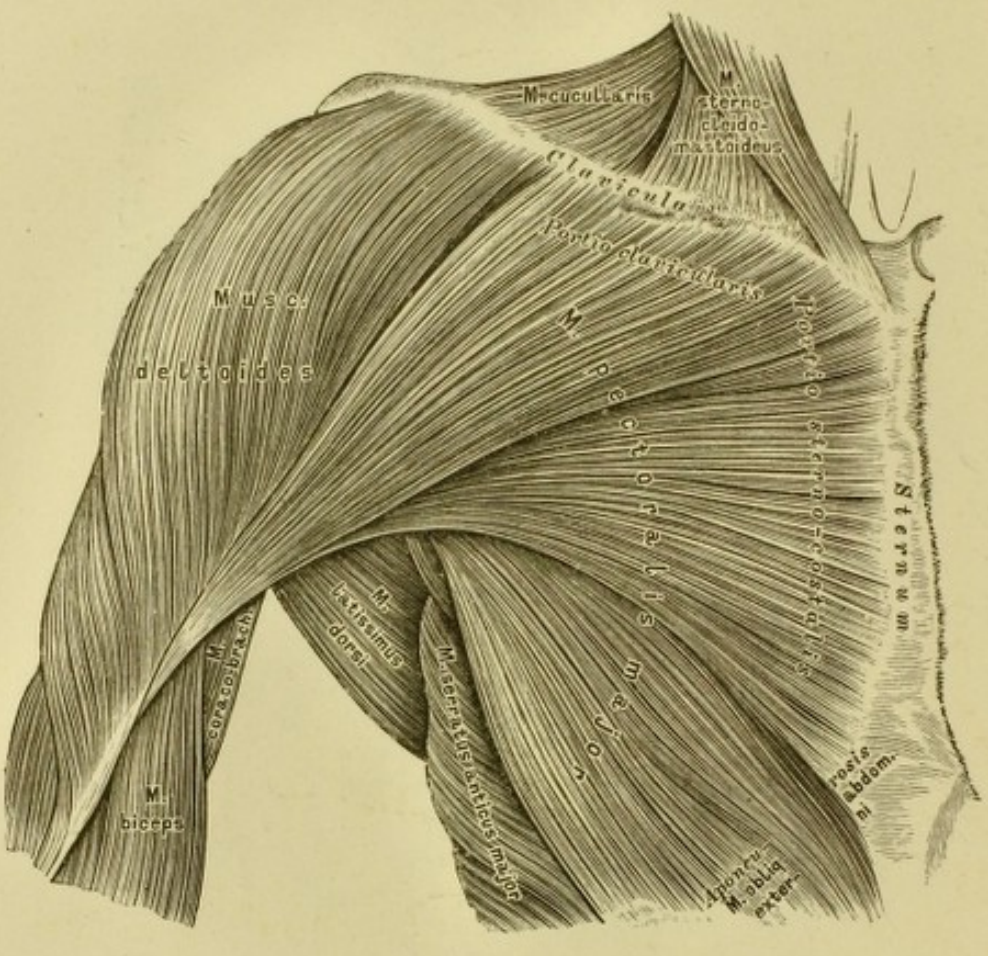
212. The Cervical Fascia. Superficial Layer.

The superficial layer of the cervical fascia (below the *Platysma myoides*) covers the *MM. sterno-cleido-mast., sterno-hyoid., sterno-thyreoid., thyreo-hyoid.* and the anterior belly of the *Omo-hyoid.*, is continued superiorly into the *Fascia parotideo-masseterica*, and is attached above to the lower border of the lower jaw, and below to the *Manubrium sterni* and *Lig. interclaviculare*. The deep layer (Fig. 213) forms the floor of the *Trig. inframaxill.* and *supraclavicul.*, covers the posterior belly of the *Omo-hyoideus*, forms sheaths for the large vessels (the *Nerv. vagus* has no separate sheath) and divides into two layers. One forms the praevertebral fascia behind the pharynx and oesophagus; the other extends in front of the thyroid gland and the trachea to the median line, and at the root of the neck may be traced over the large vessels, to be continuous with the fibrous layer of the pericardium.



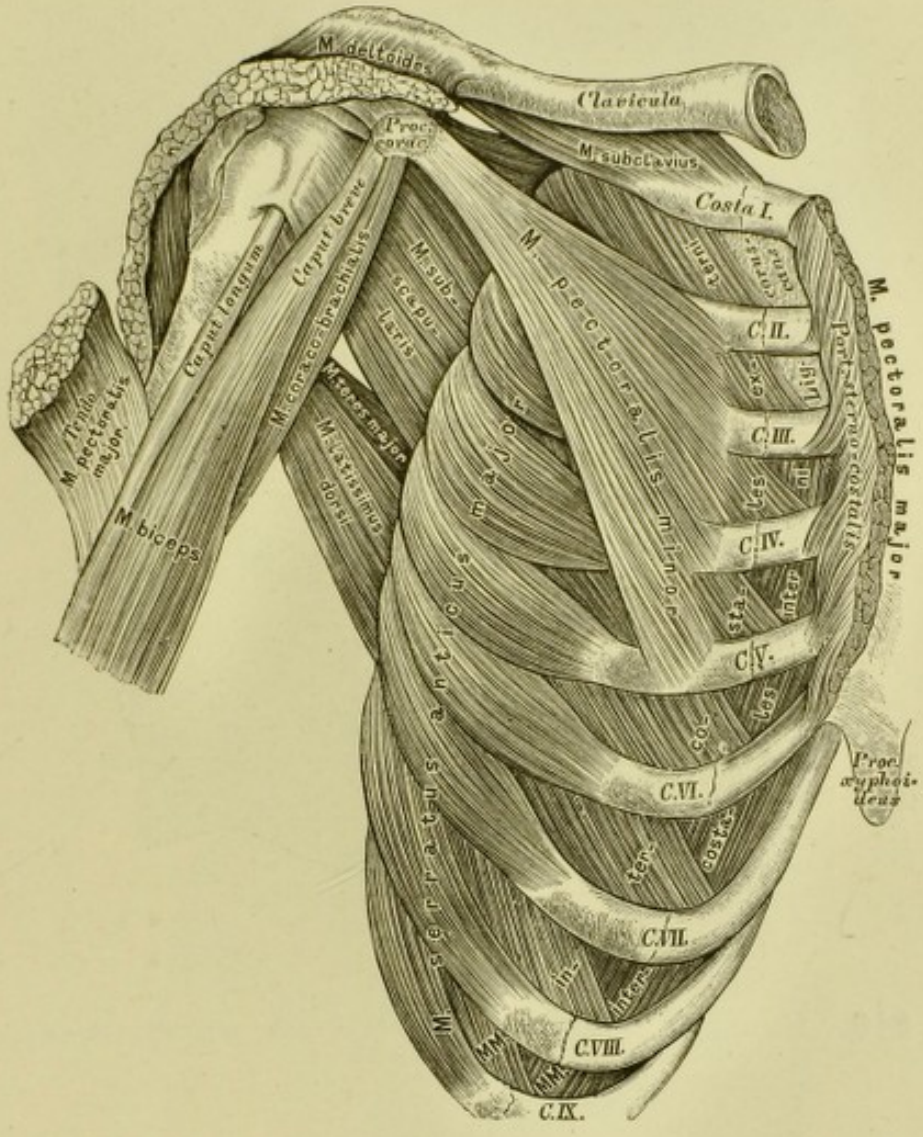
213. Horizontal Section in the Region of the Sixth Cervical Vertebra.

After L. Dittel.



214. Muscles of the Thorax. First Layer.

M. pectoralis major. Orig.: Of the clavicular portion from the sternal extremity of the clavicle; of the sterno-costal portion from the anterior surface of the sternum and the cartilages of the six upper true ribs (Fig. 215), frequently also from the aponeurosis of the external oblique muscle of the abdomen. Insert. by a flat tendon two inches broad: Into the anterior bicipital ridge *(Spina tuberculi majoris)* of the humerus. (Depresses the arm and draws it forwards.)



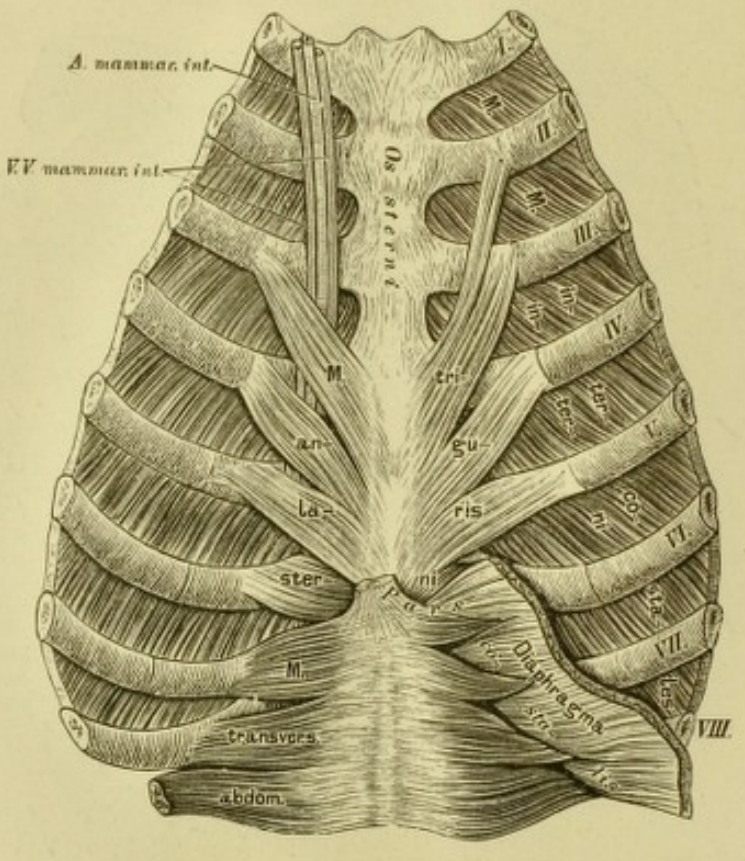
215. Muscles of the Thorax. Second and Third Layers.

Second Layer:

M. subclavius arises from the under surface of the clavicle, and is inserted into the upper border of the first costal cartilage. (Depresses the clavicle and acts as support to the sterno-clavicular articulation.)

M. pectoralis minor arises by three or four tendinous slips from the outer surface of the second to the fifth ribs, being inserted into the coracoid process of the scapula. (Depresses the shoulder, elevates the ribs.)

M. serratus anticus major s. serratus magnus arises by eight or nine fleshy digitations from the outer surface of the eight or nine upper ribs, and is inserted into the inner border of the scapula (see Fig. 223). (The ribs being fixed it draws the scapula forwards; it also helps in supporting weights upon the shoulder.)



216. *Musculus triangularis sterni seu sterno-costalis.*

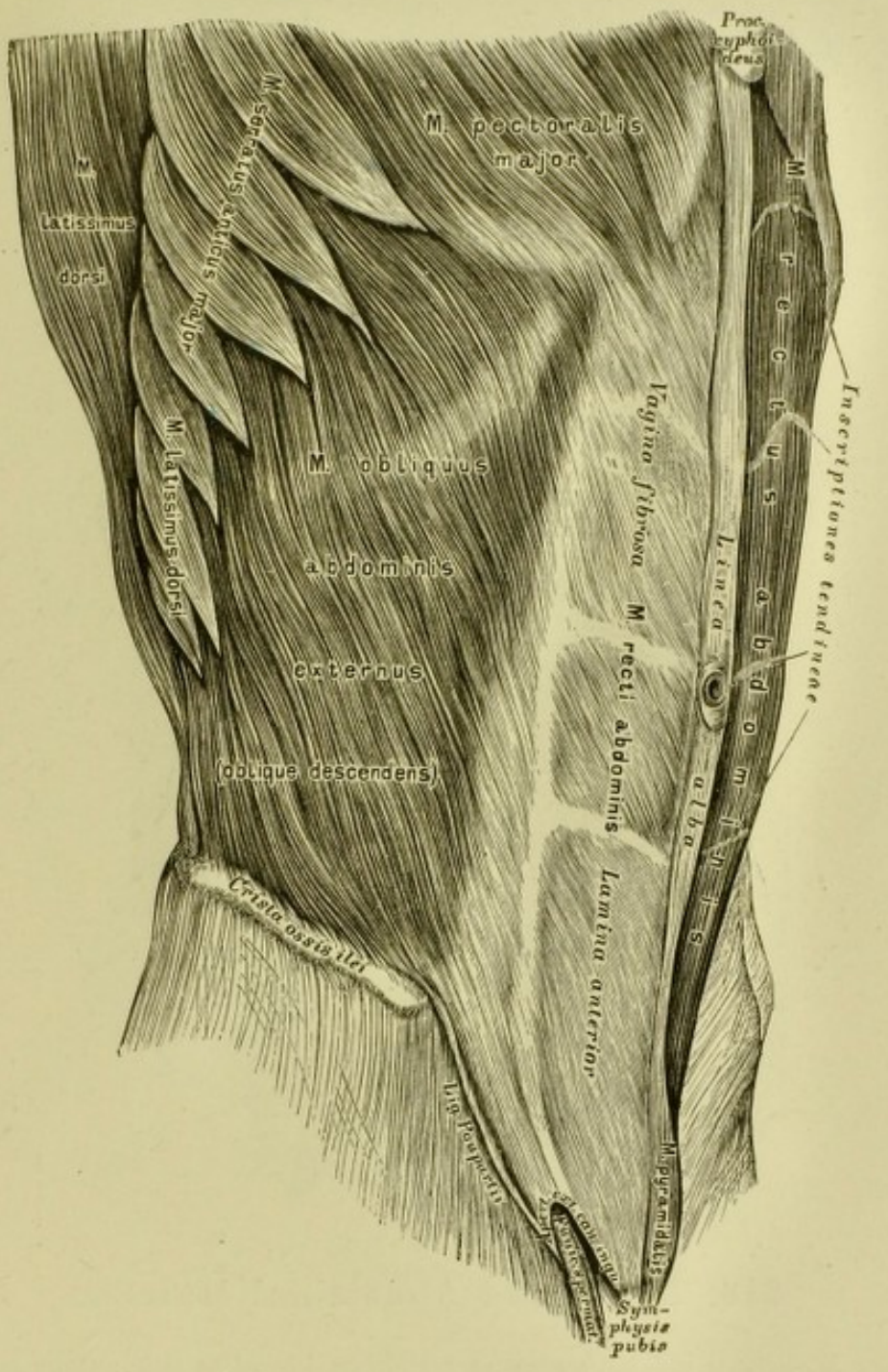
The Thoracic Muscles, third Layer:

Musculi intercostales externi. Orig.: Lower borders of the eleven upper ribs. Insert.: Each into the upper border of the rib below up to the commencement of the costal cartilages; beyond these points at which the muscles cease, the spaces are occupied by the aponeurotic *Ligamentum coruscans.*

Musculi intercostales interni. Orig.: Lower borders of the eleven upper ribs and costal cartilages. Insert.: Each into the upper border of the rib below throughout its entire length.

M. triangularis sterni at the posterior surface of the sternum and the costal cartilages. Orig.: Xiphoid appendix and body of the sternum. Insert.: By fleshy digitations into the posterior surface of the third to the sixth costal cartilages.

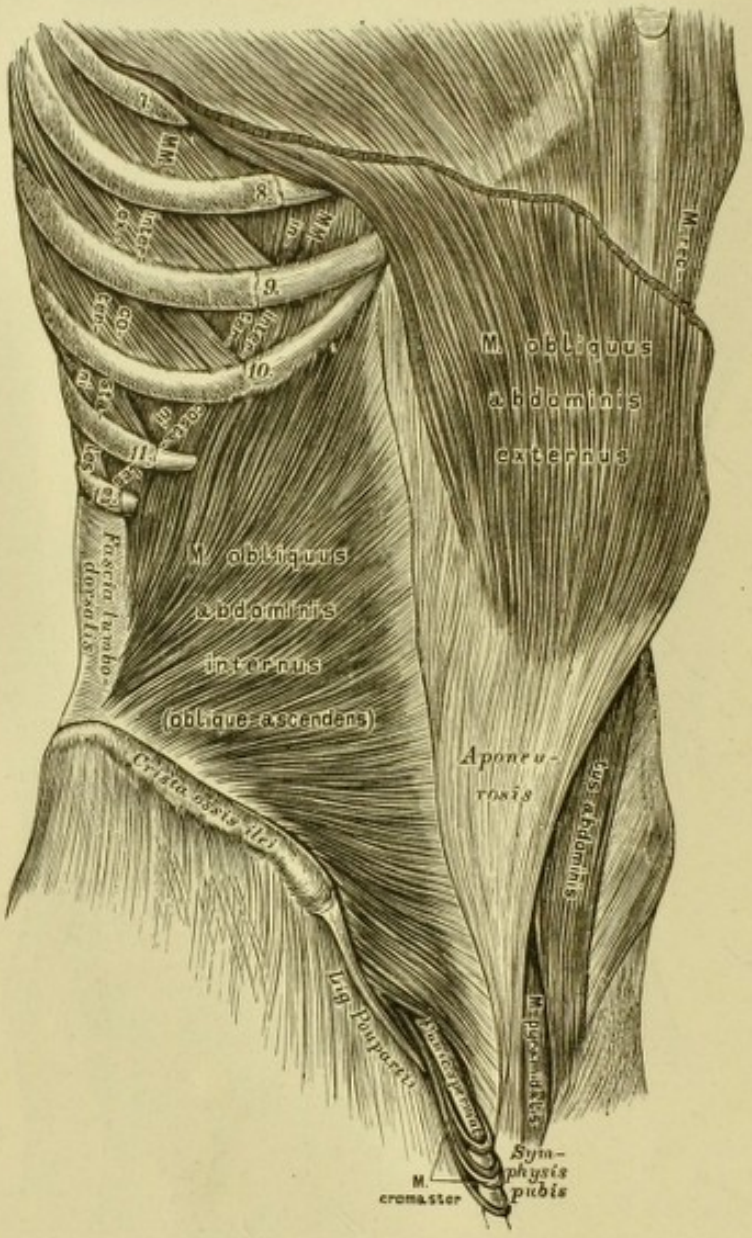
All these muscles act in respiration.



217. The Long Abdominal Muscles.

M. rectus abdominis arises from the outer surface of the cartilages of the fifth to the seventh ribs and the xiphoid appendix, being inserted into the upper border and anterior surface of the *Symphisis pulis*. The fibrous sheath of the *Rectus abdominis* formed by the aponeuroses of the broad abdominal muscles, covers the whole of its anterior surface, while on its posterior surface it ends two or three fingers breadth below the umbilicus as *Linea semicircularis Douglasii* (semi-lunar fold of Douglas) (see Fig. 219).

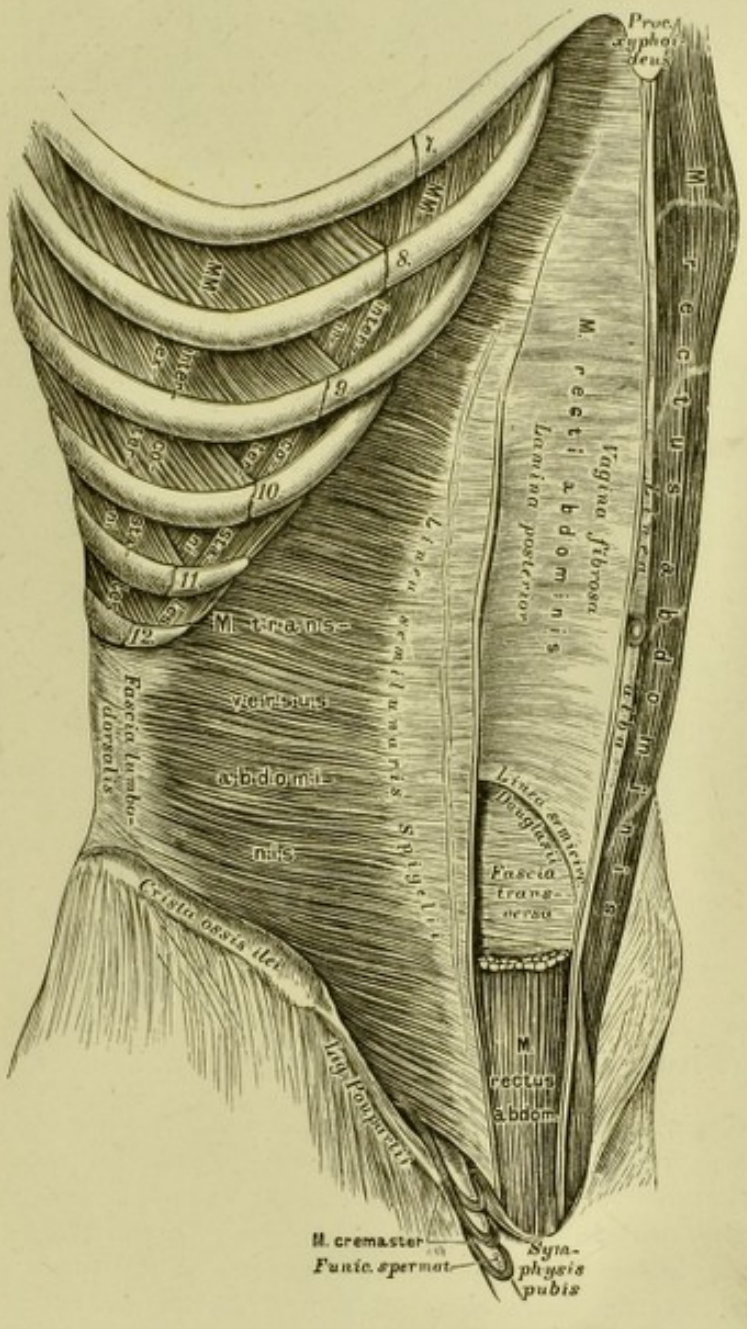
M. pyramidalis abdominis arises from the upper border of the pubis and is inserted into the fibrous sheath *(Vagina fibrosa)* of the *Rectus abdominis*.



218. The Broad Abdominal Muscles.

M. obliquus abdominis externus seu oblique descendens. Orig.: Outer surface of the seven or eight lower ribs. Insert.: External lip of the crest of the ilium and into a broad aponeurosis which is attached at the *Ligamentum Poupartii* and extends in front of it as fibrous sheath of the *Rectus abdominis* to the *Linea alba*. In the aponeurosis, one inch external to the *Symphisis pubis* is a triangular opening, the external abdominal ring. *(Apertura externa canalis inguinalis.)*

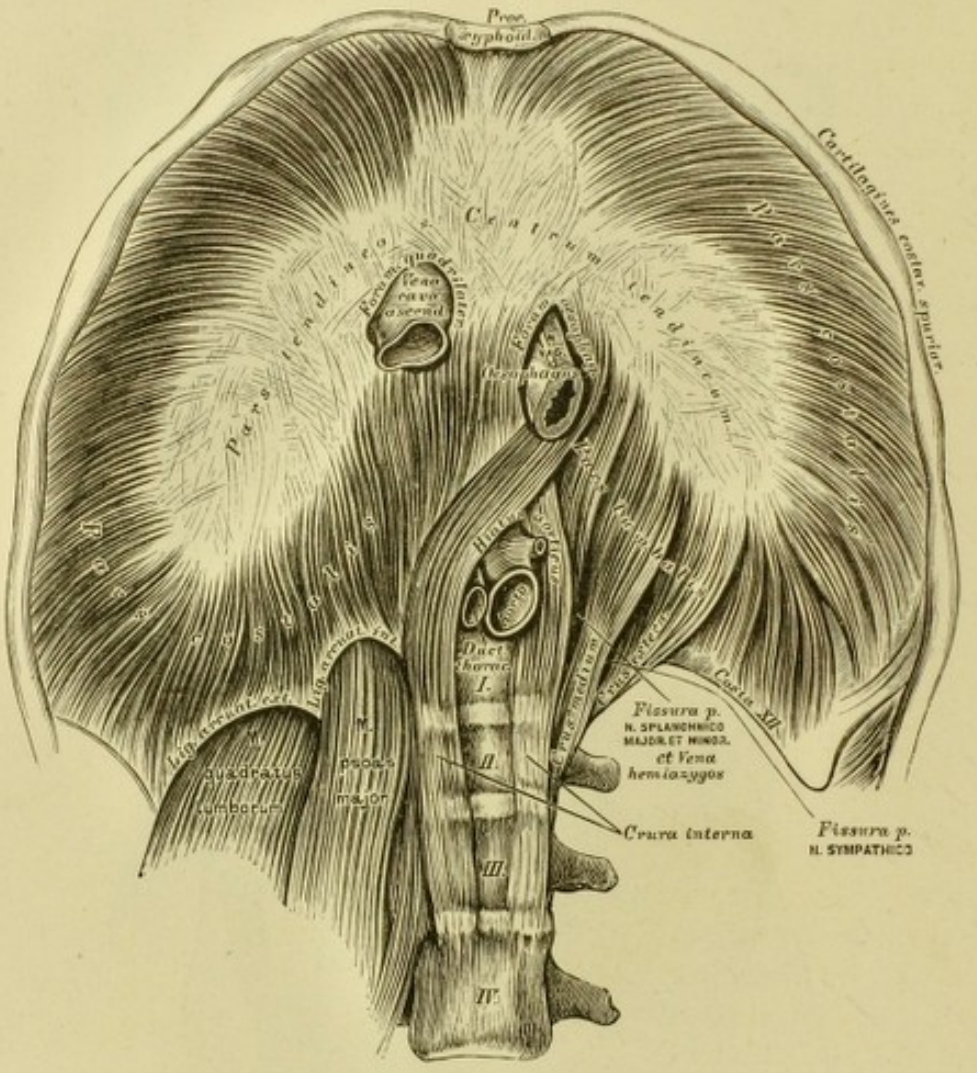
M. obliquus abdominis internus seu oblique ascendens. Orig.: Middle lip of the crest of the ilium, anterior superior spine, and outer half of Poupart's ligament; it ends in an aponeurosis which divides into two lamellae, of which the one in front of the rectus is spread along the whole length of the abdominal wall, while the posterior lamella only reaches to the *Linea Douglasii*. From the lower border of this muscle and the *Transversus abdominis* bundles of muscle fibres run in loops down to the spermatic cord — *Musculus cremaster*.



219. The Broad Abdominal Muscles.

M. transversus s. transversalis abdominis. Orig.: From the inner surface of the seventh to the twelfth costal cartilages, lower lamella of the *Fascia lumbodorsalis,* internal lip of the crest of the ilium and outer half of Poupart's ligament. Insert.: Into an aponeurosis, curved as *Linea semilunaris Spigelii;* the aponeurosis strengthens above the posterior wall, below the anterior wall of the fibrous sheath of the *Rectus abdominis.*

M. quadratus lumborum (see Fig. 225). Orig.: Posterior portion of the crest of the ilium, fifth lumbar vertebra and *Lig. ileo-lumbale.* Insert.: Transverse processes of the four upper lumbar vertebrae and lower border of the twelfth rib.



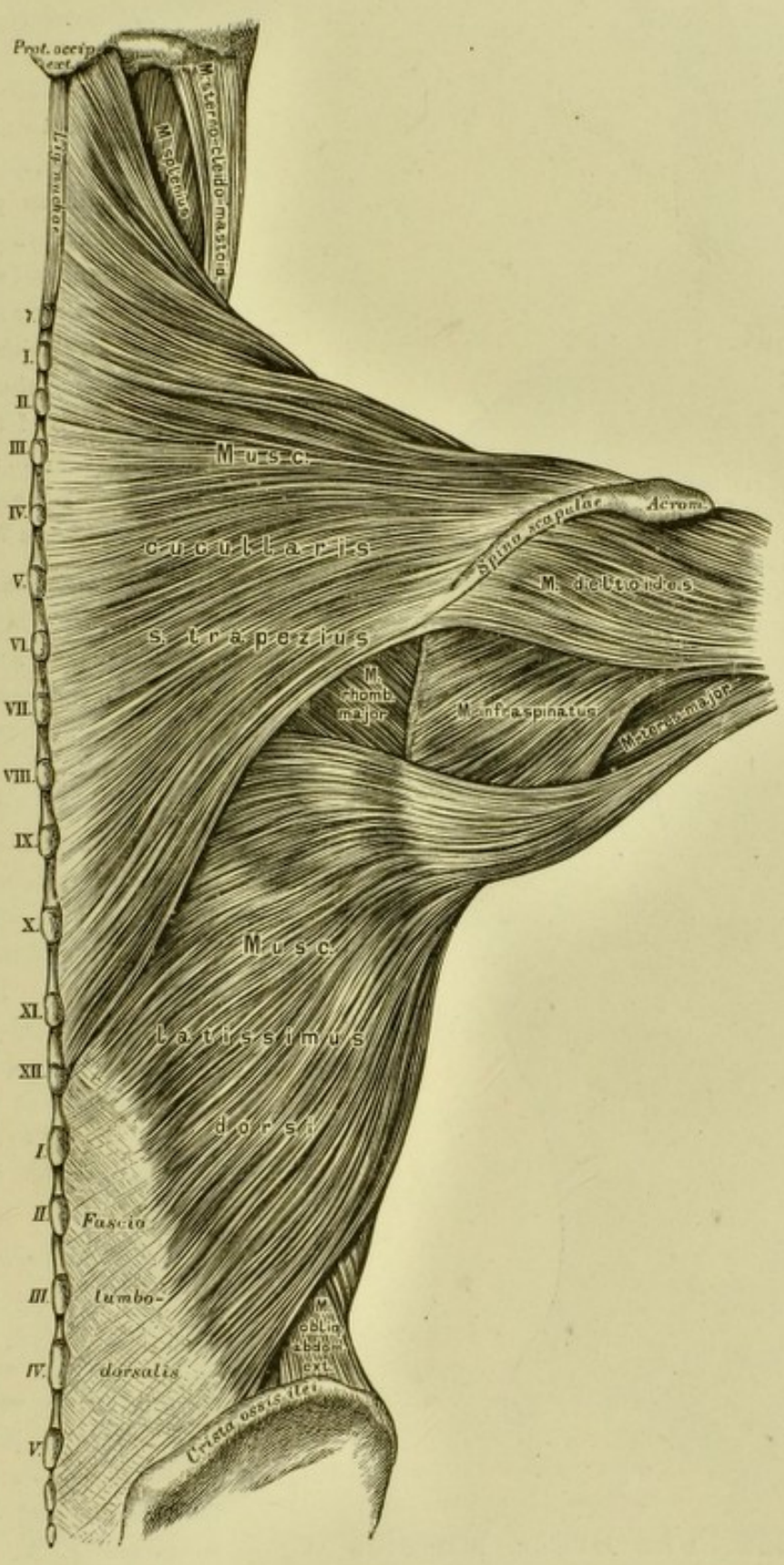
220. The Diaphragm, *Diaphragma.* Under Surface.

The diaphragm consists of a muscular portion, *Pars muscularis*, and a tendinous portion, *Pars tendinea.*

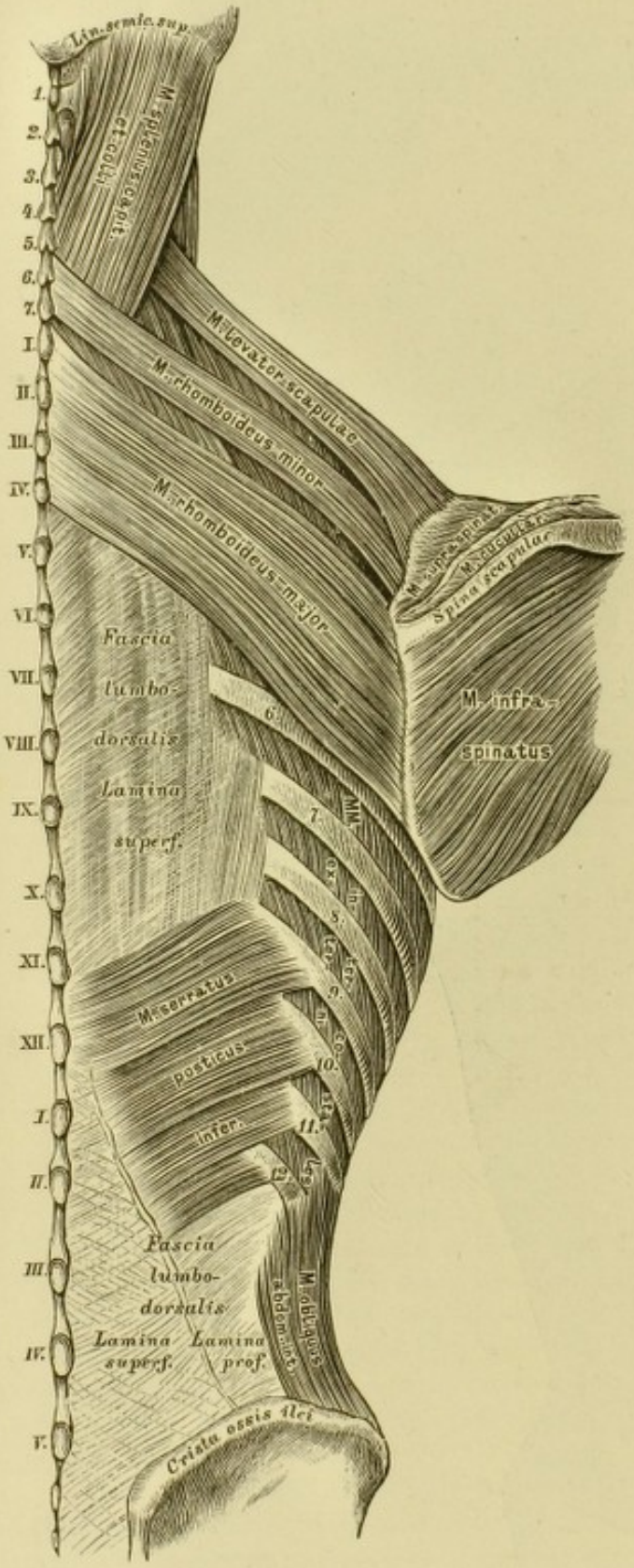
The *Pars muscularis* is divided into the *Pars lumbalis*, and the *Pars costalis.*

The *Pars lumbalis* is formed by three pairs of crura. The inner pair, *Crura interna*, arises from the anterior surface of the third and fourth lumbar vertebrae; the crura cross once to form the aortic opening, *Hiatus aorticus*, then a second time, whereby the oesophageal opening, *Foramen oesophageum*, is formed. The middle pair of crura arises from the lateral region of the second lumbar vertebra; the outer pair of crura from the lateral region and the transverse processes of the first lumbar vertebra.

The *Pars costalis* arises from the six or seven lower ribs, the xiphoid appendix (see Fig. 216) and the *Ligamenta arcuata Halleri.* The *Pars muscularis* is continued into the *Pars tendinea seu Centrum tendineum* (central or cordiform tendon), which is shaped somewhat like a trefoil leaf, and has in its right leaflet the quadrilateral *Foramen venosum seu quadrilaterum* (opening for the *Vena cava*).



221. The Broad Muscles of the Back.

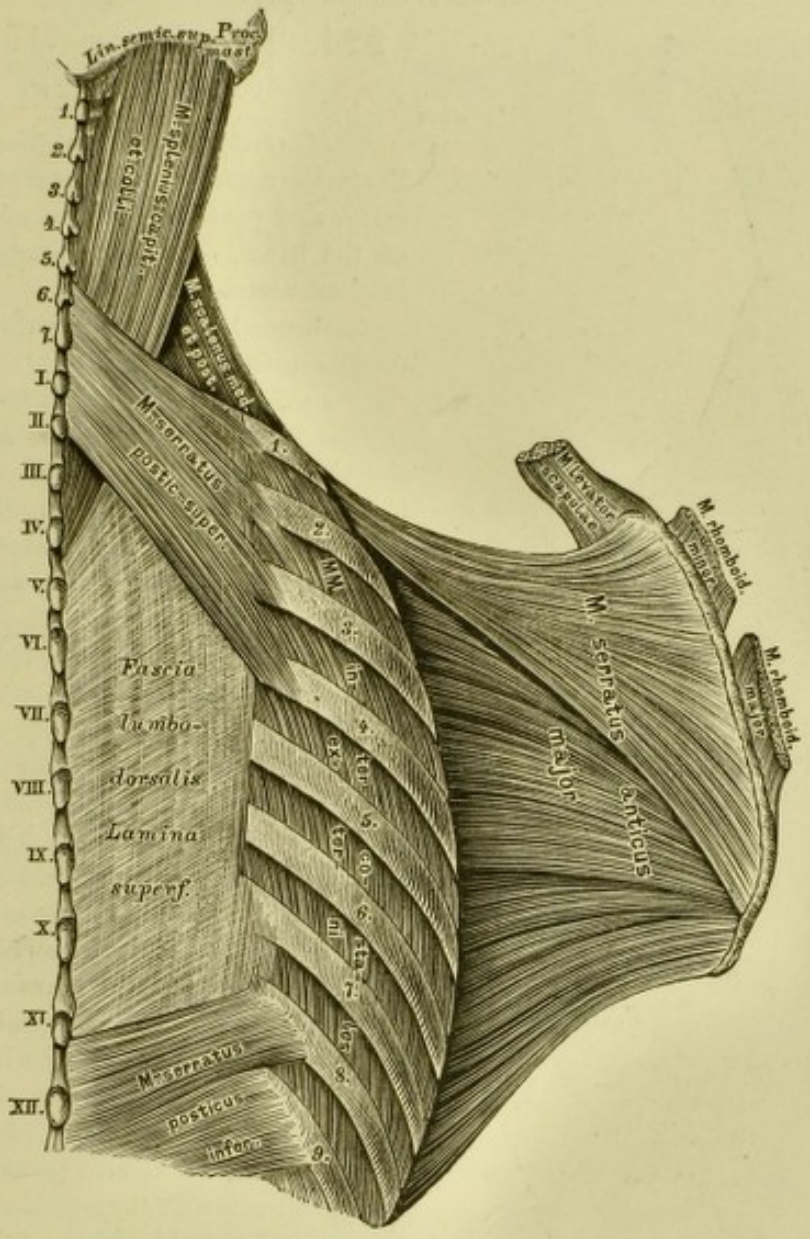


222. The Broad Muscles of the Back.

M. cucullaris seu trapezius (see Fig. 221). Orig.: Superior curved line, external protuberance of the occipital bone, *Ligamentum nuchae*, spinous processes of the seventh cervical and all the dorsal vertebrae and supraspinous ligament. Insert.: Posterior border of the spine of the scapula, inner border of the acromion process and acromial extremity of the clavicle. (Rotator of the scapula.)

M. latissimus dorsi, the broadest muscle of the back (see Fig. 221). Orig.: By an aponeurosis *(Fascia lumbo-dorsalis)* from the spinous processes of the four or six lower dorsal, and of all the lumbar and sacral vertebrae, from the external lip of the crest of the ilium and the lowest ribs. Insert.: Posterior bicipital ridge *(Spina tuberculi minoris)* of the humerus, adherent to the tendon of the *M. teres major*. (Draws the humerus backwards.)

MM. rhomboideus major et minor. Orig.: Spinous processes of the two inferior cervical and four upper dorsal vertebrae. Insert.: Into the inner border of the scapula. (Rotate the scapula and draw it backwards.)



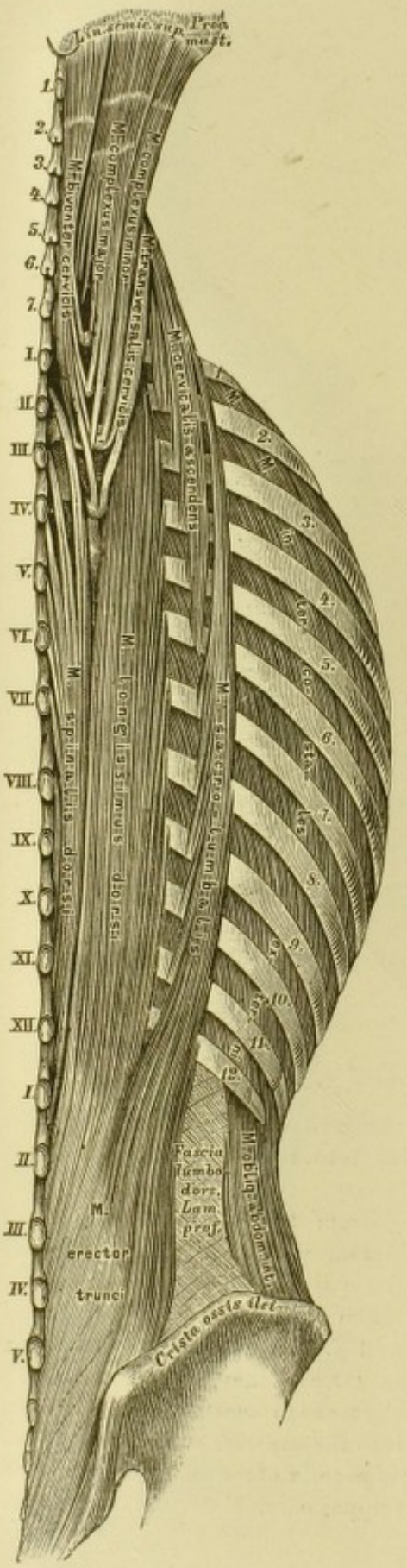
223. The Broad Muscles of the Back.

M. levator scapulae arises from the transverse processes of the four upper cervical vertebrae, and is inserted into the inner superior angle of the scapula. (Raises this angle.)

M. serratus posticus superior arises from the spinous processes of the 6. and 7. cervical and I. and II. dorsal vertebrae, and is inserted into the 2.—5. ribs. (Elevates the ribs.)

M. serratus posticus inferior arises from the *Fascia lumbo-dorsalis* in the region of the XI. and XII. dorsal and I. and II. lumbar vertebrae, and is inserted into the 8. to the 12. ribs. (Draws these ribs downwards.)

M. splenius capitis et colli arises from the spinous processes of the 3. cervical to the IV. dorsal vertebrae, being inserted into the superior curved line of the occipital bone, posterior border of the mastoid process of the temporal bone, and the transverse processes of the two or three upper cervical vertebrae. (Rotates the head and neck.)



224. The Long Muscles of the Back.

M. erector trunci seu spinae. Orig.: Posterior surface of the sacrum, tuberosity, and posterior portion of the crest of the ilium, spinous processes of the lumbar vertebrae.

Opposite the last rib this muscle divides into the:

a) *M. sacrolumbalis* which is attached by twelve tendinous slips into the twelve ribs; from the six or seven lower ribs accessory bundles arise *(M. accessorius ad sacro-lumbalem)*. The analogous bundles of the five or six upper ribs unite to form the *M. cervicalis ascendens,* which is inserted into the transverse processes of the 6.—4. cervical vertebrae.

b) *M. longissimus dorsi* which is attached by ten tendinous slips at the tubercles of the ribs (except the I. and XII.) and the transverse processes of the dorsal vertebrae. Its continuation is the *M. transversalis cervicis;* this muscles arises from the transverse processes of the four upper dorsal and two lower cervical vertebrae, and is inserted into the transverse processes of the five upper cervical vertebrae. (Acting on both sides they extend the spinal column, acting on one side they produce lateral flexion and rotation of the column.)

MM. levatores costarum (Fig. 225). Orig.: Transverse processes of the 7. cervical to the XI. dorsal vertebrae. Insert.: Each to the rib below. At the lower ribs are the *Levatores costarum longi,* which are inserted in the second rib below their origin.

M. biventer cervicis. Orig.: By three or four tendinous slips from the transverse processes of the upper dorsal vertebrae; the middle of the muscle is tendinous; above the 6. cervical vertebra it again becomes fleshy *(Inscriptio tendinea)* and is inserted below the superior curved line of the occipital bone. (Draws the head backwards.)

225. The Long Muscles of the Back.

M. complexus major (Fig. 224) arises by seven tendinous slips from the transverse processes of the four lower cervical and three upper dorsal vertebrae and the articular processes of the 3.—6. cervical vertebrae; *Inscriptiones tendineae.* It is inserted between the superior and inferior curved lines of the occipital bone. (Draws the head backwards.)

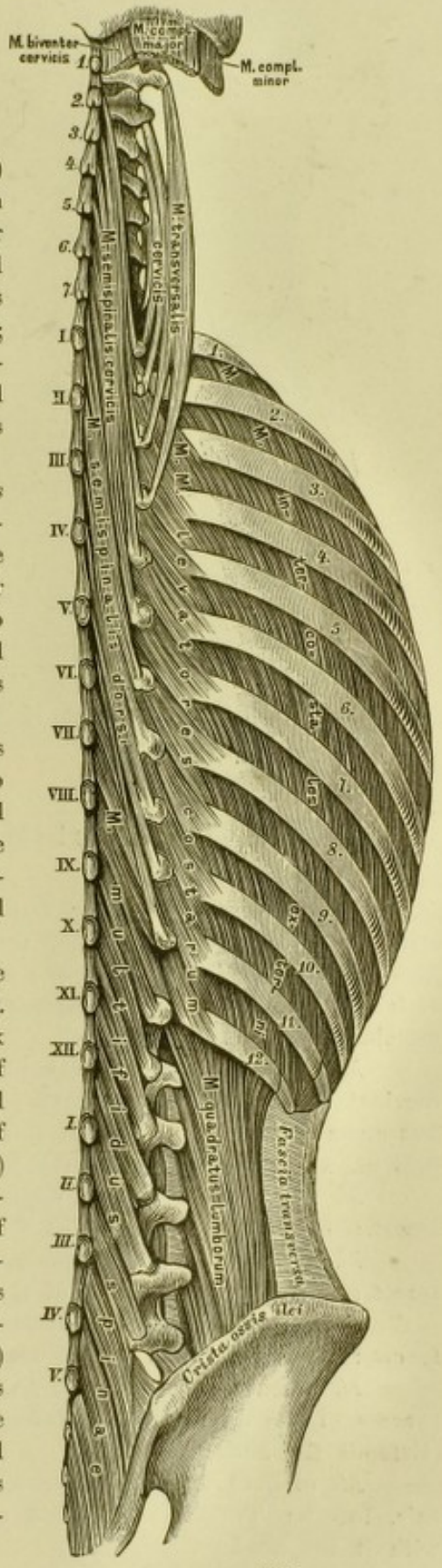
M. trachelo-mastoideus s. complexus minor (Fig. 224) arises from the transverse and articular processes of the four lower cervical and three upper dorsal vertebrae, and is inserted into the posterior margin of the mastoid process. (Draws the head backwards and rotates it.)

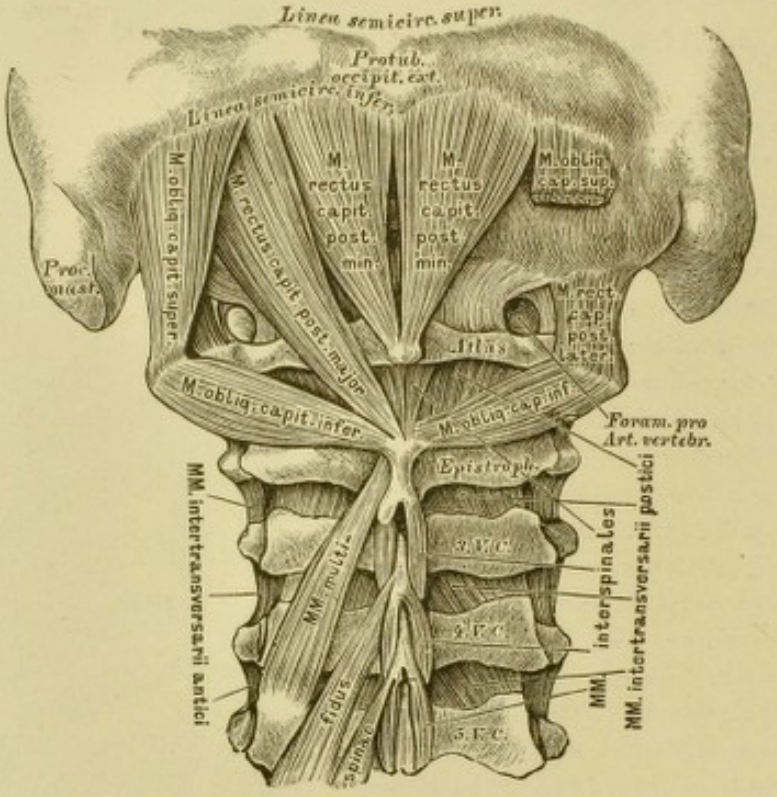
M. spinalis dorsi (Fig. 224) arises from the spinous processes of the two upper lumbar and three lower dorsal vertebrae, and is inserted into the spinous processes of the VIII.—II. dorsal vertebrae. (Extends the spinal column and head.)

M. semispinalis dorsi arises from the transverse processes of the VI.—XI. dorsal vertebrae. It is inserted by six tendons into the spinous processes of the 7. cervical and five upper dorsal vertebrae. (Produces lateral flexion of the spinal column and rotates it.)

M. spinalis cervicis s. colli (not illustrated) arises from the spinous processes of the lower cervical and upper dorsal vertebrae, and is inserted into the spinous processes of the upper cervical vertebrae, excepting the atlas. (Extends.)

M. semispinalis cervicis s. colli arises from the transverse processes of the upper dorsal vertebrae, being inserted by four tendinous slips into the spinous processes of the 2.—5. cervical vertebrae.





226. The Short Muscles of the Back.

M. multifidus spinae (Fig. 225). Orig.: Articular and transverse processes of lower vertebrae. Insert.: Spinous processes of upper vertebrae.

MM. interspinales. With the exception of the III. to the X. dorsal vertebrae, these are placed between the spinous processes of contiguous vertebrae.

MM. intertransversarii, each between two transverse processes; at the cervical and lumbar vertebrae they are double on both sides, *MM. intertransversarii antici et postici;* at the upper dorsal vertebrae they are not present, at the lower on both sides single.

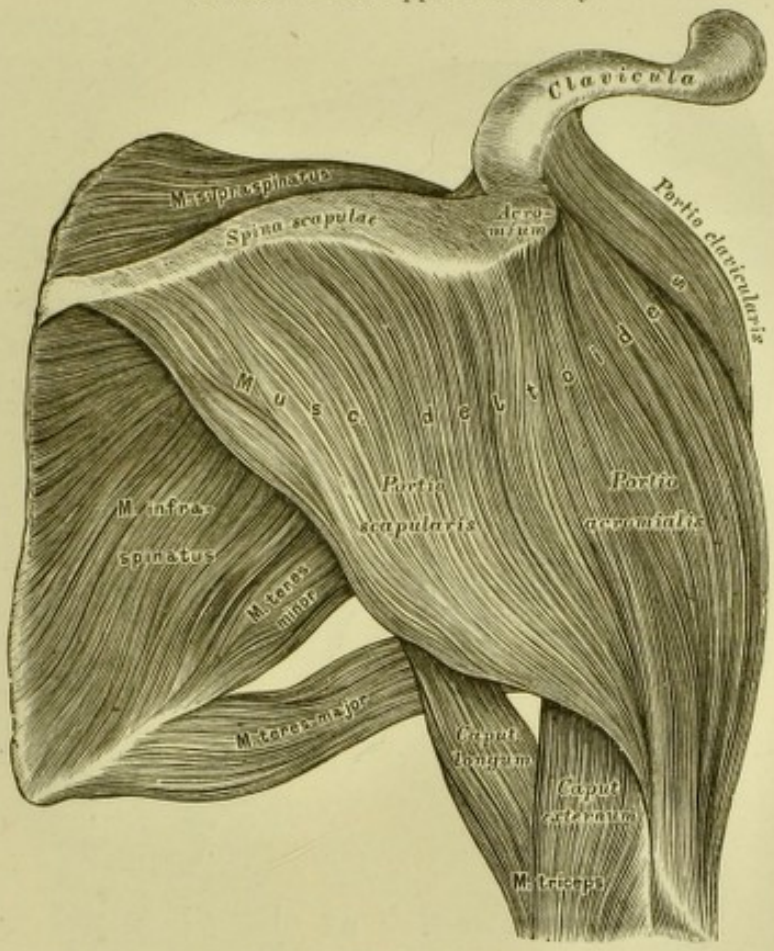
M. rectus capitis posticus major. Orig.: Spinous process of the axis. Insert.: Inferior curved line of the occipital bone. (Extends the head.)

M. rectus capitis posticus minor. Orig.: Posterior tubercle of the atlas. Insert.: Inferior curved line of the occipital bone. (Extends the head.)

M. rectus capitis posticus lateralis. Orig.: Lateral portion of the atlas. Insert.: Jugular process of the occipital bone.

M. obliquus capitis superior s. minor. Orig.: Summit of the transverse process of the atlas. Insert.: Inferior curved line of the occipital bone. (Extends the head.)

M. obliquus capitis inferior s. major. Orig.: Spinous process of the axis. Insert.: Transverse process of the atlas. (Rotates the atlas and with it the head.)



227. The Muscles at the Shoulder.

M. deltoides. The clavicular or anterior portion arises from the acromial extremity of the clavicle; the acromial or middle portion from the acromion process; the scapular or posterior portion from the spine of the scapula. It is inserted into the tuberosity on the middle of the outer surface of the humerus. (Raises the arm.)

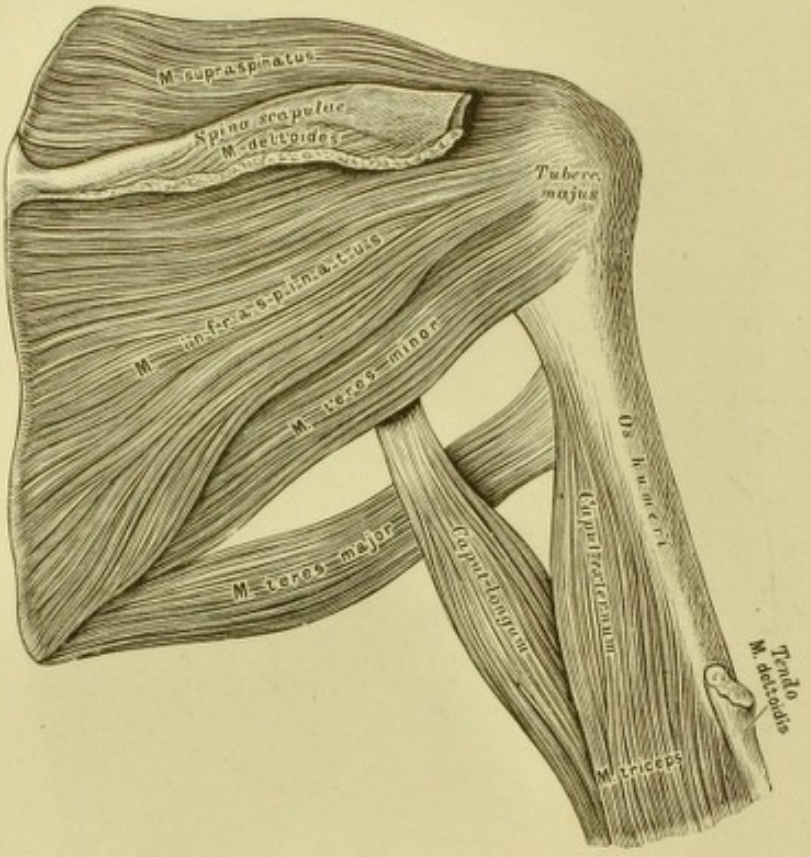
Rotators outwards: a) *M. supraspinatus* (Fig. 228) arises from the supraspinous fossa of the scapula and is inserted into the great tuberosity of the humerus. (Raises the arm and rotates it outwards.)

b) *M. infraspinatus* (Fig. 228) arises from the infraspinous fossa of the scapula, and is inserted into the great tuberosity of the humerus. (Rotates the arm outwards and draws it downwards.)

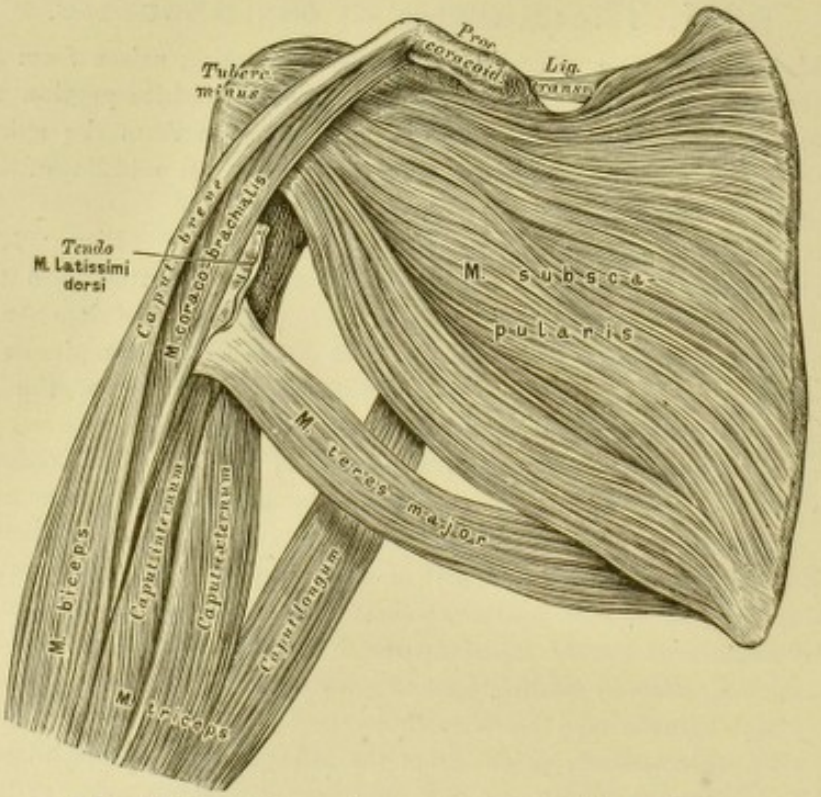
c) *M. teres minor* (Fig. 228) arises from the upper two thirds of the axillary border of the scapula. It is inserted into the great tuberosity of the humerus. (Rotates the arm outwards and draws it downwards.)

Rotators inwards: a) *M. teres major* (Fig. 228) arises from the lower portion of the axillary border of the scapula, and is inserted near the tendon of the *M. latissimus dorsi* into the posterior bicipital ridge *(Spina tuberculi minoris)* of the humerus. (Rotates the humerus inwards and draws it downwards and backwards.)

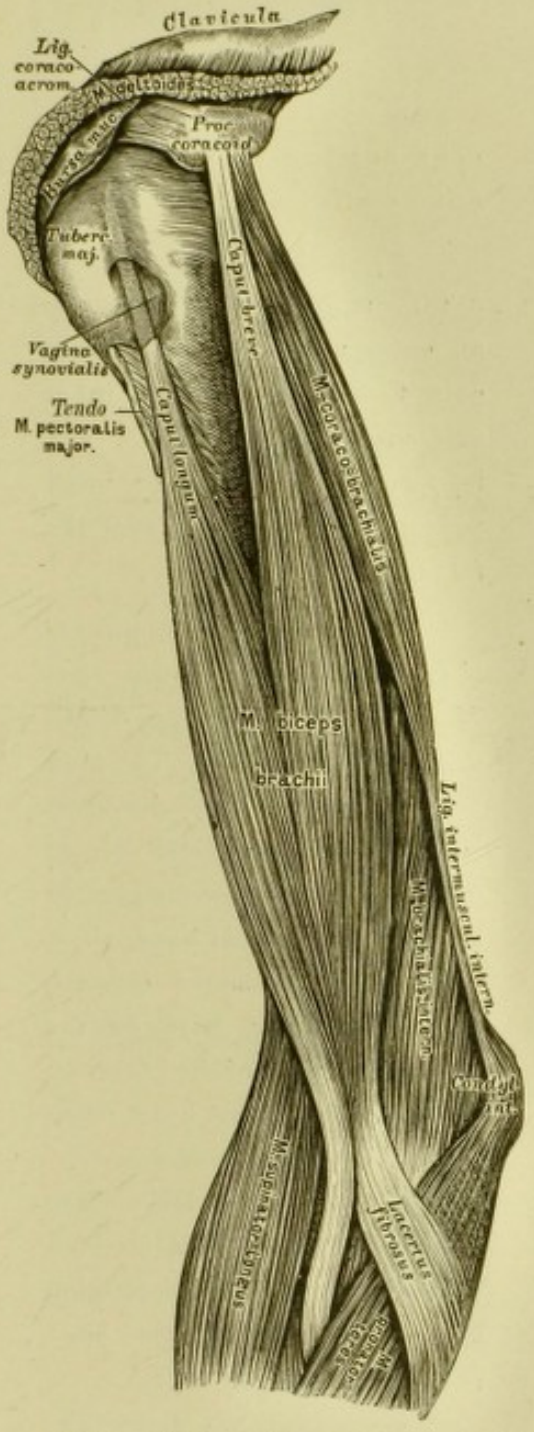
b) *M. subscapularis* arises from the subscapular fossa, and is inserted into the lesser tuberosity of the humerus and its neck further down. (Rotates the arm inwards.)



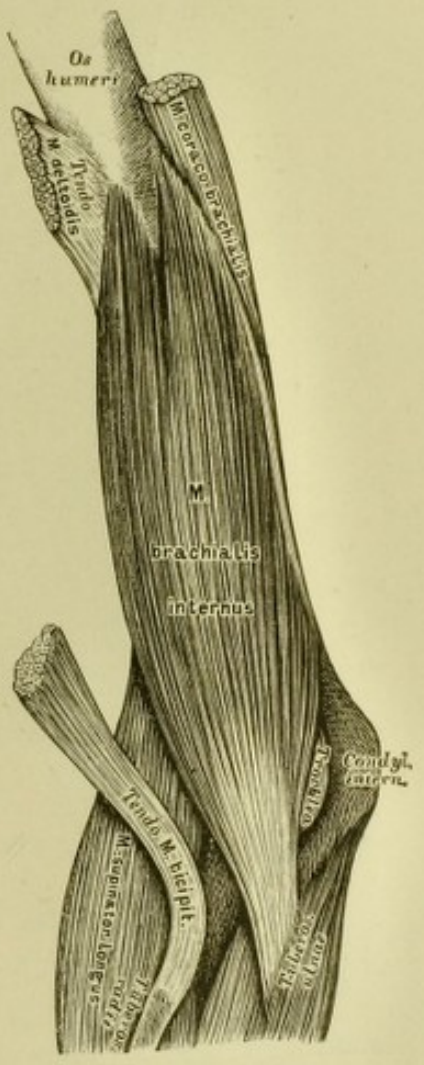
228. The Muscles at the Shoulder.



229. The Muscles at the Shoulder.



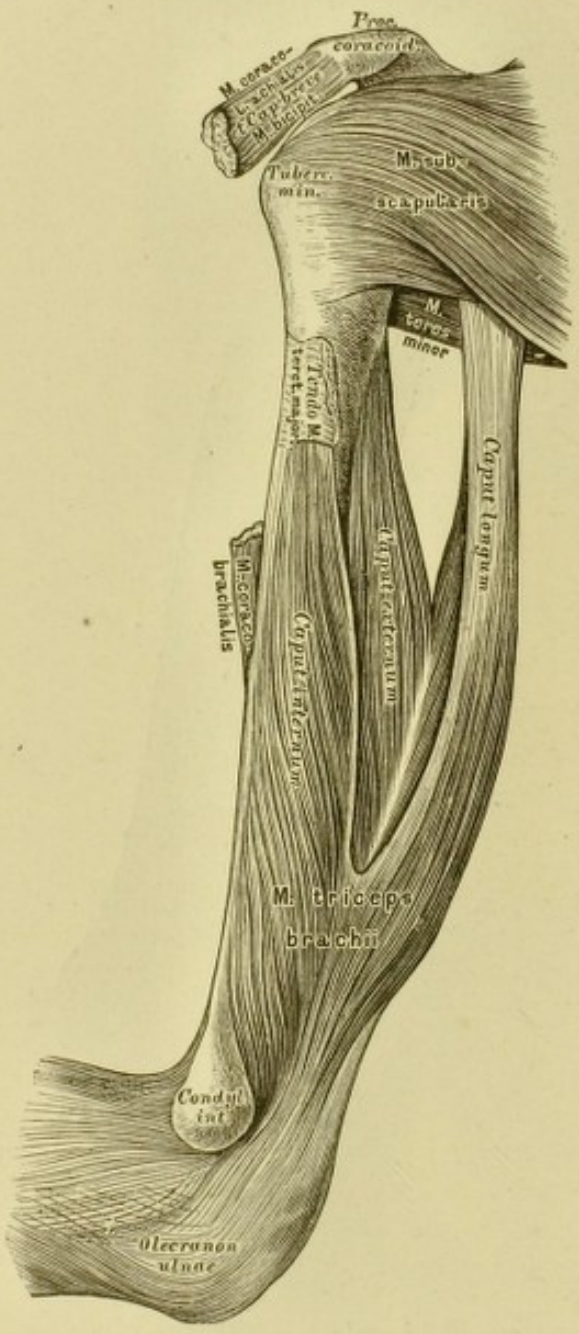
230. The Muscles at the Anterior Region of the Humerus.



231. The Muscles at the Anterior Region of the Humerus.

M. biceps brachii arises by two heads: The short head, *Caput breve,* in common with the *M. coraco-brachialis* from the coracoid process; the long head, *Caput longum,* from the upper margin of the glenoid cavity of the scapula. It is inserted into the tuberosity of the radius. From the tendon of insertion an aponeurotic band, *Lacertus fibrosus* (semilunar fascia), runs to the fascia of the humerus. (Supinates the pronated radius and flexes the forearm.)

M. coraco-brachialis arises from the coracoid process and is inserted into the end of the *Spina tuberculi minoris* in the middle of the humerus. It is perforated by the musculo-cutaneous nerve. (Draws the humerus forwards and inwards.)



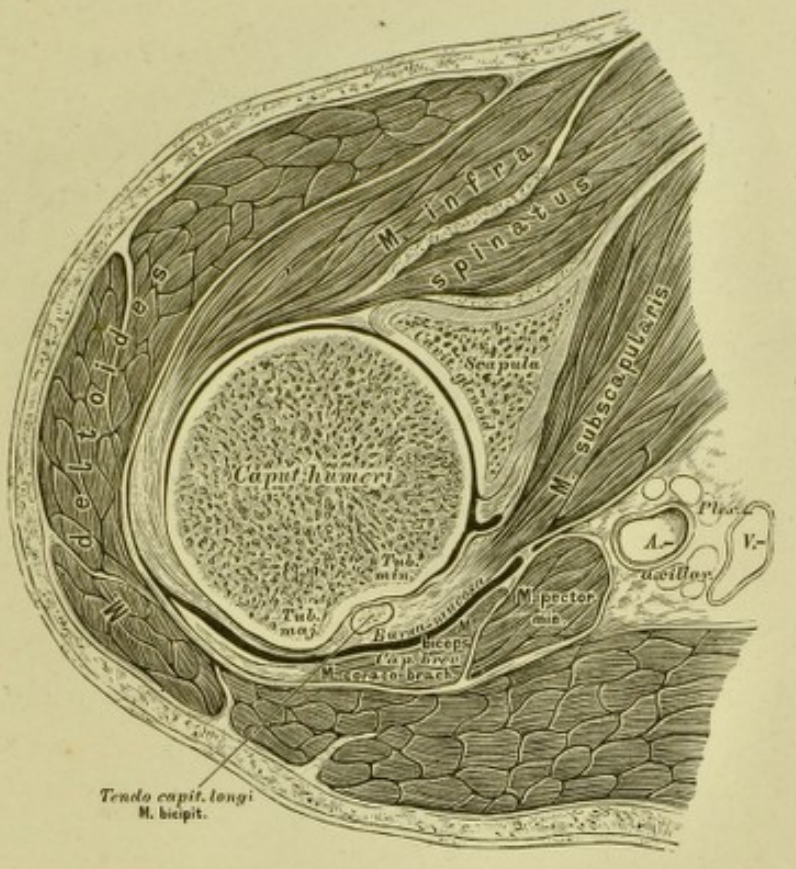
232. The Muscles at the Posterior Region of the Humerus.

Muscles at the anterior region of the humerus, continued.

M. brachialis anticus s. internus (see Fig. 231) arises by an outer and inner fleshy process from the outer and inner surfaces of the humerus, and is inserted into the coronoid process of the ulna. (Flexes the forearm.)

Muscles at the posterior region of the humerus: *M. triceps seu extensor brachii* arises by three heads: The long head, *Caput longum s. Anconaeus longus* from the axillary border of the scapula below the glenoid cavity; the external head, *Caput externum s. Anconaeus externus,* from the outer part of the posterior surface of the humerus; the internal or short head, *Caput internum s. breve s. Anconaeus internus* from the posterior surface of the humerus. It is inserted by a tendon of insertion into the olecranon process of the ulna. (Extends the forearm.)

M. anconaeus quartus (see Fig. 240) arises from the external condyle of the humerus, and is inserted into the posterior angle and outer surface of the upper third of the ulna. (Also extends the forearm.)



233. Horizontal Section through the Shoulder,

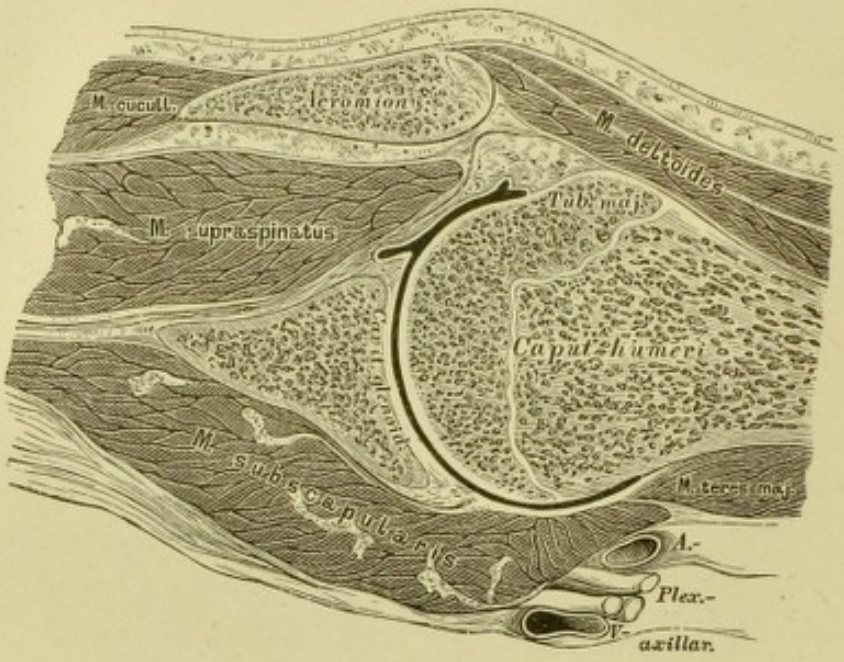
in the Region of the Great Tuberosity.

For all sections the following will serve as an explanation:

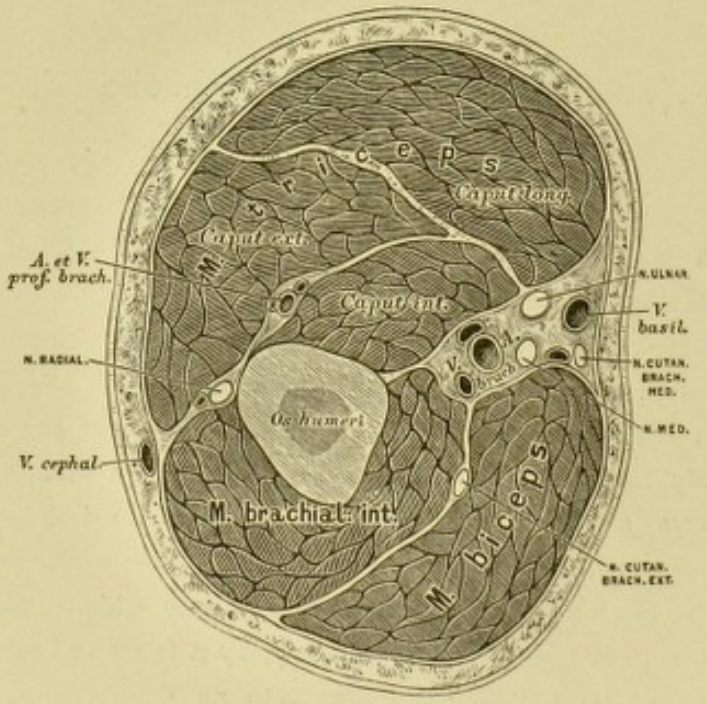
The sections were made with the saw on hard frozen cadavers, and the drawings taken in $^{2}/_{3}$ the natural size, after the sawn surface was washed with water, and slightly thawed.

For all horizontal sections the right extremity was chosen, and the drawings made from the lower cut surface; we therefore see the sections as if on a person standing with his right side towards us, in bird's eye view.

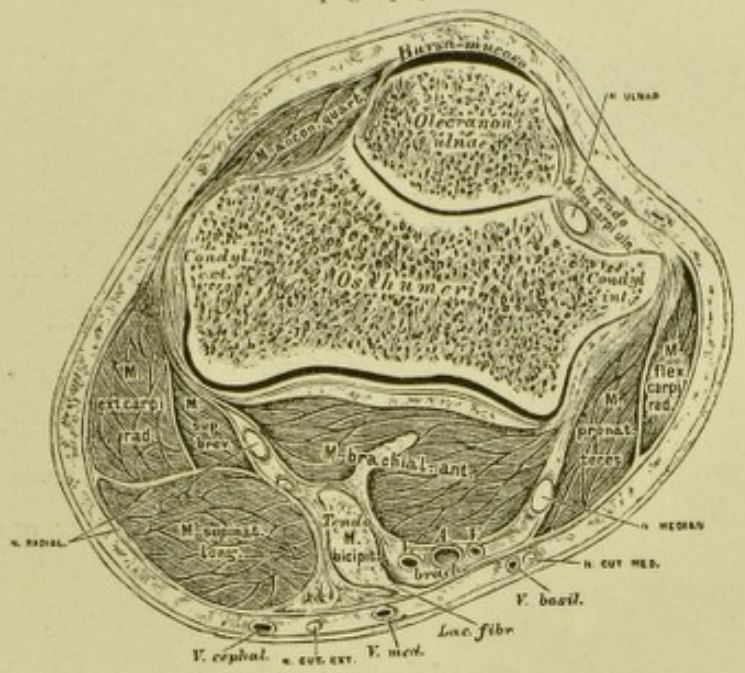
By a horizontal section is meant one which falls vertically on the long axis of the body (the extremity); by a frontal section one which divides the body (the extremity) into an anterior and a posterior half; by a sagittal section one, which runs parallel with the median plane, therefore divides the body (the extremity) into a right and left, or external and internal half.



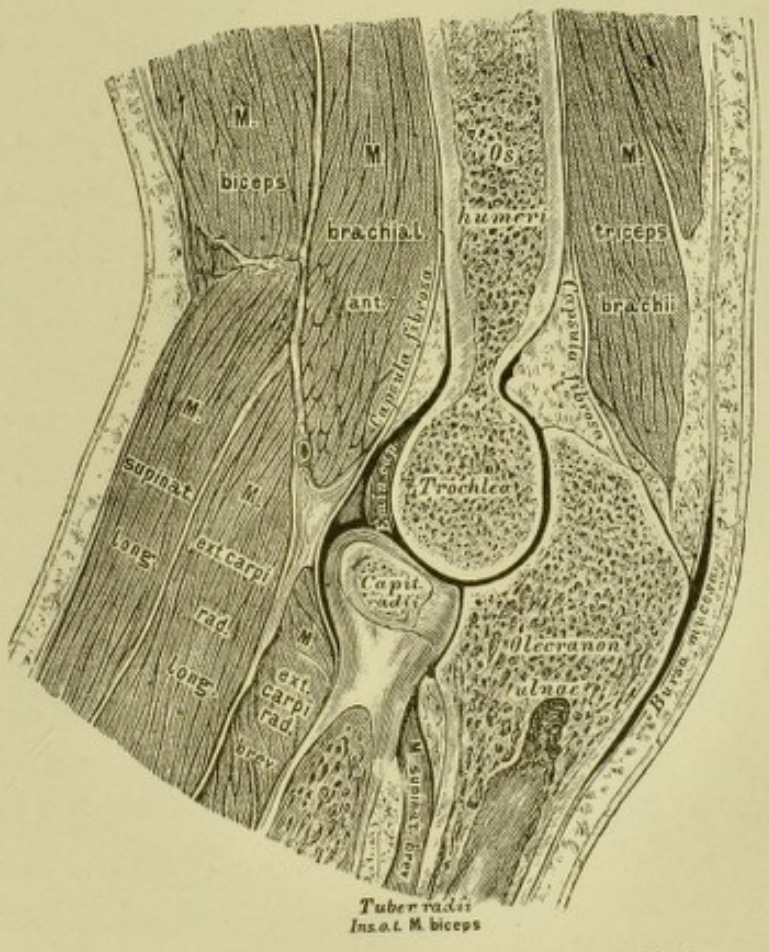
234. Frontal Section through the Shoulder
the arm being placed horizontally.



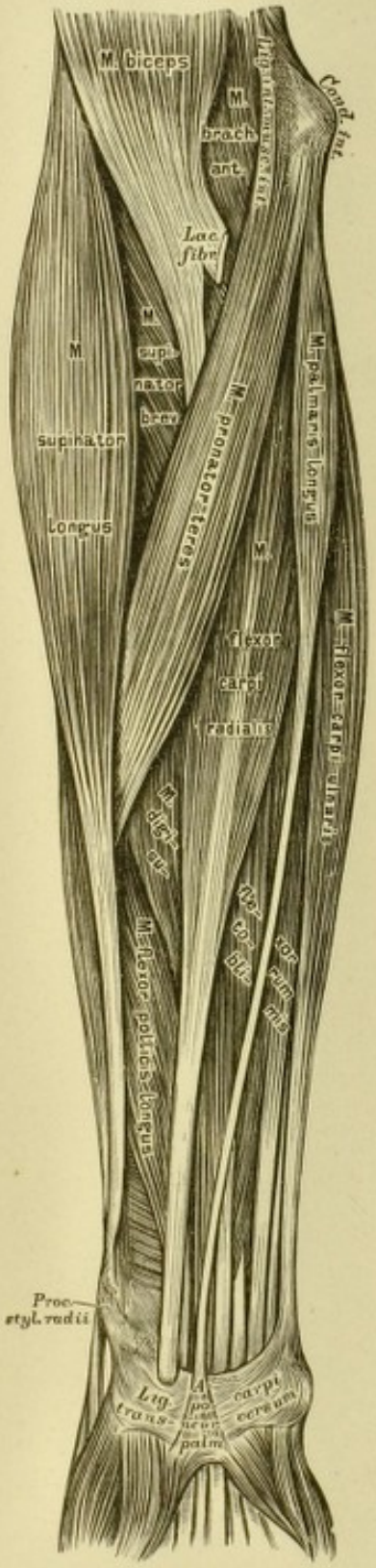
235. Horizontal Section in the Middle Third of the Humerus.



236. Horizontal Section in the Region of the Condyles of the Humerus.



237. Sagittal Section through the Elbow-Joint.



238. The Muscles at the Inner Side of the Forearm.

First Layer:

M. pronator radii teres. Orig.: Internal condyle of the humerus and coronoid process of the ulna. Insert.: Middle of the outer surface of the radius.

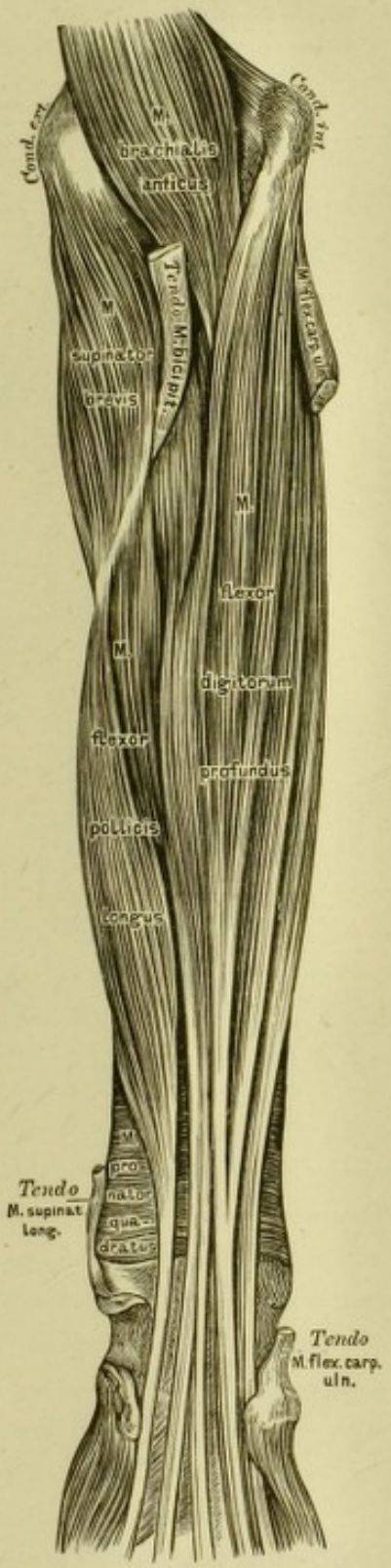
M. flexor carpi radialis s. radialis internus. Orig.: Internal condyle of the humerus. Insert.: Base of the metacarpal bone of the index finger. (Pronator and flexor of the hand.)

M. palmaris longus. Orig.: Internal condyle of the humerus. Insert.: *Aponeurosis palmaris* (palmar fascia). (Tensor of the palmar fascia and flexor of the hand.)

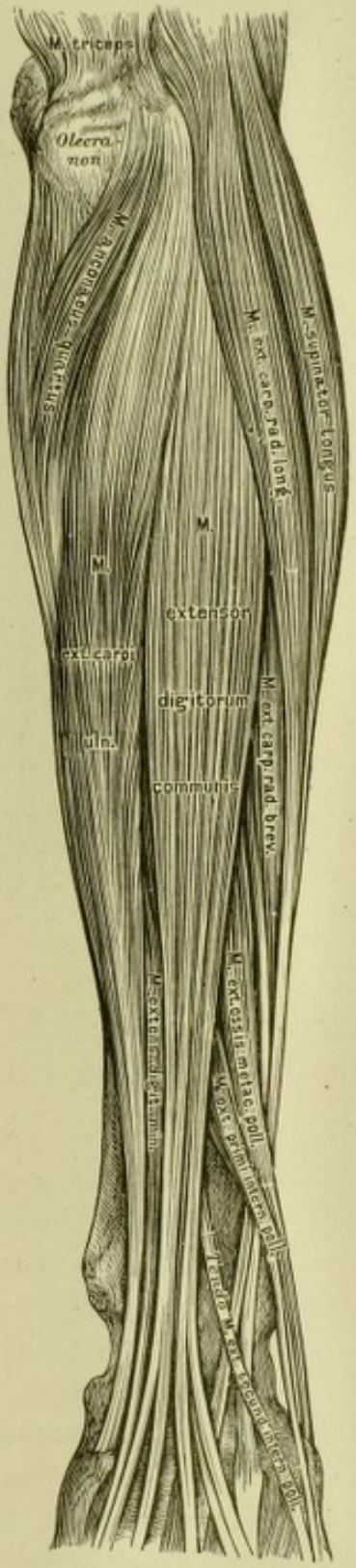
M. flexor carpi ulnaris s. ulnaris internus. Orig.: Internal condyle of the humerus, olecranon, and posterior border of the ulna. Insert.: Pisiform bone (see Fig. 241, 248). (Flexor and abductor of the hand.)

Second Layer:

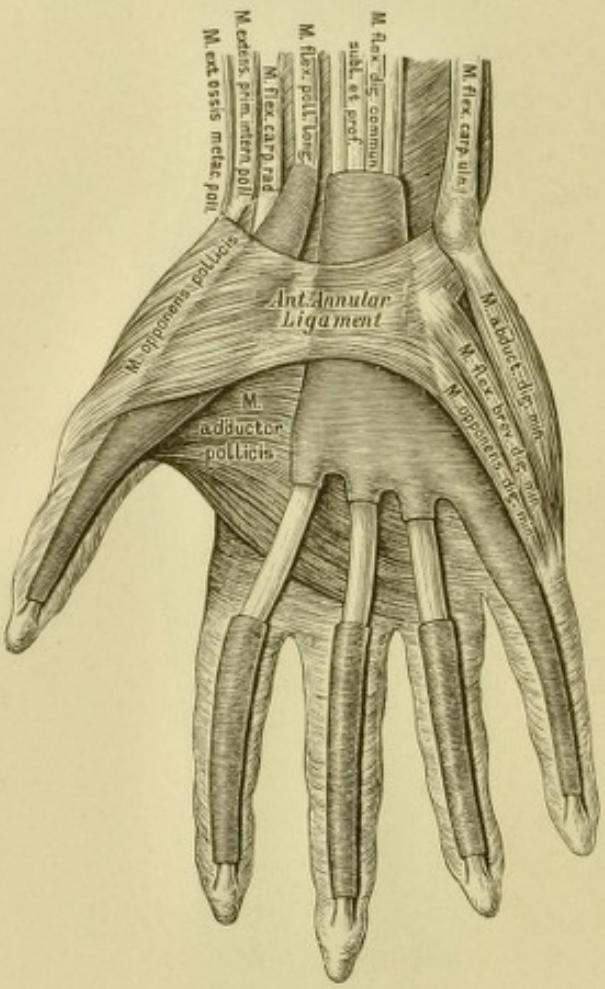
M. flexor digitorum sublimis s. perforatus. Orig.: Internal condyle of the humerus, internal lateral ligament of the elbow-joint, coronoid process of the ulna and radius below the tuberosity. Insert.: By four tendons, which, in the region of the first phalanx, are perforated by the tendons of the deep flexor, into the sides of the second phalanges of the second to the fifth fingers (see Fig. 247, 248). (Flexor of the second phalanges.)



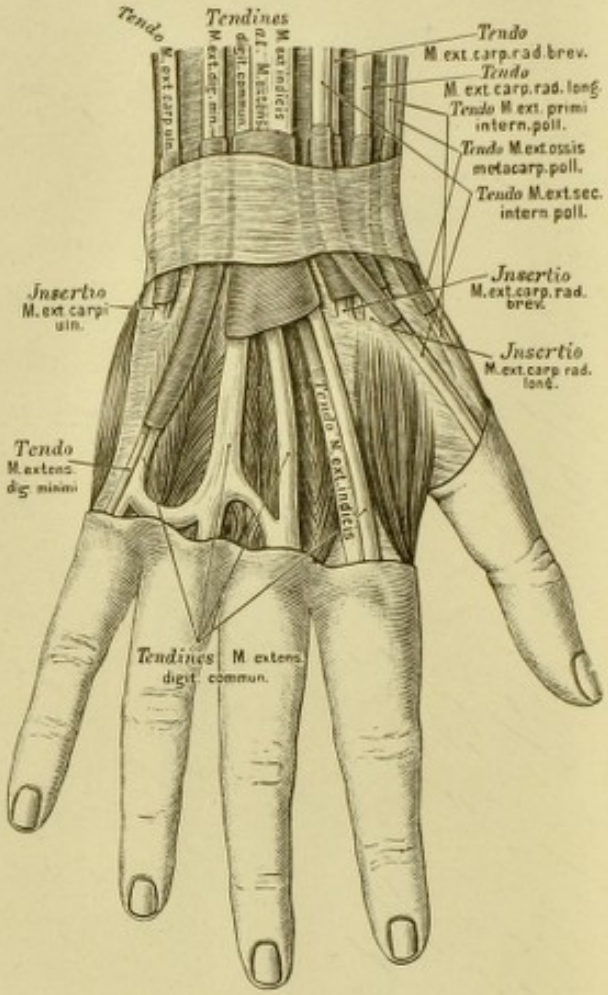
239. The Muscles at the Inner Side of the Forearm.



240. The Muscles at the Outer Side of the Forearm.



241. The Tendinous Sheaths in the Palm of the Hand.



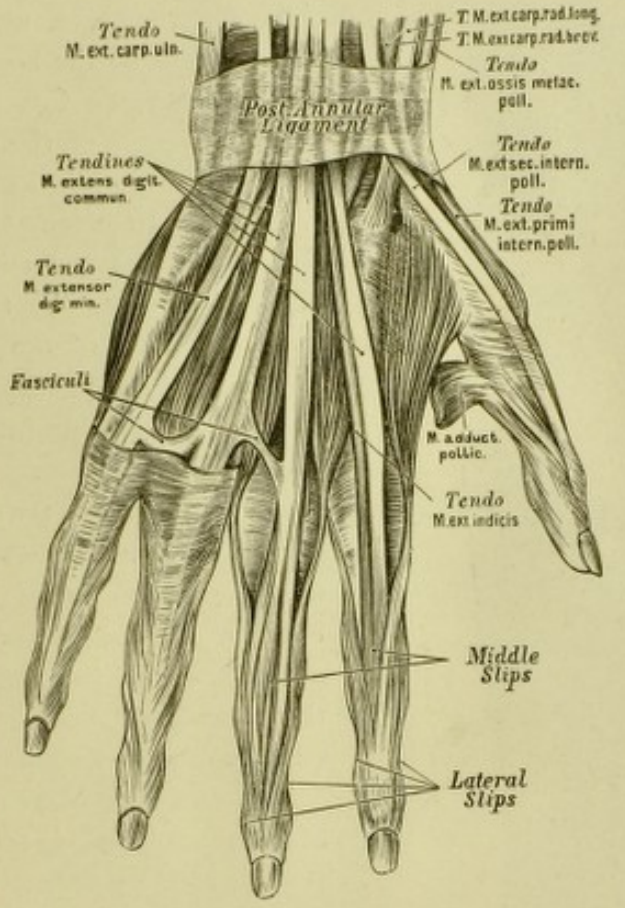
242. The Tendinous Sheaths at the Back of the Hand.

Third Layer:

M. flexor digitorum profundus s. perforans. Orig.: Upper two thirds of the inner surface of the ulna and interosseous membrane. Insert.: By four tendons into the third phalanges of the second to the fifth fingers; opposite the first phalanges these tendons pass between the two slips of the tendons of the *Flexor sublimis.* (Flexor of the III. phalanges.) — From the radial borders of the tendons of this muscle, in the palm of the hand, the *Musculi lumbricales* arise; they run to the radial borders of the first phalanges and from there to the aponeurosis on the back of the fingers (see Fig. 247, 248).

M. flexor pollicis longus. Orig.: Anterior surface of the radius. Insert.: Second phalanx of the thumb (see Fig. 247, 248).

M. pronator quadratus. Orig.: Anterior surface of the ulna. Insert.: Anterior surface of the radius (see Fig. 246).



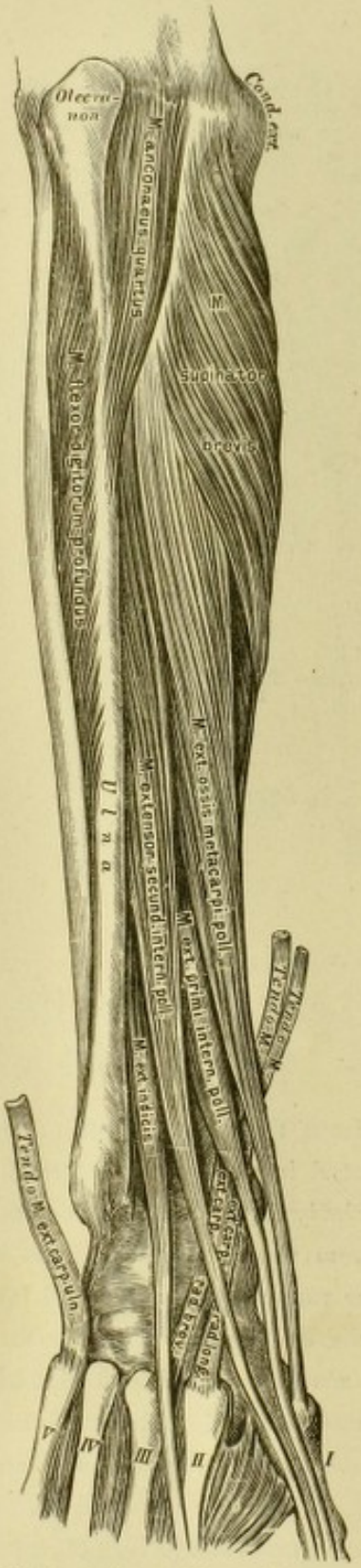
243. The Extensor Tendons at the Back of the Hand.

M. supinator longus (Fig. 238) arises from the lower third of the external border of the humerus, and is inserted into the lower extremity of the radius above the styloid process. (Chiefly flexor of the forearm.)

M. supinator brevis (Fig. 244) arises from the external condyle of the humerus and the orbicular ligament of the radius, and is inserted into the inner surface of the radius below the tuberosity. (Strong supinator.)

M. extensor carpi radialis longior s. radialis externus longus (Fig. 240, 244) arises above the external condyle of the humerus, and is inserted into the base of the metacarpal bone of the index finger. (Extensor and adductor of the hand.)

M. extensor carpi radialis brevior s. radialis externus brevis (Fig. 240, 244) arises from the external condyle of the humerus and the orbicular ligament of the radius, and is inserted into the base of the metacarpal bone of the middle finger. (Extensor and adductor of the hand.)



244. The Muscles at the Outer Side of the Forearm.

M. extensor digitorum communis (see Fig. 240, 243); it arises from the external condyle of the humerus and the *Fascia antibrachii*, being inserted by four tendons at the dorsum of the first phalanges into the aponeurosis of the second to the fifth fingers. The aponeurosis divides into three slips, of which the middle is inserted into the II. phalanx, the two lateral into the lateral borders of the III. phalanx.

M. extensor digiti minimi (Fig. 240, 243) has the same origin as the preceding muscle; the tendon of insertion is united with the fourth tendon of the *Extensor communis*.

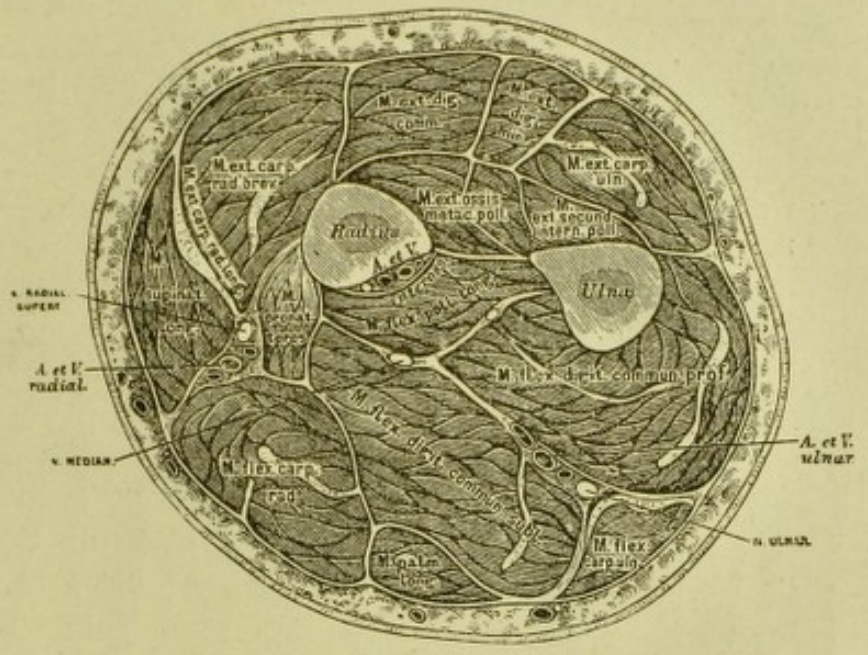
M. extensor carpi ulnaris s. ulnaris externus (Fig. 240) arises from the external condyle of the humerus and the *Fascia antibrachii*, and is inserted into the base of the metacarpal bone of the little finger. (Extensor and abductor of the hand.)

M. extensor ossis metacarpi pollicis s. abductor pollicis longus arises from the middle portion of the posterior surface of the ulna, the outer surface of the interosseous ligament and the radius; it is inserted into the base of the metacarpal bone of the thumb.

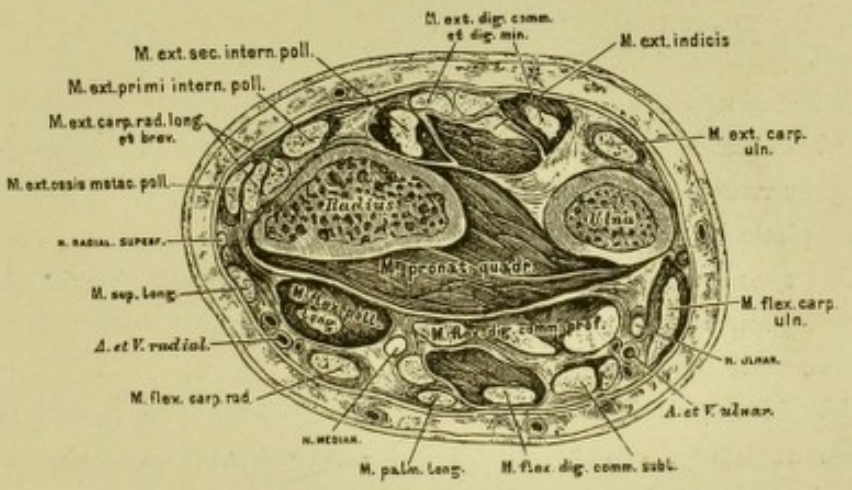
M. extensor primi internodii pollicis s. extensor pollicis brevis has the same origin as the preceding, and is inserted into the dorsal aponeurosis of the first phalanx of the thumb (Fig. 243).

M. extensor secundi internodii pollicis s. extensor pollicis longus arises from the crest of the ulna and the interosseous membrane, and is inserted into the dorsal aponeurosis of the second phalanx of the thumb (Fig. 243).

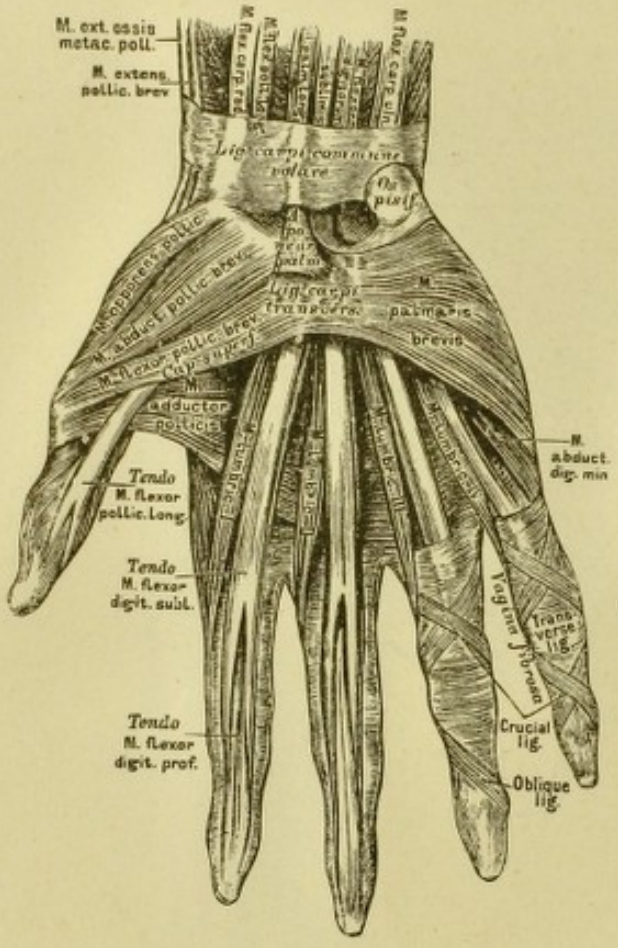
M. extensor indicis s. indicator arises from the crest and outer surface of the ulna; it unites with the tendon of the index finger of the *M. extensor digitorum communis* (Fig. 243).

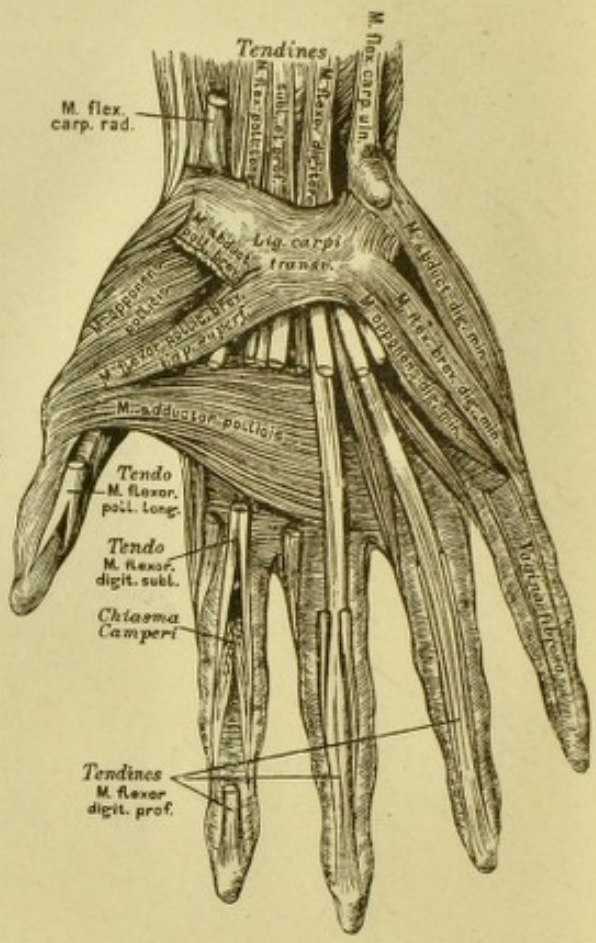


245. Horizontal Section in the Middle Third of the Forearm.



246. Horizontal Section in the Lower Third of the Forearm.





247. The Muscles of the Hand.

248. The Muscles of the Hand.

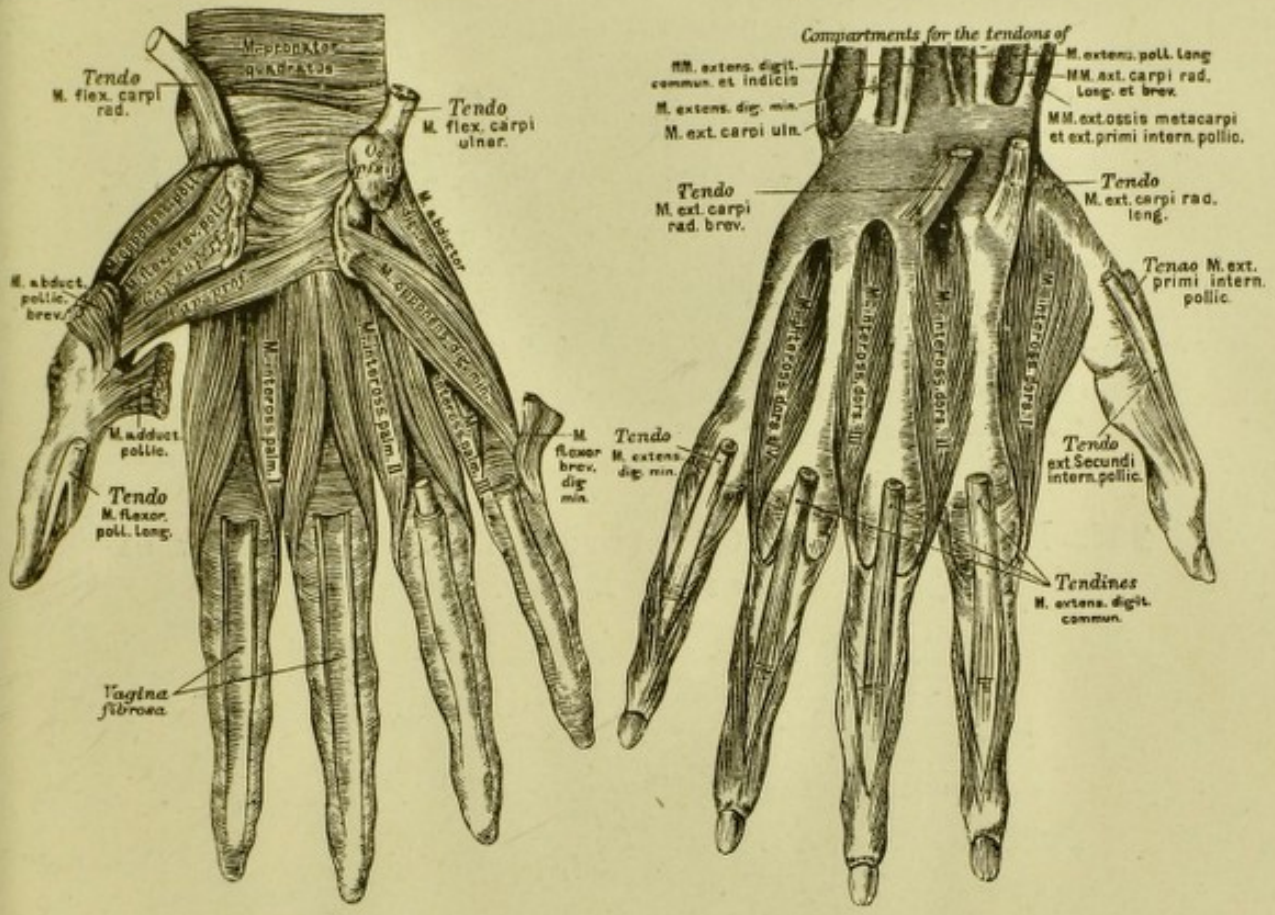
The Muscles of the Ball of the Thumb, *Thenar:*

M. abductor pollicis brevis arises from the annular ligament *(Lig. carpi transversum)*, and is inserted into the radial border of the base of the first phalanx of the thumb.

M. opponens pollicis s. flexor ossis metacarpi pollicis arises from the annular ligament and is inserted into the radial border and head of the metacarpal bone of the thumb.

M. flexor pollicis brevis arises by two heads: The superficial head from the annular ligament, the deep head from the trapezium, os magnum, and unciform bone (Fig. 249); it is inserted into the base of the first phalanx of the thumb.

M. adductor pollicis arises by its broad base from the metacarpal bone of the middle finger, and is inserted into the base of the first phalanx of the thumb or the inner sesamoid bone of the first articulation of the thumb.



249. The Muscles of the Hand. **250.** The Muscles of the Hand.

The Muscles of the Little Finger, *Hypothenar:*

M. palmaris brevis (Fig. 247) arises from the palmar aponeurosis, and is inserted into the skin on the ulnar border of the palm of the hand.

M. abductor digiti minimi (Fig. 248) arises from the pisiform bone and is inserted into the base of the first phalanx and dorsal aponeurosis of the little finger.

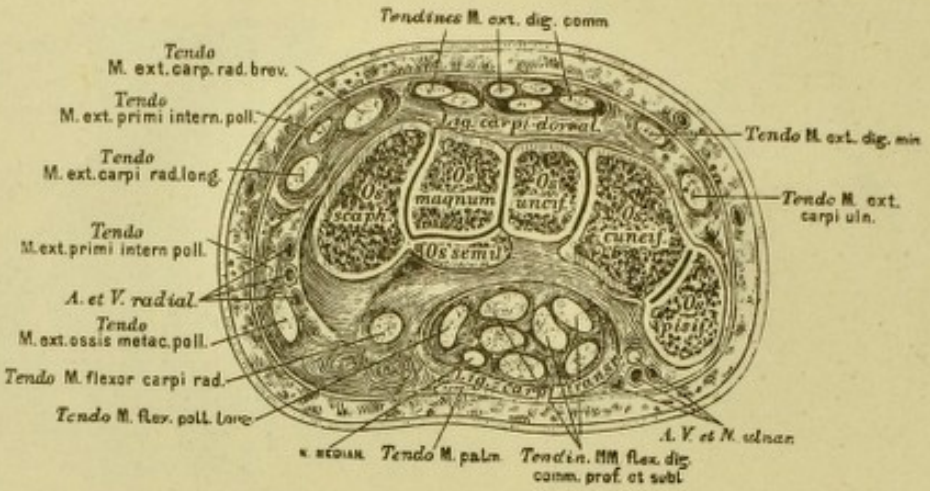
M. flexor brevis dig. min. (Fig. 248) arises from the annular ligament *(Lig. carpi transversum)* and the process of the unciform bone; its insertion is like the preceding.

M. opponens dig. min. s. flexor ossis metacarpi dig. min. arises from the unciform process and annular ligament and is inserted into the shaft and head of the metacarpal bone of the little finger.

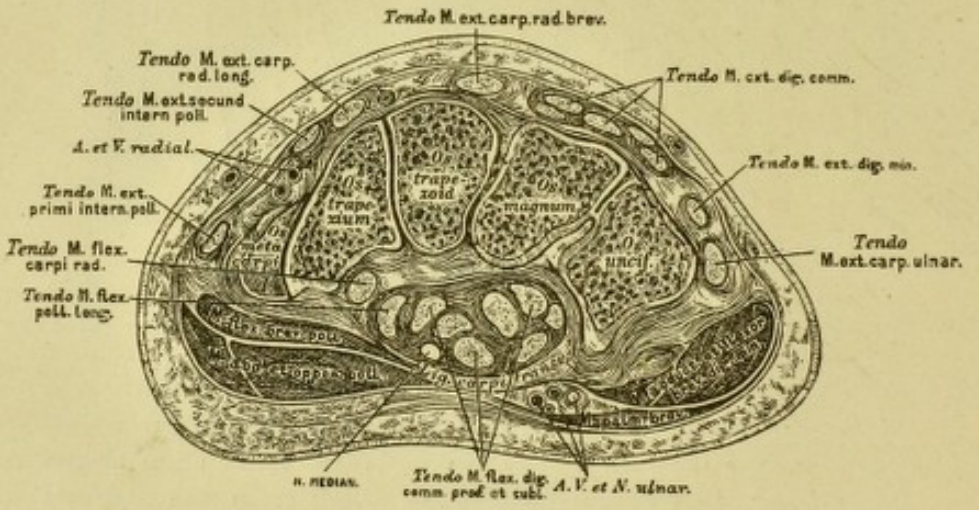
The *Musculi interossei:*

Three palmar or internal interossei muscles. Orig.: Of the first from the ulnar surface of the metacarpal bone of the index finger; of the second from the radial surface of the metacarpal bone of the fourth finger; of the third from the radial surface of the metacarpal bone of the fifth finger. Insert.: Dorsal aponeurosis of the first phalanges. (Adductors.)

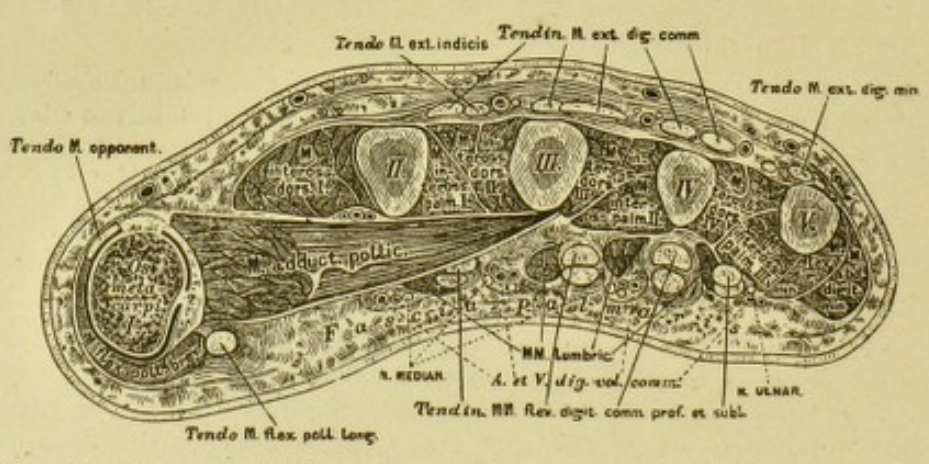
Four dorsal or external interossei muscles. Orig.: By two heads from the contiguous surfaces of the four metacarpal bones. Insert.: Dorsal aponeurosis of the second, third, and fourth fingers. (Abductors.)



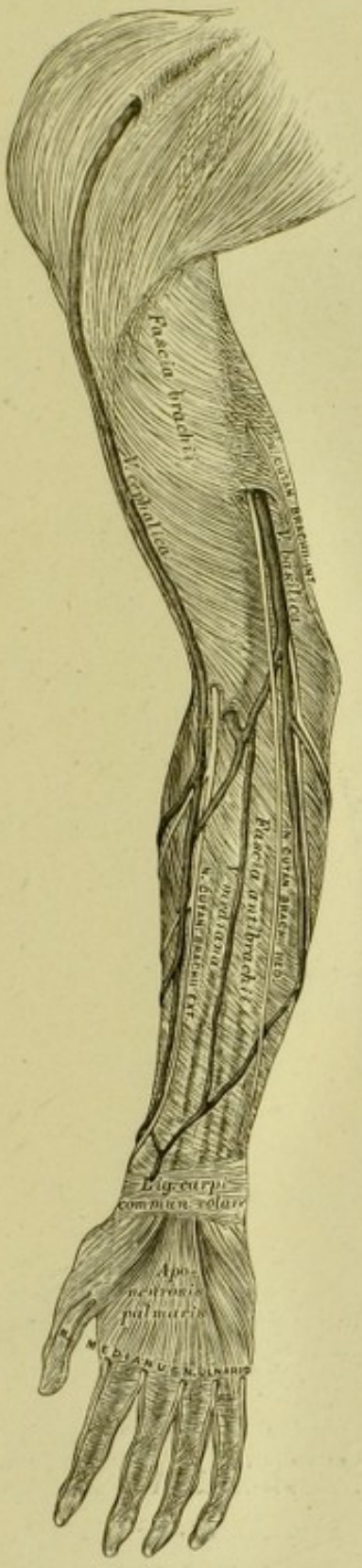
251. Horizontal Section through the First Row of Carpal Bones.



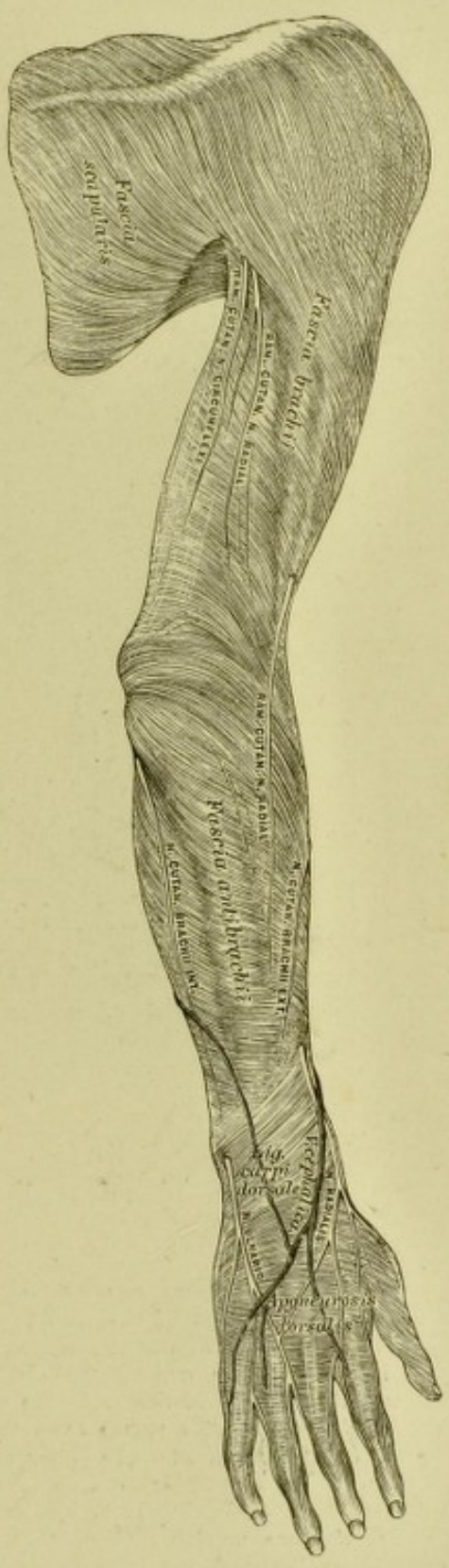
252. Horizontal Section through the Second Row of Carpal Bones.



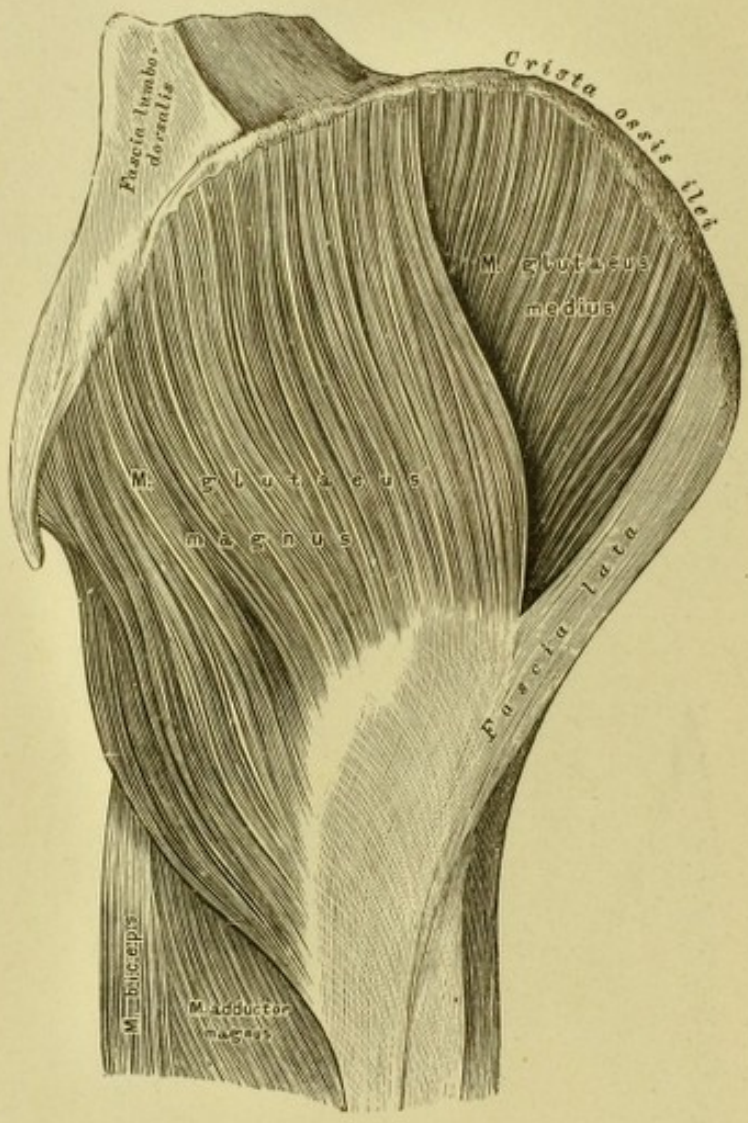
253. Horizontal Section through the Metacarpus.



254. The Fascia of the Upper Extremity on the Flexor Surface.



255. The Fascia of the Upper Extremity on the Extensor Surface.



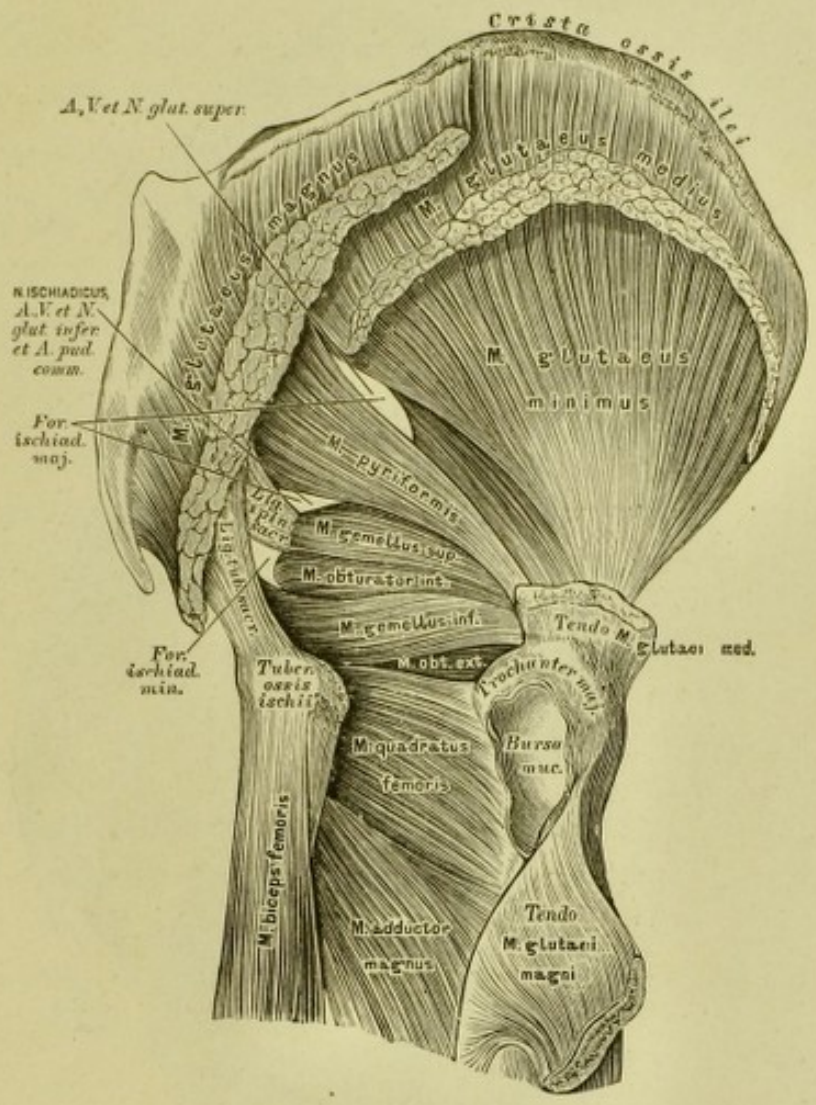
256. The External Muscles of the Hip.

M. glutaeus magnus s. maximus arises from the posterior portion of the external lip of the crest of the ilium, the *Fascia lumbo-dorsalis,* the coccyx and the great sacro-sciatic ligament *(Lig. tuberoso-sacrum);* it is inserted by a broad tendon into the *Linea aspera femoris* and the *Fascia lata.* (Abducts the thigh and draws it backwards. Supports the pelvis.)

M. glutaeus medius arises from the anterior portion of the external lip of the crest of the ilium and the outer surface of the ilium, and is inserted into the upper border and outer surface of the great trochanter. (Abducts the thigh and rotates it inwards. Supports the pelvis.)

M. glutaeus minimus (Fig. 257) arises from the external surface of the ilium, and is inserted into the upper border of the great trochanter. (Abducts the thigh and rotates it inwards. Supports the pelvis.)

M. tensor vaginae femoris seu tensor fascia lata (Fig. 259) arises from the anterior superior spine of the ilium, and is inserted into the *Fascia lata.* (Tensor of the fascia and rotator inwards of the thigh.)



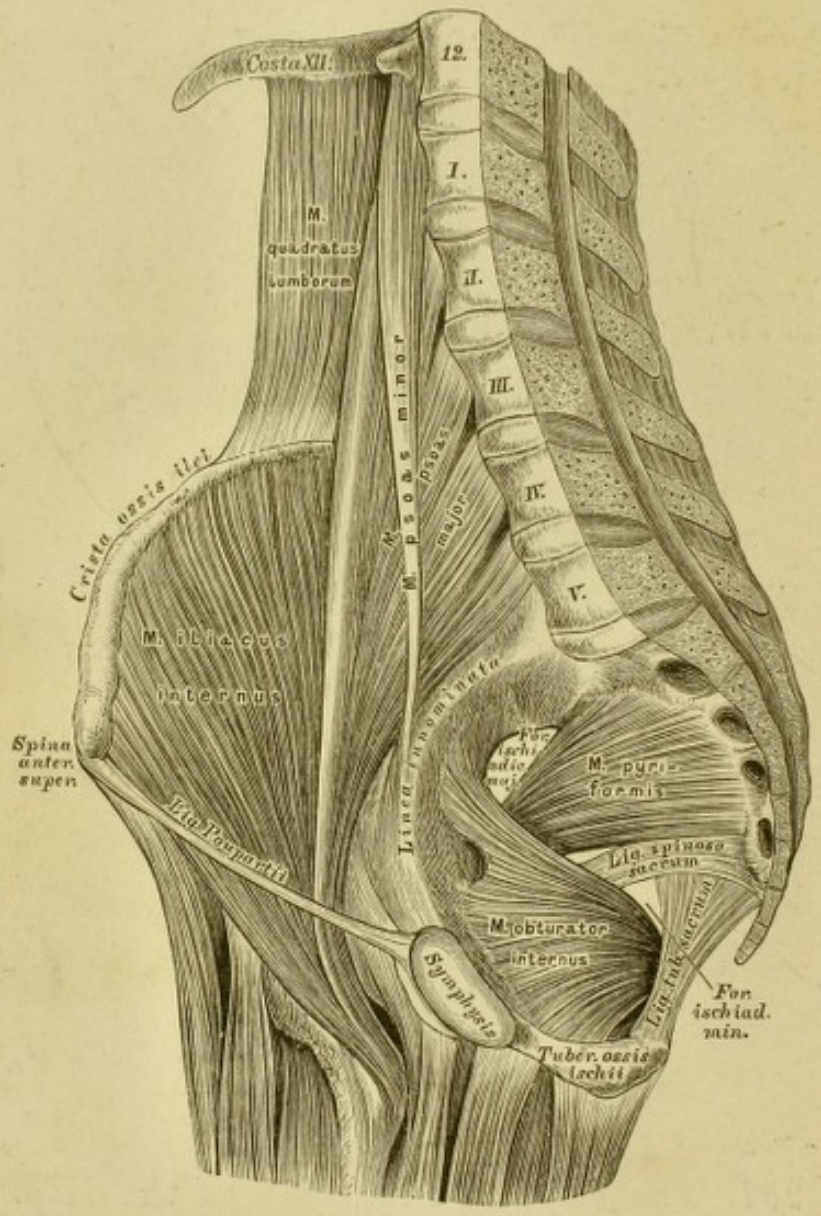
257. The External Muscles of the Hip.

M. pyriformis arises within the pelvis from the anterior surface of the sacrum and from the lower portion of the *Symphisis sacro-iliaca;* it passes through the great sacro-sciatic foramen and is inserted into the upper border of the great trochanter. (Rotator outwards of the thigh.)

M. obturator internus arises within the pelvis from the border of the obturator foramen and from the inner surface of the obturator membrane; it passes trough the lesser sacro-sciatic foramen and receives the attachment of the *Musculi gemelli,* of which the superior arises from the spine of the ischium and the inferior from the tuberosity of the ischium; these muscles are inserted into the *Fossa trochanterica.* (Rotators outwards of the thigh.)

M. quadratus femoris arises from the tuberosity of the ischium, and is inserted into the the *Linea quadrati* on the posterior surface of the femur below the great trochanter. (Rotator outwards of the thigh.)

M. obturator externus (Fig. 260) arises from the inner and inferior margin of the obturator foramen, and is inserted into the *Fossa trochanterica.* (Rotator outwards of the thigh.)



258. The Internal Muscles of the Hip.

M. psoas major s. magnus arises from the sides of the bodies and the transverse processes of the XII. dorsal, and the four upper or all the lumbar vertebrae and from the intervertebral substances; it is inserted into the lesser trochanter. (Rotates the thigh outwards and flexes it.)

M. iliacus internus arises from the inner lip of the crest of the ilium and the whole of the iliac fossa, and is inserted into the tendon of the psoas magnus muscle. (Rotates the thigh outwards and flexes it.)

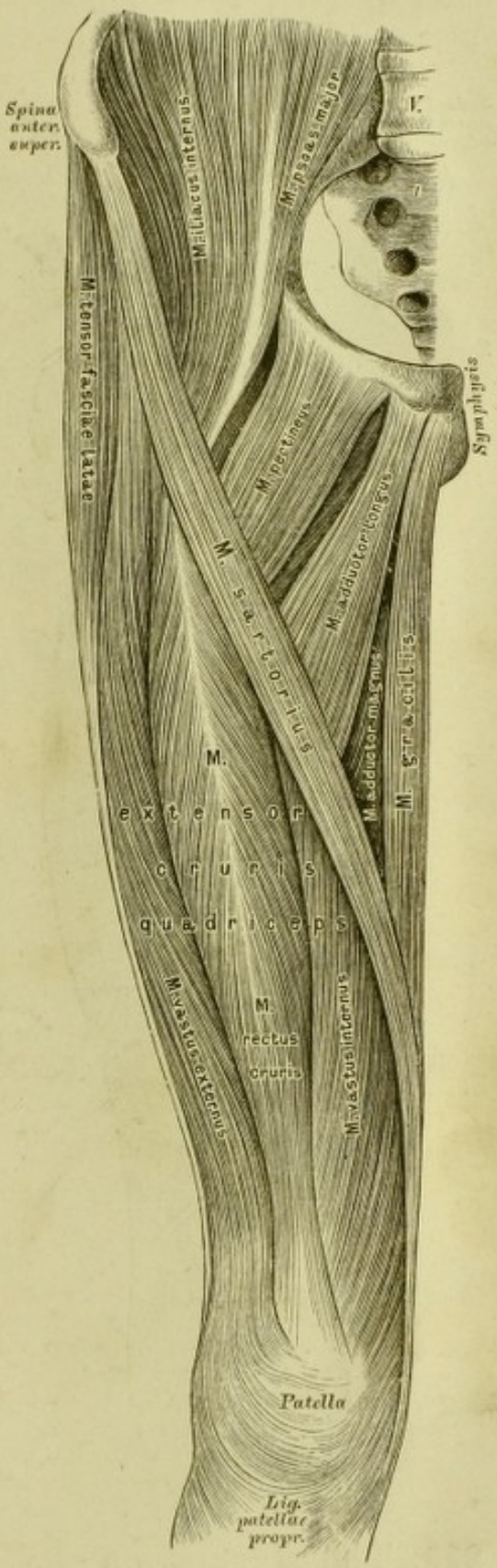
M. psoas minor s. parvus arises from the last dorsal and first lumbar vertebrae, and is inserted into the ileo-pectineal eminence and the iliac fascia. (Tensor of the iliac fascia.) Not always present.

M. coccygeus (not illustrated) runs from the spine of the ischium along the lesser sacro-sciatic ligament *(Lig. spinoso-sacrum)* to the coccyx. It is usually only slightly developed.

M. sartorius arises from the anterior superior spine of the ilium, and is inserted into and below the tuberosity of the tibia. (Adductor of the extremity, flexor and then rotator inwards of the leg.)

M. extensor cruris quadriceps. Origins: a) *Caput longum s. M. rectus cruris (femoris)* by two tendons from the anterior inferior spine of the ilium and the groove above the brim of the acetabulum; b) *Caput externum s. M. vastus externus* from the base of the great trochanter and from the outer lip of the *Linea aspera;* c) *Caput internum s. M. vastus internus* from the inner lip of the *Linea aspera;* d) *Caput medium s. M. vastus medius s. M. crureus* (s. Fig. 262) from the anterior intertrochanteric line and the anterior surface of the femur. Insert.: By a common tendon into the patella and by means of the *Ligamentum patellae proprium* into the tuberosity of the tibia.

Musculi subcrurales (not illustrated), are thin bands of muscular fibres, which run from the lower third of the anterior surface of the femur to the capsule of the knee-joint; they stretch this capsule.



259. The Muscles at the Front of the Thigh.

260. The Muscles on the inner Side of the Thigh.

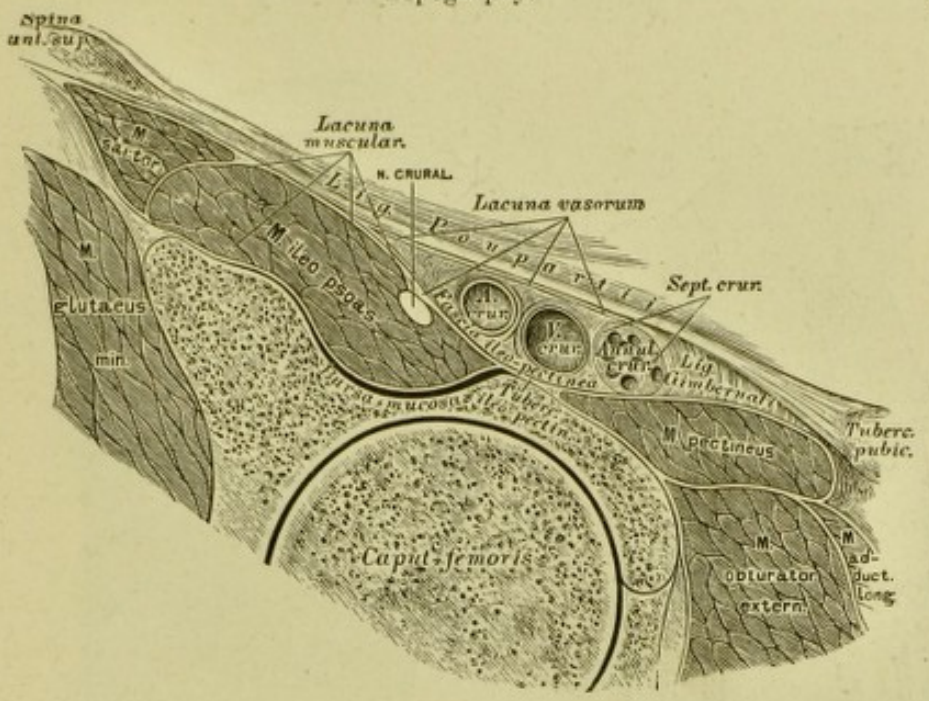
M. gracilis arises from the *Symphisis pubis*, and is inserted into the inner surface of the tibia below the tuberosity. (Adducts the thigh, flexes the knee and rotates the leg inwards.)

M. adductor longus arises from the pubes below the crest, and is inserted into the inner lip of the *Linea aspera femoris.*

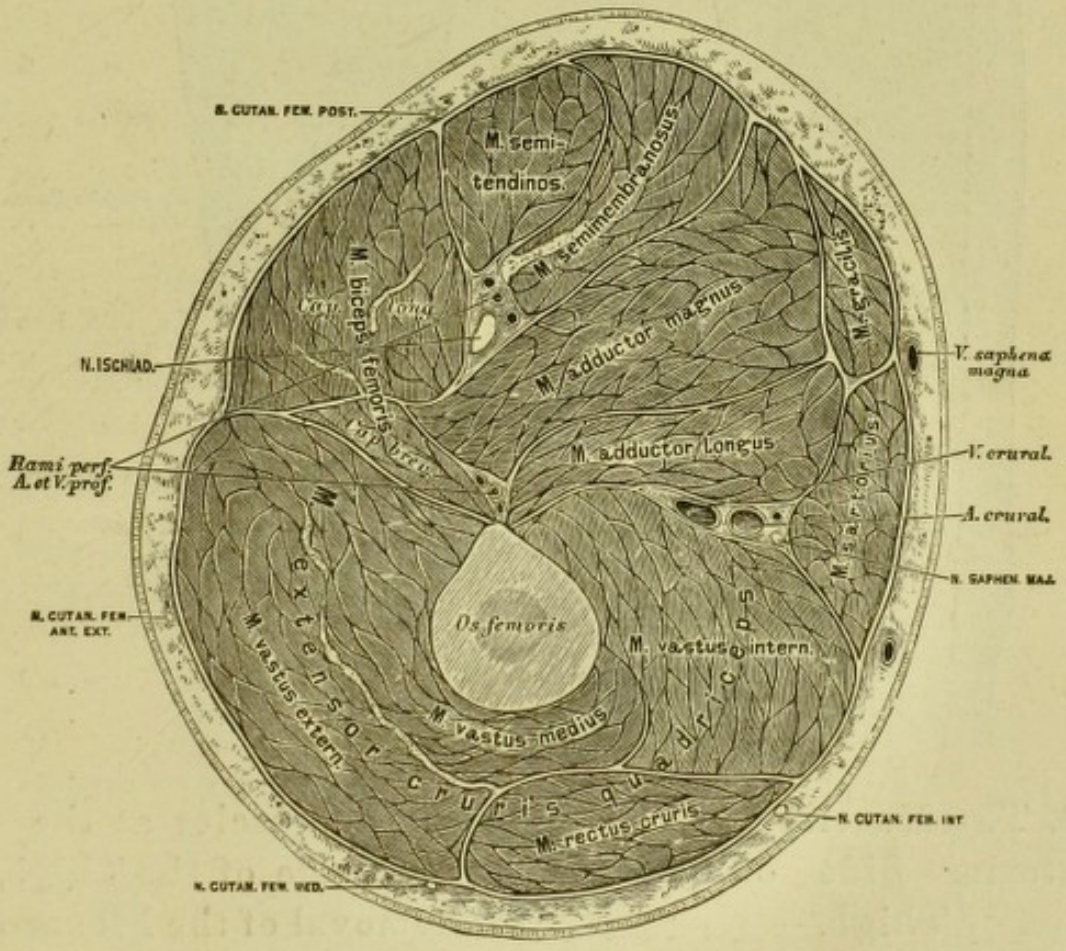
M. adductor brevis arises from the descending ramus of the pubes, and is inserted into the inner lip of the *Linea aspera femoris.*

M. adductor magnus arises from the descending ramus of the pubes, the ascending ramus of the ischium and the *Tuber ischii;* it is inserted into the *Linea aspera femoris.*

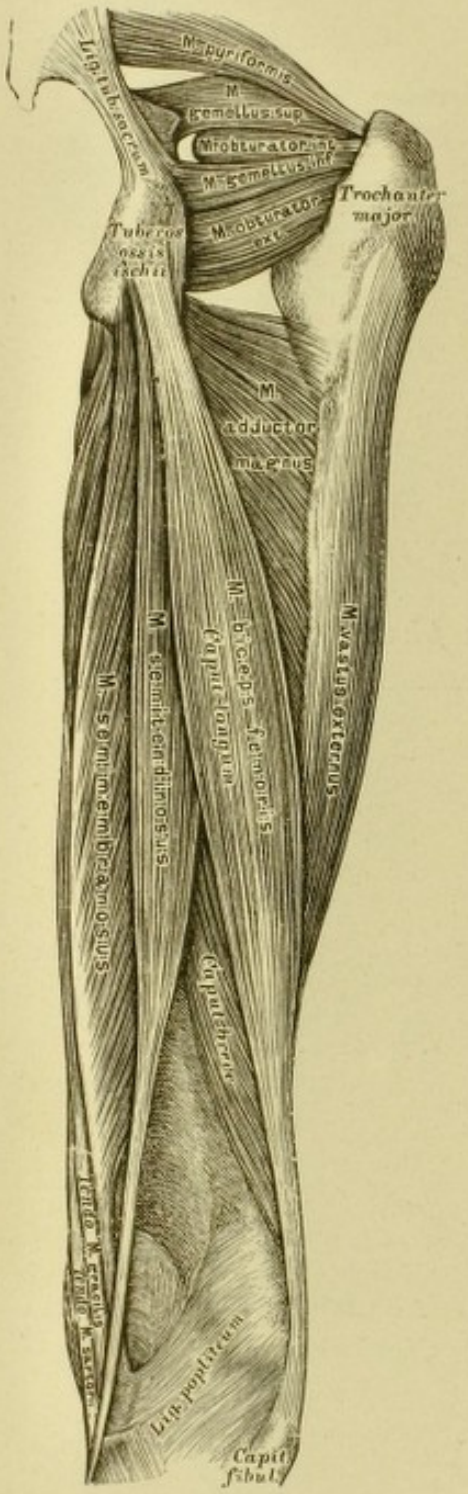
M. pectineus (Fig. 259) arises from the crest of the pubes and the pubic ligament, and is inserted into the inner lip of the *Linea aspera*, below the lesser trochanter. (Adducts the thigh and rotates it outwards.)



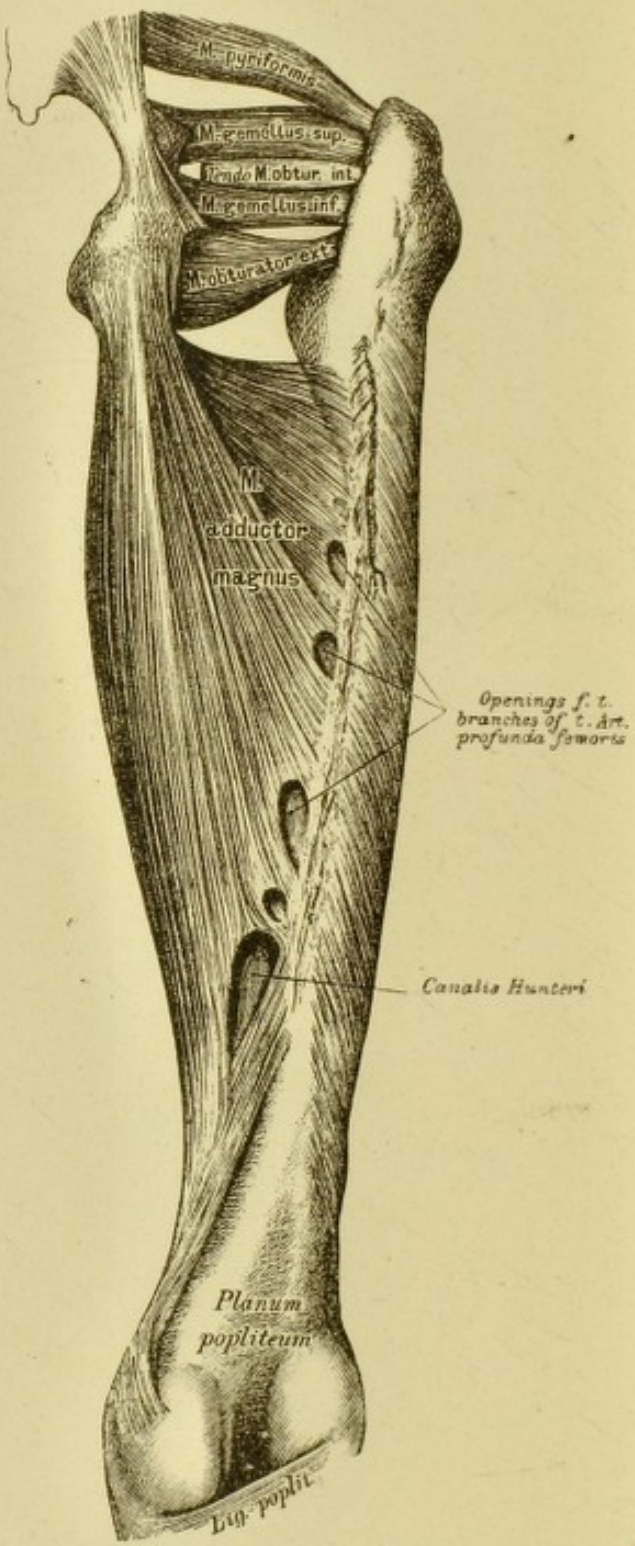
261. Section through the Femur in the Region of the *Ligamentum Poupartii*.



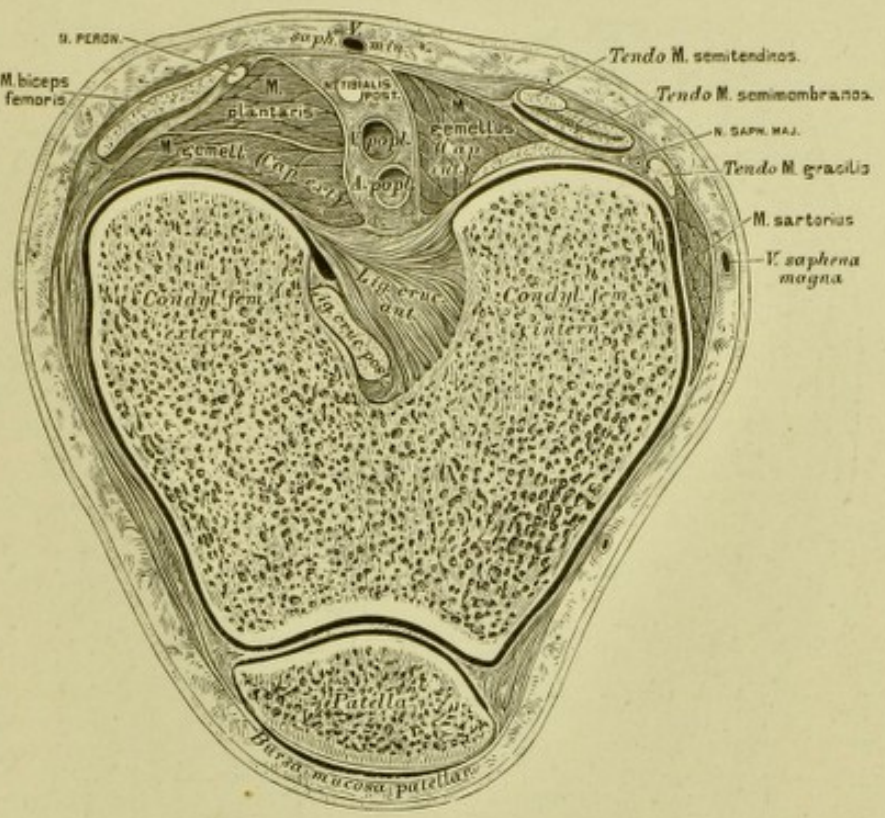
262. Horizontal Section in the Middle Third of the Femur.



263. The Muscles at the Posterior Side of the Thigh.



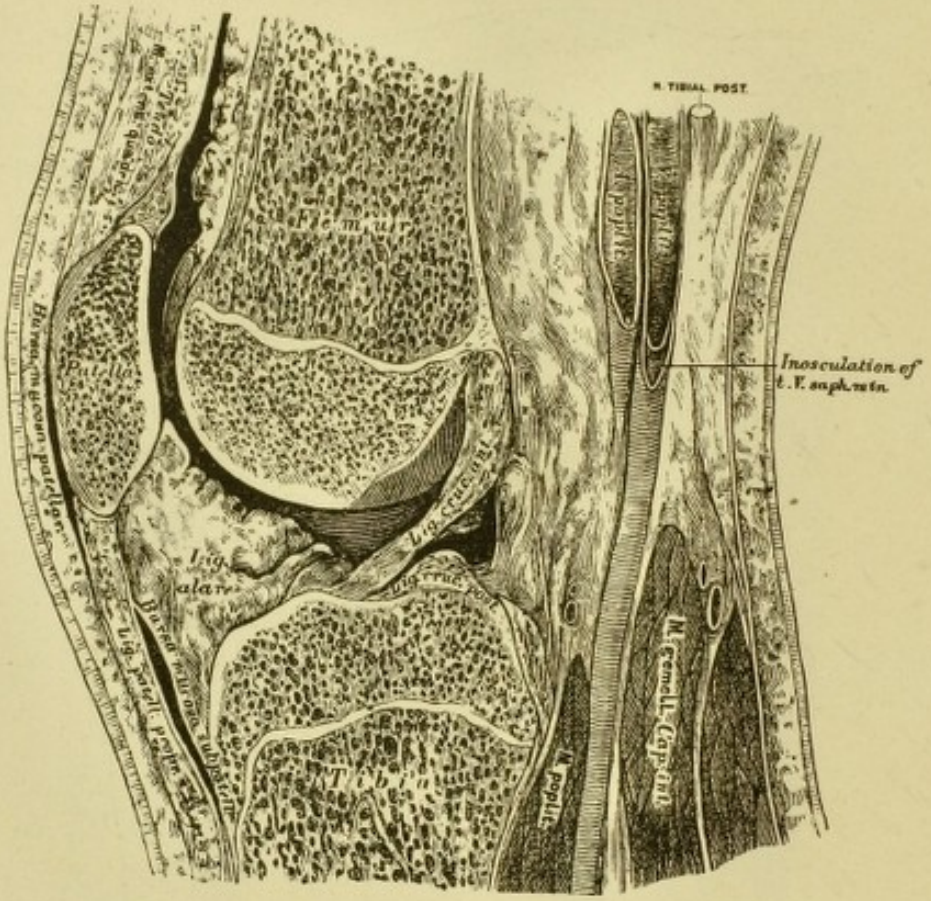
264. The Muscles at the Posterior Side of the Thigh, after Removal of the Flexors.



265. Horizontal Section in the Region of the Condyles of the Femur.

M. biceps femoris arises by two heads: The long head, *Caput longum*, from the *Tuber ischii;* this runs obliquely downwards and outwards to the knee-joint; the short head, *Caput breve*, from the external lip of the *Linea aspera femoris;* it is inserted by a single tendon into the head of the fibula. (Flexor of the leg.)

M. semitendinosus arises from the *Tuber ischii* in common with the long head of the biceps, and is inserted by a long round tendon into the inner surface of the tibia near the *Spina tibiae.* (Flexor of the leg.)



266. Sagittal Section through the Knee-Joint.

M. semimembranosus arises from the *Tuber ischii;* the tendon commences about the middle of the femur; from it spring numerous short fleshy fibres; it is inserted into the inner tuberosity of the tibia. (Flexor of the leg, and strong supporter of the pelvis.)

The Muscles at the Anterior Side:

M. tibialis anticus arises from the external tuberosity and outer surface of the tibia, the interosseous membrane and *Fascia cruris;* it is inserted into the internal cuneiform bone and base of the metatarsal bone of the great toe (Fig. 272). (Flexes the tarsus and raises the inner border of the foot.)

M. extensor proprius pollicis seu extensor pollicis (hallucis) longus arises from the middle two-fourth of the anterior surface of the fibula and the interosseous membrane; it is inserted into the II. phalanx of the great toe (Fig. 272).

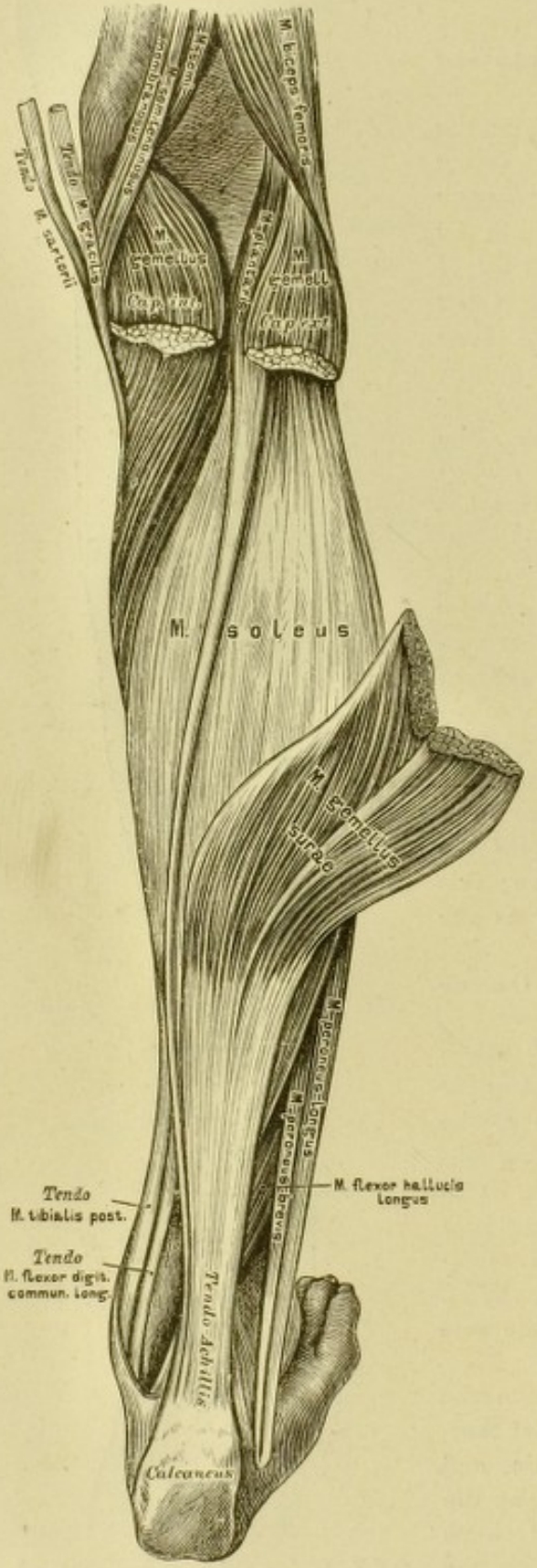
M. extensor digitorum communis longus arises from the head and anterior surface of the fibula, the outer tuberosity of the tibia and the interosseous membrane; it is inserted by four tendons into the aponeurosis on the back of the II. and III. phalanges of the four outer toes, and by a fifth tendon into the base of the fifth metatarsal bone; this fifth tendon is often spoken of as the *M. peroneus tertius* (Fig. 272).

The Muscles on the Outer Side:

M. peroneus longus (Fig. 269) arises by two heads from the head and upper two-thirds of the outer surface of the shaft of the fibula, and, running obliquely across the *Planta pedis,* it is inserted into the internal cuneiform bone, and base of the I. and II. metatarsal bones (Fig. 276 and 277). (Extends the foot and everts the sole of the foot.)

M. peroneus brevis arises from the lower two-thirds of the external surface of the shaft of the fibula, and is inserted into the projection at the base of the fifth metatarsal bone (Fig. 272). (Extends and abducts the foot.)

267. The Muscles at the Anterior and Outer Sides of the Leg.



268. The Muscles at the Posterior Side of the Leg.

Superficial Layer:

M. gastrocnemius s. gemellus surae arises by two heads above the external and internal condyles of the femur; it is inserted into the *Tendo Achillis* and by means of this into the tuberosity of the *Os calcis*. (Extends the foot.)

M. soleus arises from the head and posterior border of the fibula, the *Linea poplitea* and inner border of the tibia (Fibular and Tibial portion); it is inserted by means of the *Tendo Achillis* into the tuberosity of the *Os calcis*. (Extends the foot.)

M. plantaris arises from the external condyle of the femur and is inserted by a long slender tendon at the side of the *Tendo Achillis* into the posterior part of the *Os calcis*. (It slightly extends the foot, but is not always present.)

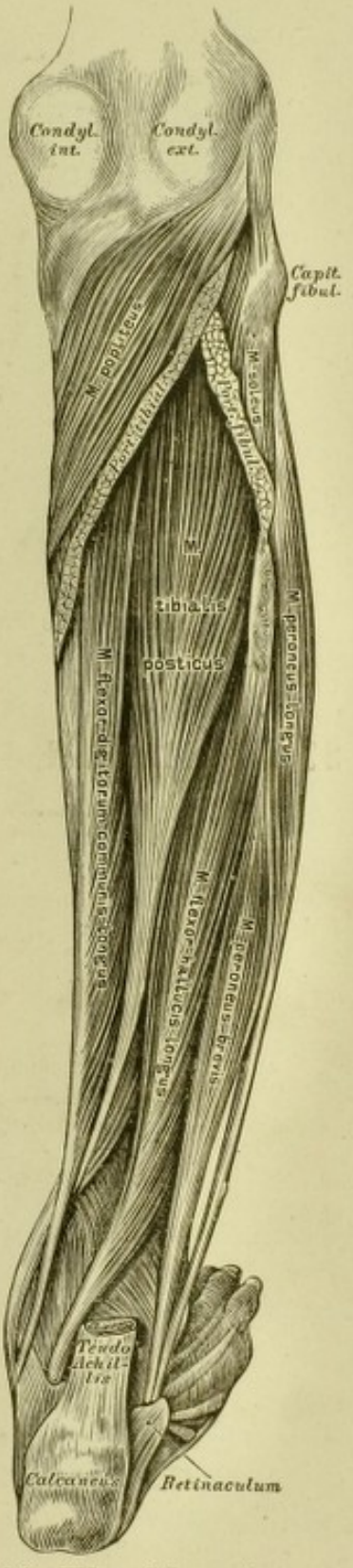
Deep Layer:

M. popliteus arises from the external condyle of the femur and the external interarticular fibro-cartilage of the knee-joint; it is inserted into the inner border of the tibia. (Flexes the leg and rotates it inwards.)

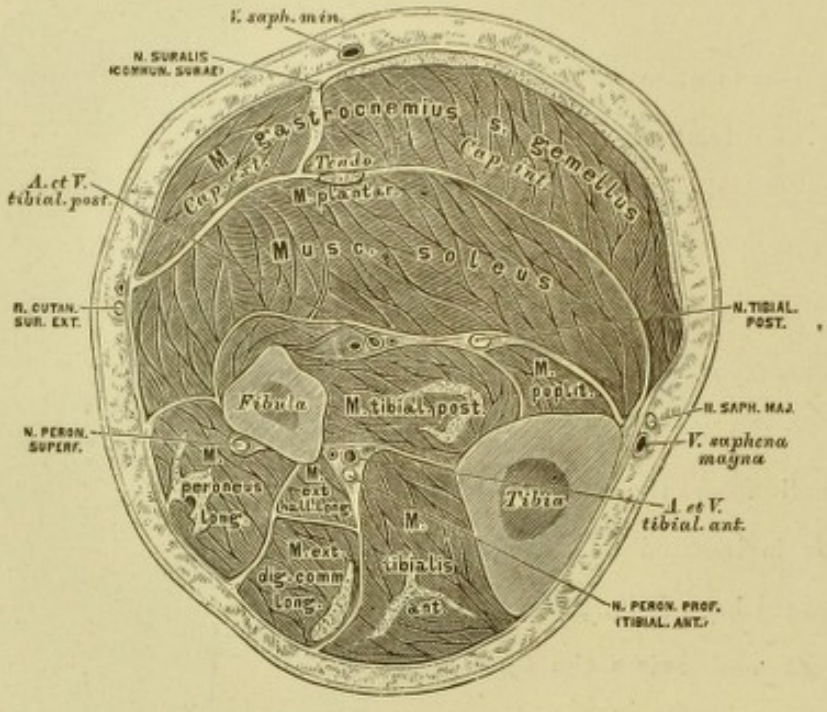
M. tibialis posticus arises from the posterior surface of the tibia, the interosseous membrane and from the inner surface of the fibula; it is inserted into the tuberosity of the scaphoid bone (Fig. 276, 277). (Extends the tarsus and raises the inner border of the foot.)

M. flexor digitorum communis longus s. perforans. Origin of the long head: posterior surface of the tibia; of the short head, usually called *M. flexor accessorius:* from the under and inner surface of the *Os calcis* (Fig. 275). Insert.: By four tendons from which arise the *M. lumbricales,* into the III. phalanges of the four outer toes; opposite the I. phalanges these tendons perforate the corresponding tendons of the *M. flexor digit. comm. brevis.*

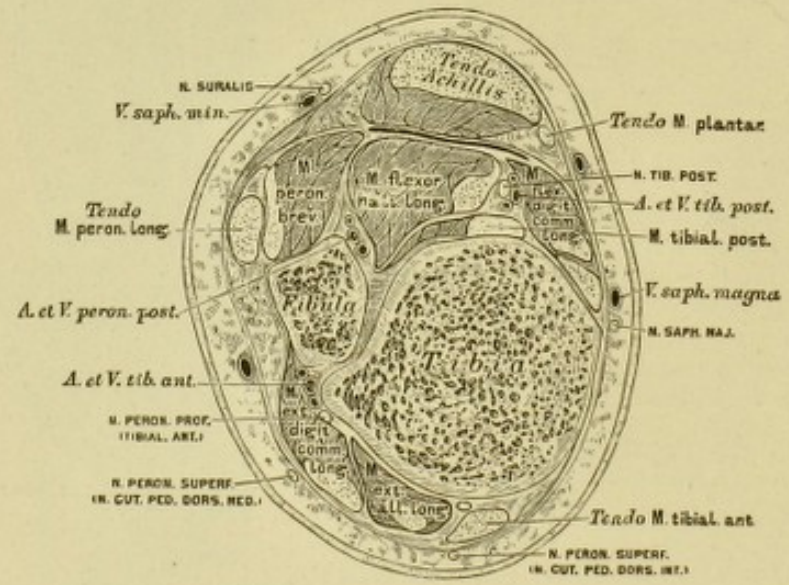
M. flexor hallucis (pollicis) longus arises from the lower two-thirds of the posterior surface of the fibula, and is inserted into the II. phalanx of the great toe (Fig. 274).



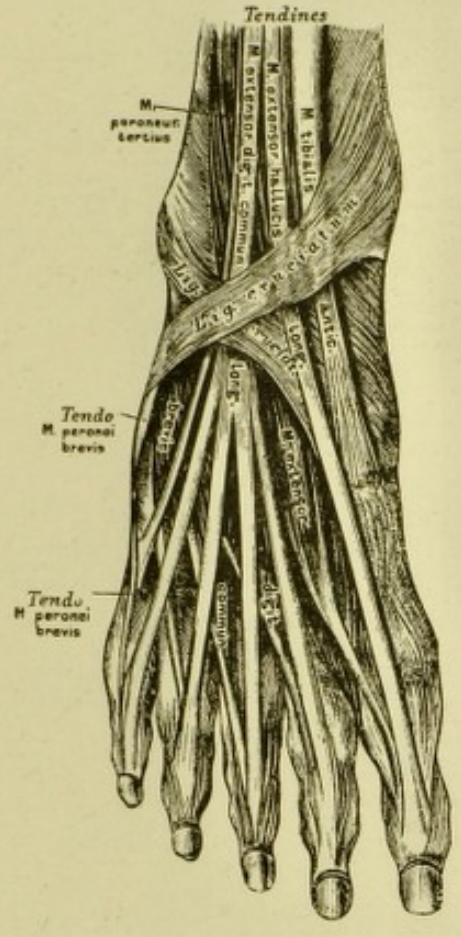
269. The Muscles at the Posterior Side of the Leg.



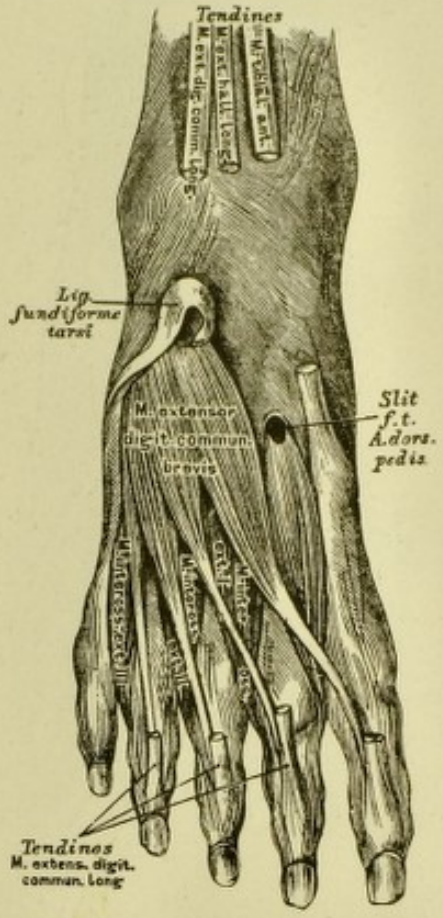
270. Horizontal Section in the Middle Third of the Leg.



271. Horizontal Section in the Region of the Malleoli of the Leg.



272. The Muscles on the Dorsal Side of the Foot.

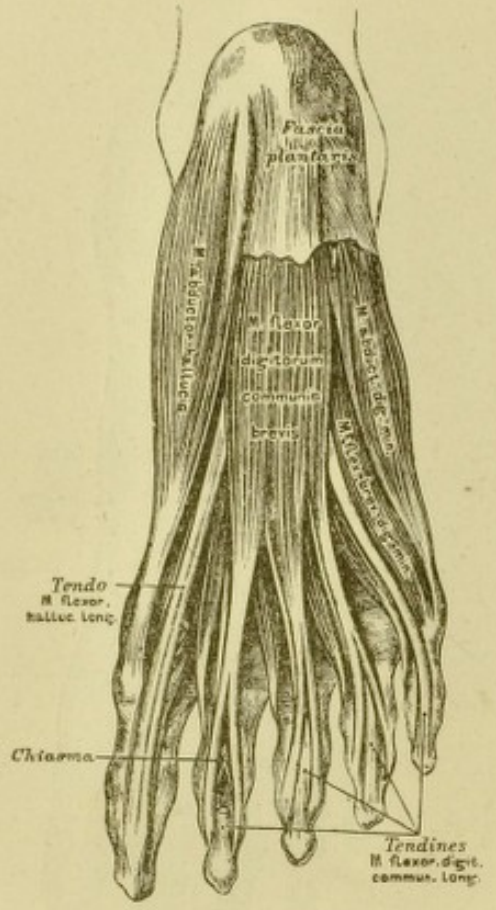


273. The Muscles on the Dorsal Side of the Foot.

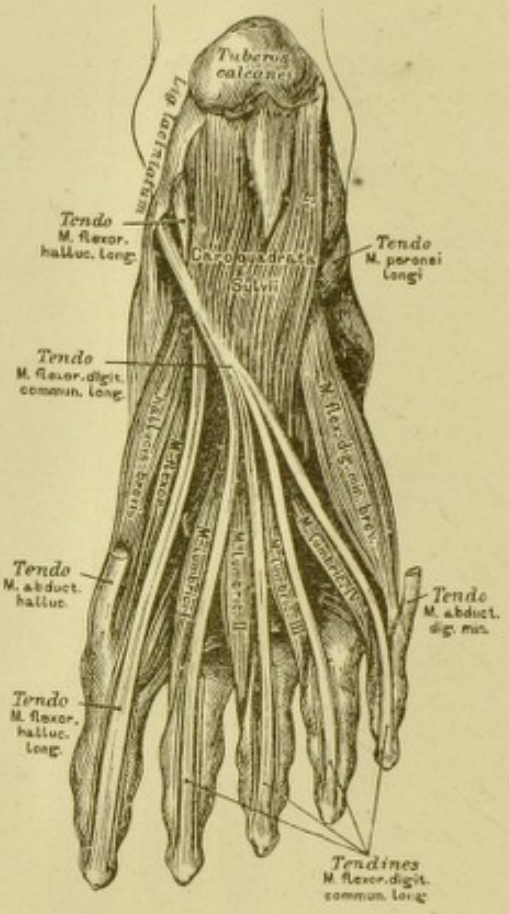
M. extensor digitorum communis brevis arises from the upper surface of the *Os calcis*, and divides into four tendons, of which the most internal is inserted separately into the dorsal surface of the I. phalanx of the great toe, the other three into the long extensor tendons of the second, third and fourth toes.

Fig. 272 shows the *Ligamentum cruciatum*, whose upper portion runs from the internal malleolus to the outer surface of the *Os calcis*, whose lower portion from the scaphoid and internal cuneiform bones to the external malleolus.

Fig. 273 illustrates the *Ligamentum fundiforme tarsi* of Retzius, which receives the tendons of the *M. extensor digitorum communis longus*; it comes from, and goes to the *Sinus tarsi*.



274. The Muscles on the Plantar Side of the Foot.



275. The Muscles on the Plantar Side of the Foot.

The Muscles on the Inner Border of the Foot:

M. abductor hallucis (pollicis) arises from the tubercle and inner surface of the *Os calcis* and from the *Lig. laciniatum s. annulare internum*, and is inserted into the I. phalanx and inner sesamoid bone of the great toe.

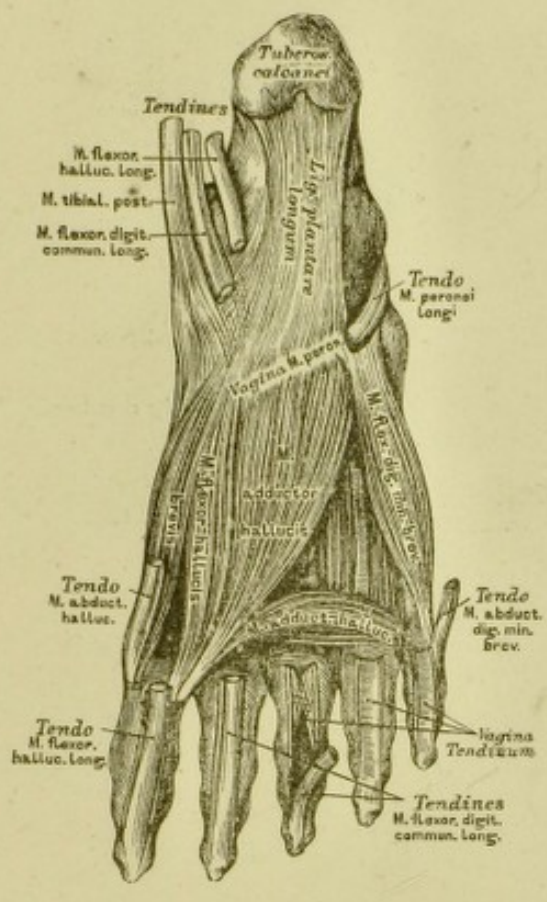
M. flexor brevis hallucis arises from the cuneiform bones and plantar ligaments between the tarsus and metatarsus; it is inserted by two portions into the two sesamoid bones at the I. phalanx of the great toe.

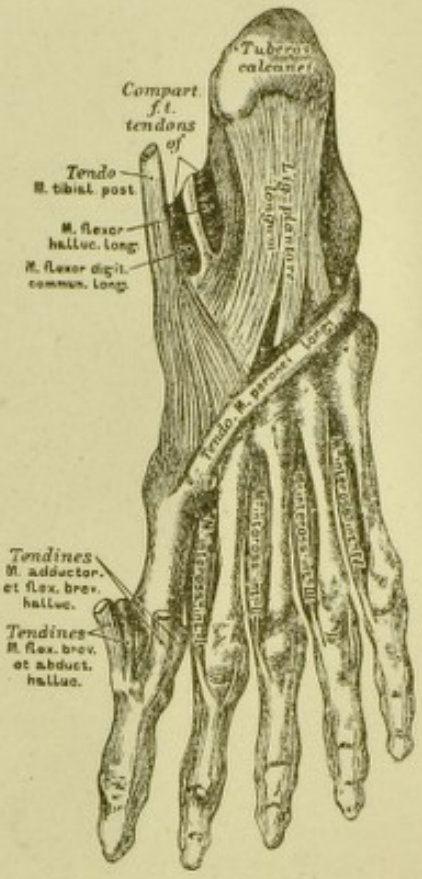
M. adductor hallucis arises by two heads (Fig. 276): a) from the base of the II., III., IV. metatarsal bones and from the fibrous sheath of the tendon of the *M. peroneus longus;* b) from the lower capsular wall of the *Articulatio metatarso-phalangea IV.*, seldom *V.;* they are inserted conjointly into the outer sesamoid bone.

The Muscles at the Outer Border of the Foot:

M. abductor digiti minimi arises from the under surface of the *Os calcis* and the plantar fascia, and is inserted into the outer side of the I. phalanx of the little toe.

M. flexor brevis minimi digiti arises from the calcaneo-cuboid ligament and base of the V. metatarsal bone, and is inserted into the lower capsular wall of the metatarso-phalangeal articulation of the little toe.





276. The Muscles at the Plantar Side of the Foot.

277. The Muscles at the Plantar Side of the Foot.

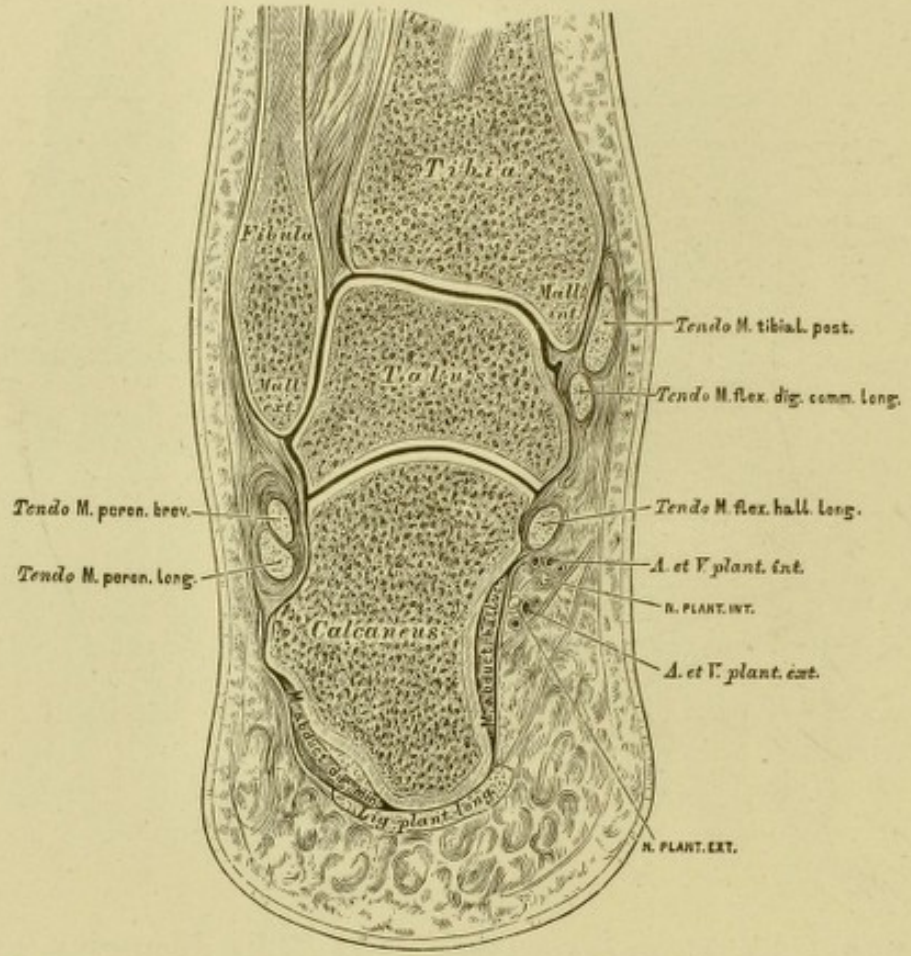
The Muscles in the Middle of the Sole of the Foot:

M. flexor digitorum communis brevis s. perforatus arises from the plantar aponeurosis and tubercle of the *Os calcis;* it divides into four tendons, which, opposite the I. phalanges are perforated by the tendons of the *M. flex. dig. comm. longus,* and are inserted into the sides of the II. phalanges of the four lesser toes. Below this muscle lies the *Flexor accessorius (Caro quadrata Sylvii),* the short head of the *M. flex. dig. comm. longus.*

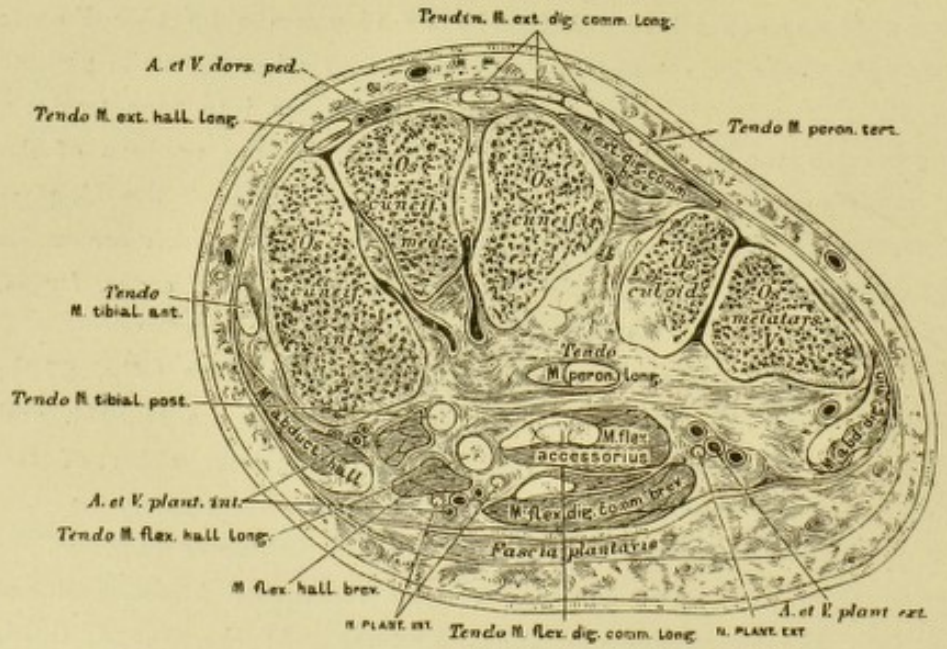
The Interosseous Muscles:

Three *Musculi interossei externi* or dorsal interosseous (Fig. 273); these arise by two heads from the adjacent sides of the II., III. and IV. metatarsal bones, and are inserted into the outer sides of the I. phalanges of the second, third and fourth toes. (Abductors.)

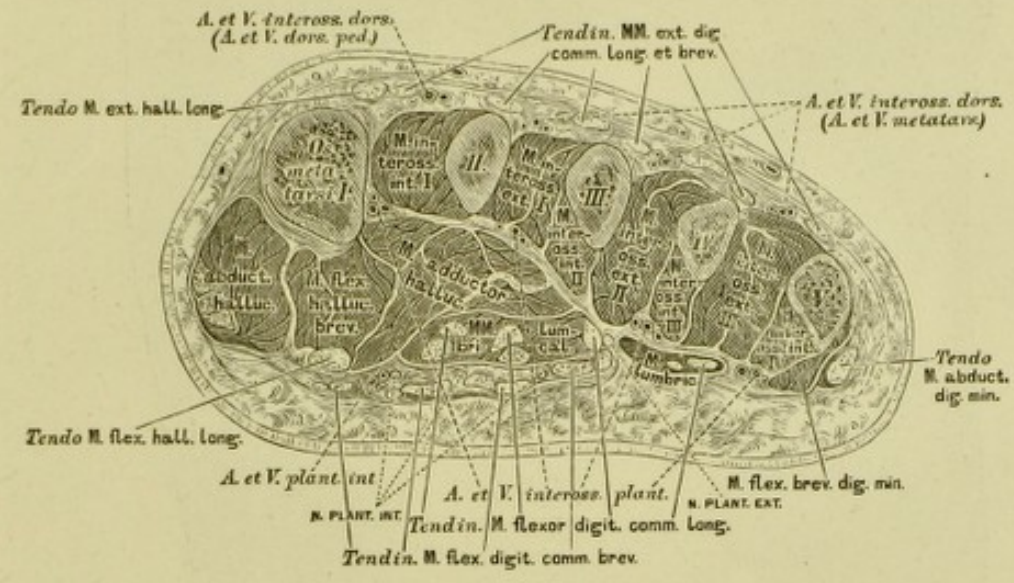
Four *Musculi interossei interni* or plantar interosseous (Fig. 277); they arise from the inner surfaces of the metatarsal bones, and are inserted into the inner sides of the I. phalanges of the second, third, fourth and fifth toes. (Adductors.)



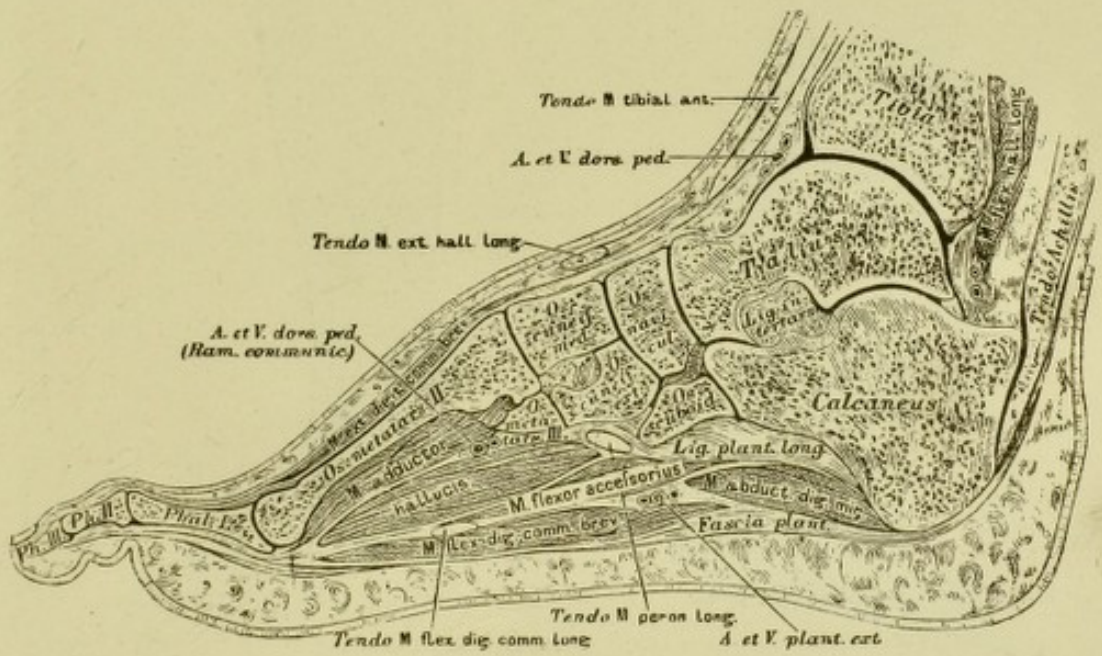
278. Frontal Section through the Ankle-Joint.



279. Frontal Section through the Tarsus.

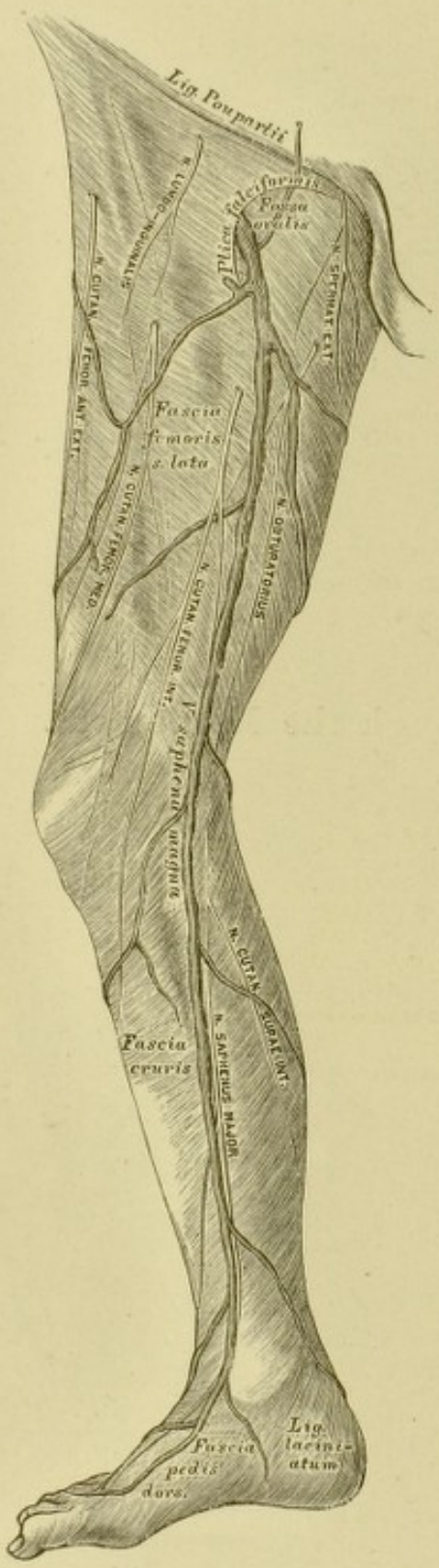


280. Frontal Section through the Metatarsus.

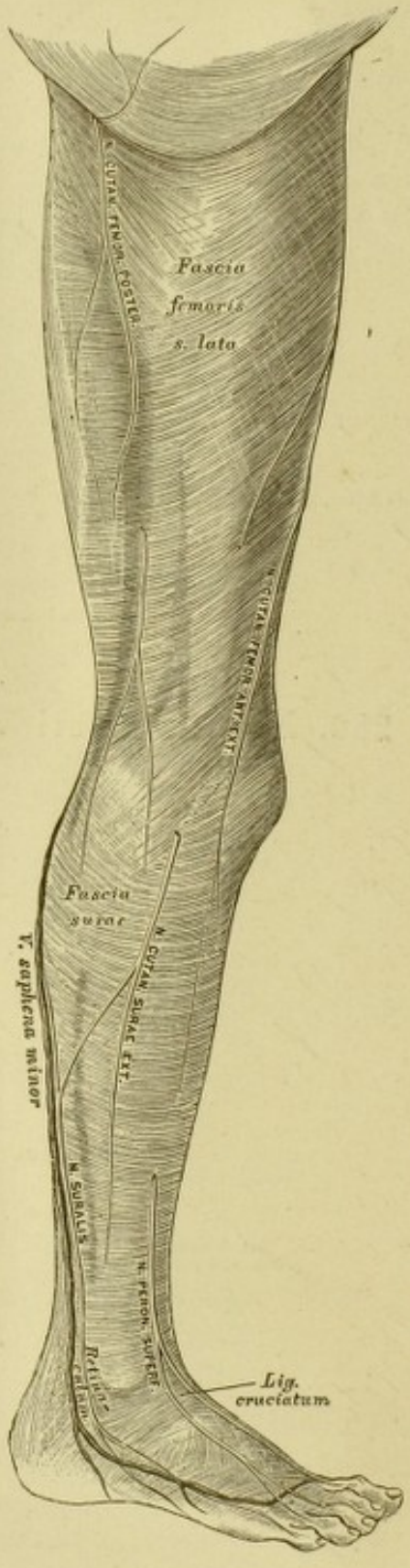


281. Sagittal Section through the Foot,

in the Plane of the Second Toe. $^1/_2$ natural size.



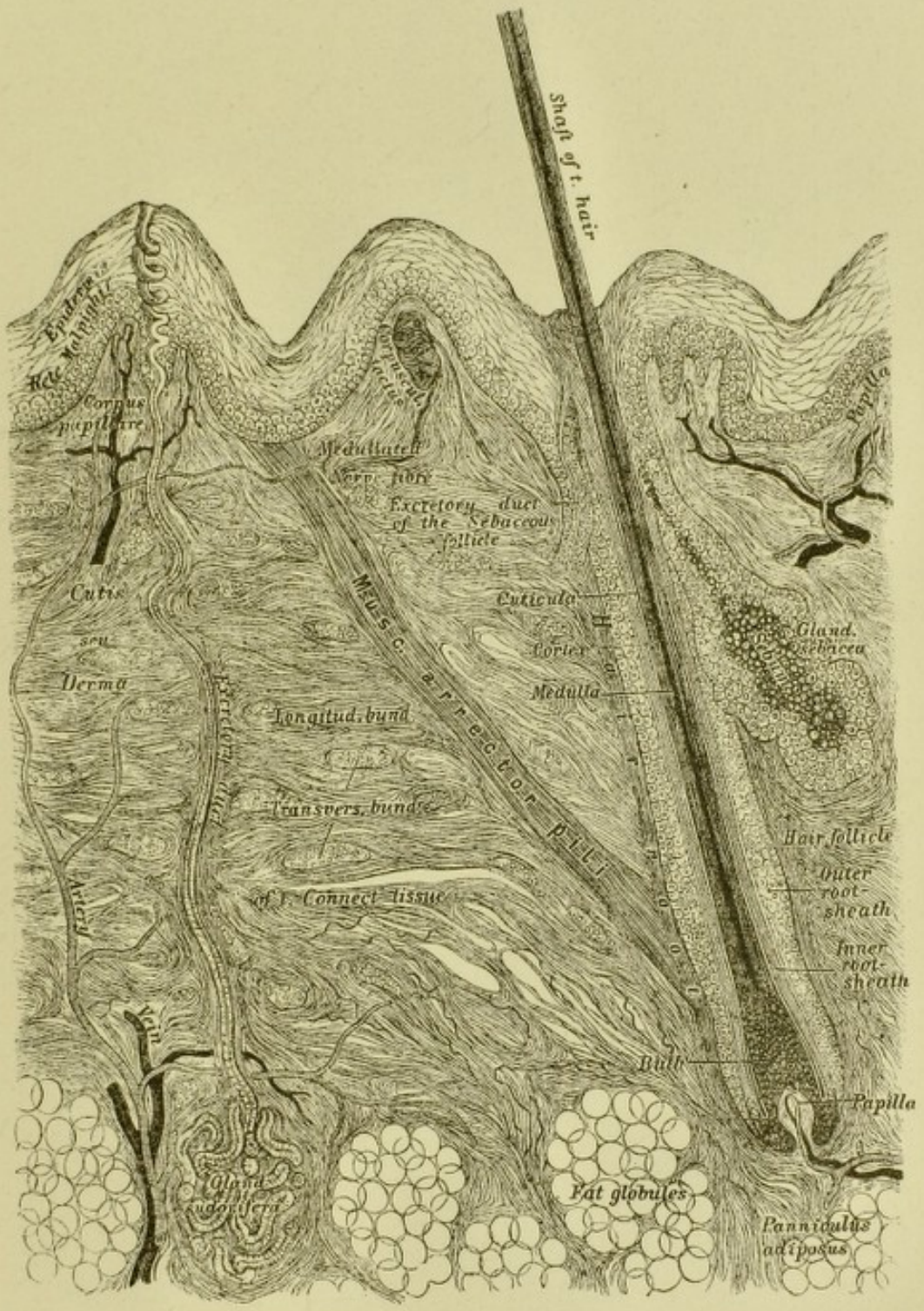
282. The Fascia of the Lower Extremity at the Inner Side.



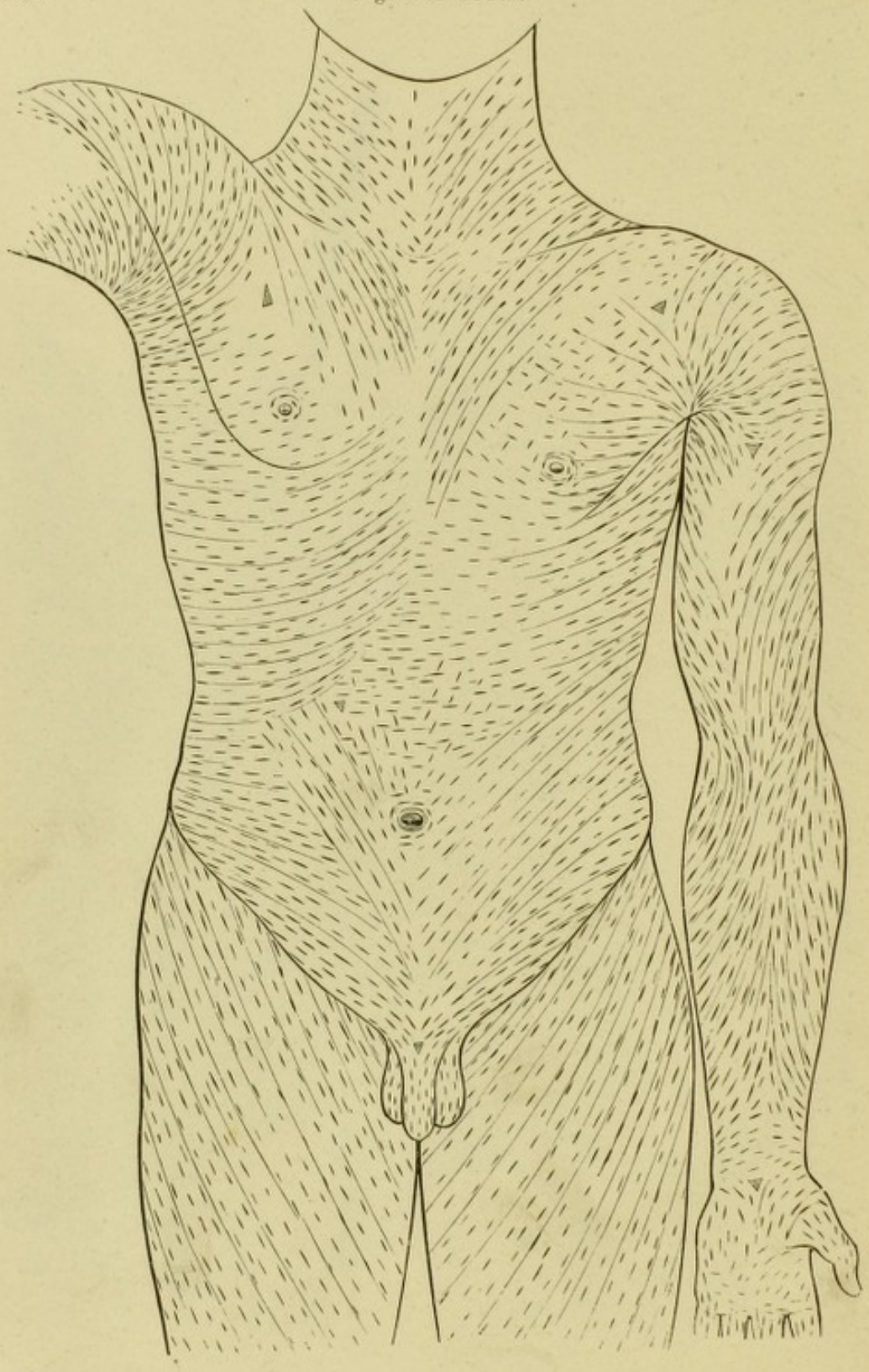
283. The Fascia of the Lower Extremity at the Outer Side.

III.

ORGANS OF SENSE.



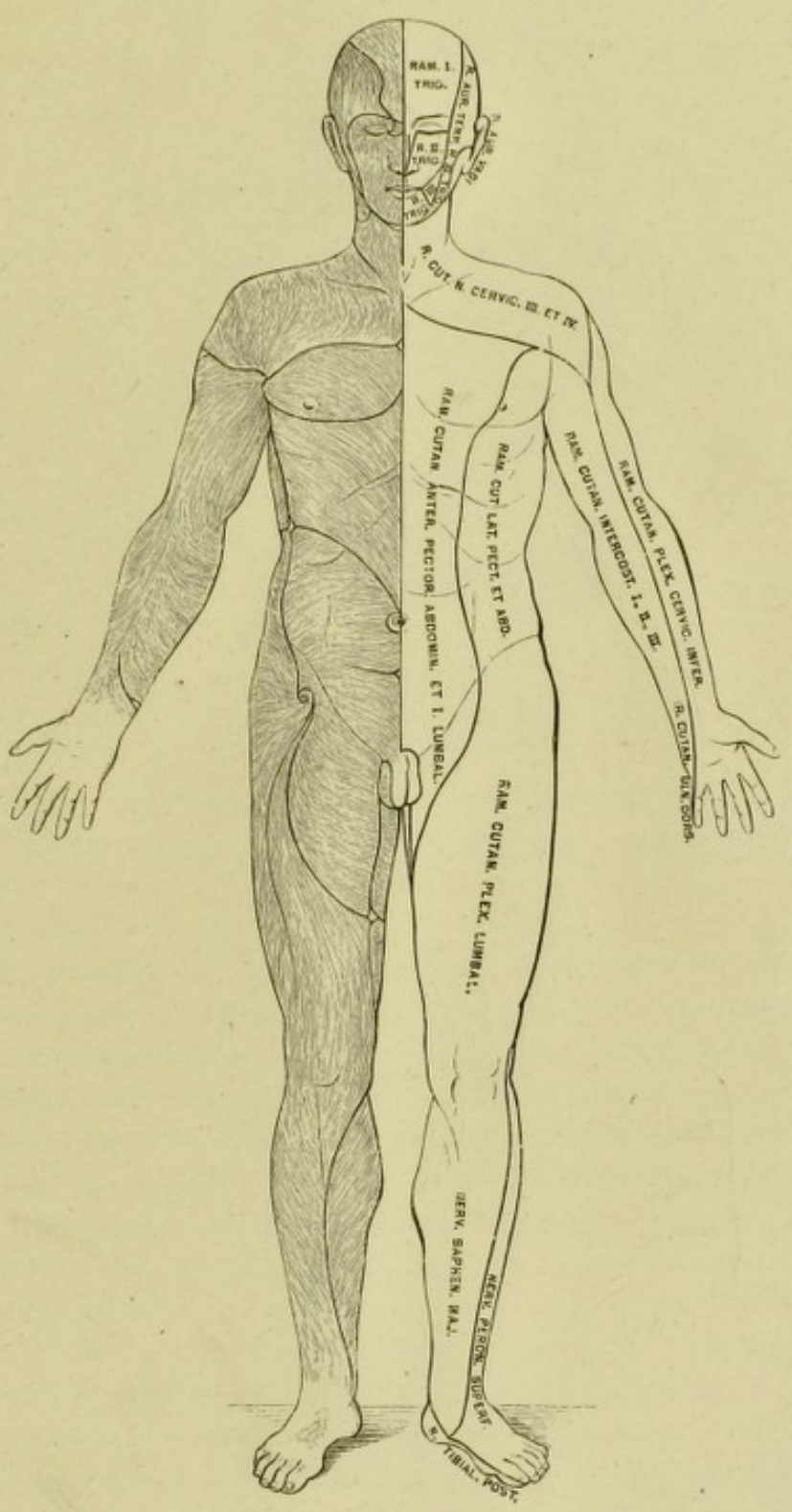
284. Vertical Section through the Skin.
(Diagrammatic.)



285. The Directions of the Cleavings of the Skin.

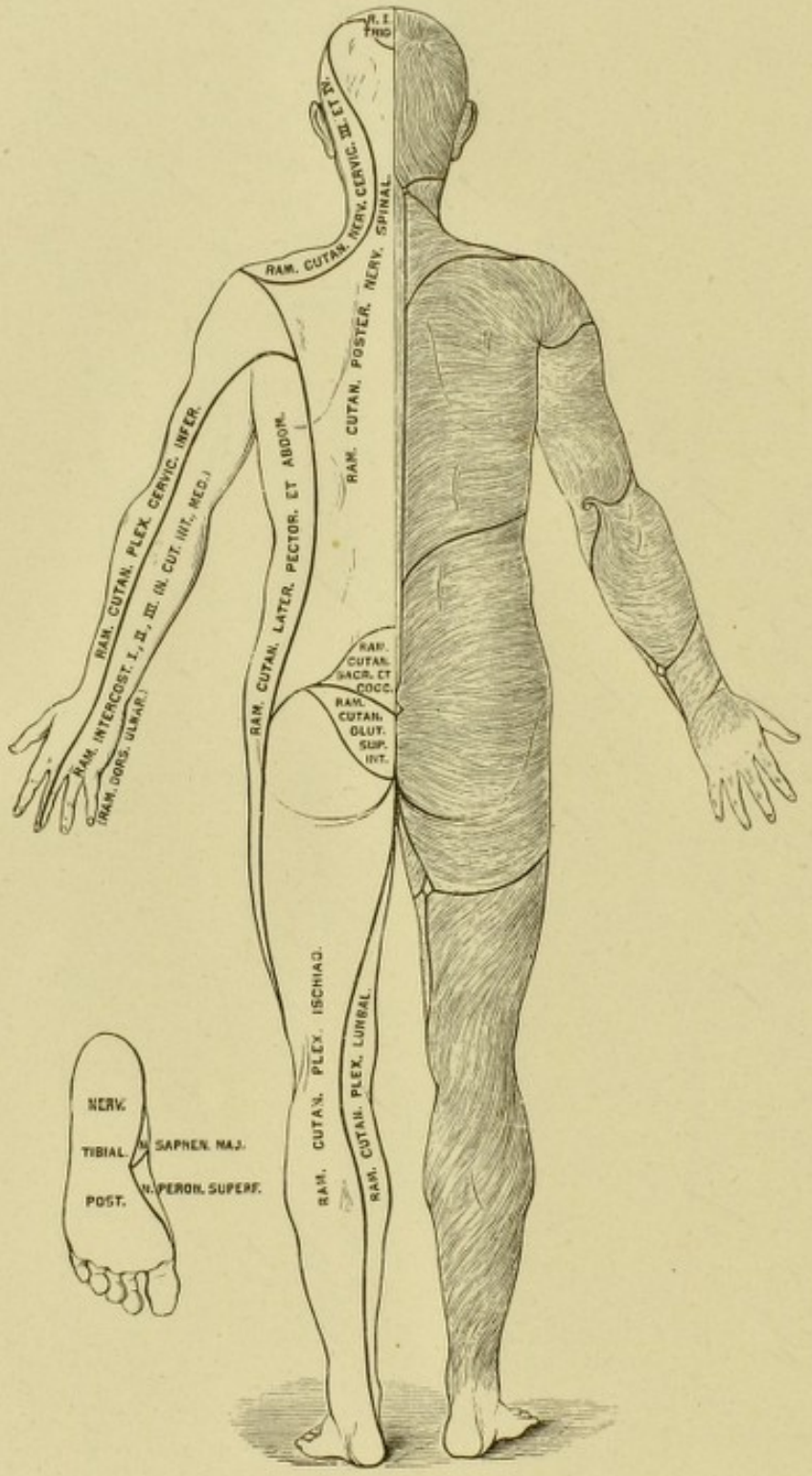
After C. Langer.

Pricks in the skin, produced by a cylindrical instrument, for instance a shoemaker's awl, will, in most cases, immediately after the withdrawal of the instrument, assume the shape of slits. These cleavings correspond to the main direction of the bundles of fibrous connective tissue of the derma.



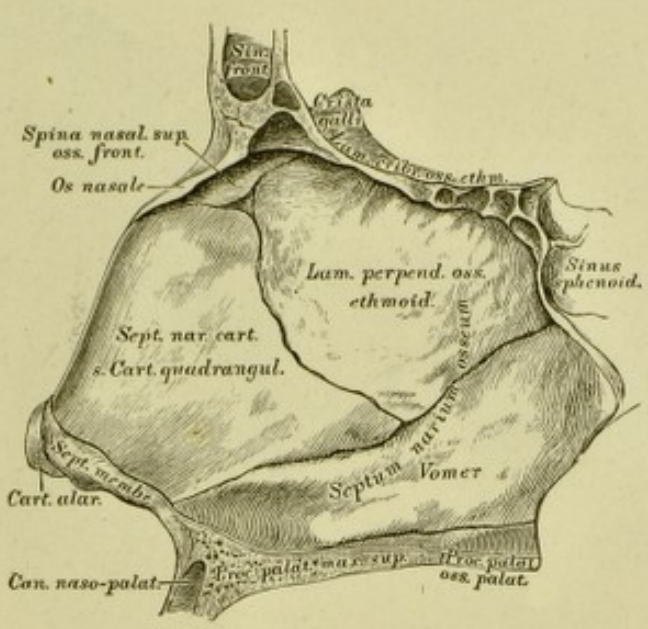
286. The Direction of the Hair and the Regions of Ramification of the Cutaneous Nerves.

After C. Aug. Voigt.



287. The Direction of the Hair and the Regions of Ramification of the Cutaneous Nerves.

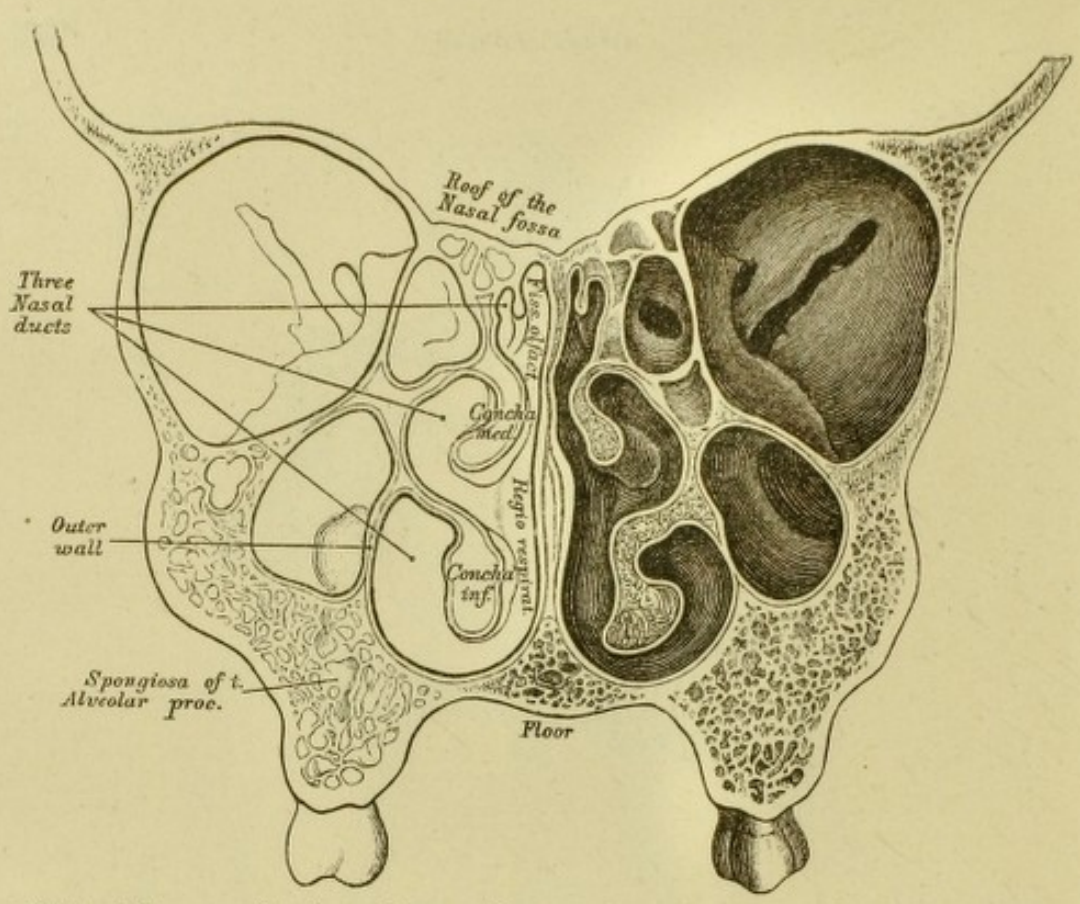
After C. Aug. Voigt.



288. The Cartilaginous and Bony Septum of the Nose, *Septum narium cartilagineum et osseum.*

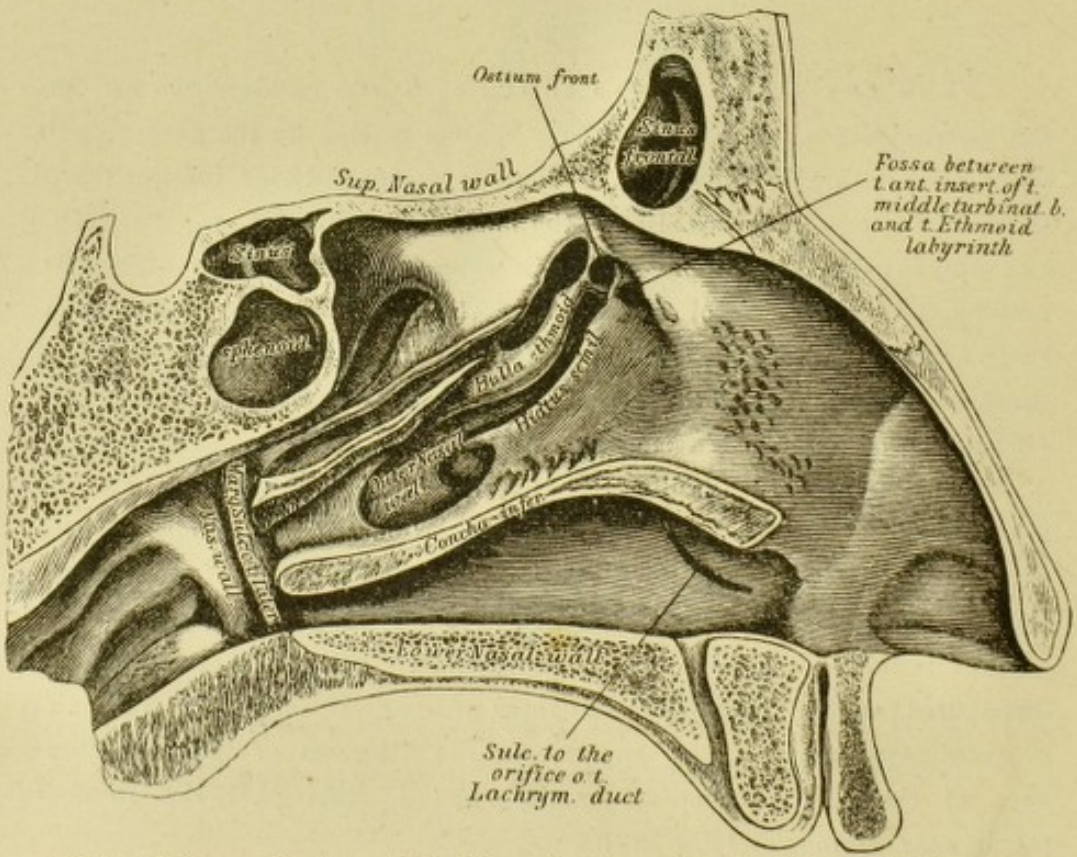
The cartilage of the septum, *Septum cartilagineum seu Cartilago quadrangularis*, completes the bony septum formed by the perpendicular plate of the ethmoid bone and the vomer; at its anterior inferior margin is the *Septum membranaceum*. Below the nasal bones are the two triangular cartilages, *Cartilagines triangulares* (upper lateral cartilages, Fig. 291), and in the upper half of the wings of the nose, the two alar cartilages, *Cartilagines alares* (lower lateral cartilages, Fig. 291); between these and the margin of the *Incisura pyriformis* are the sesamoid cartilages, *Cartilagines sesamoideae seu minores.*

The nasal cavity is lined by the pituitary or Schneiderian membrane, *Membrana pituitaria narium*, which is continuous with the skin through the nostrils, with the mucous membrane of the pharynx through the posterior nares, *Choanae*. In the upper or olfactory region of the mucous membrane, *Regio olfactoria*, the filaments of the olfactory nerve are distributed, and in this portion the sense of smell is lodged. In the lower or respiratory region, *Regio respiratoria*, the filaments of the nasal branches of the *Nervus trigeminus* ramify, and in this part the sense of touch only is lodged (Fig. 293).



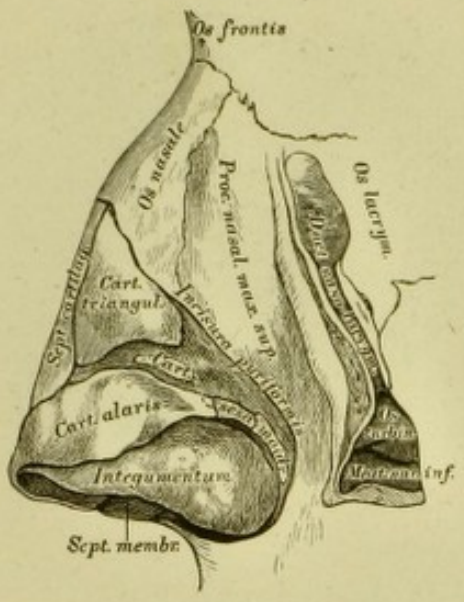
289. Frontal Section through the Nasal Cavities.

After E. Zuckerkandl.

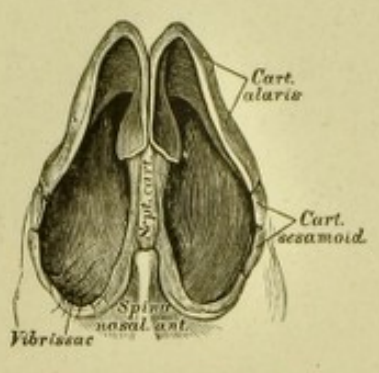


290. The Outer Wall of the Left Nasal Fossa.

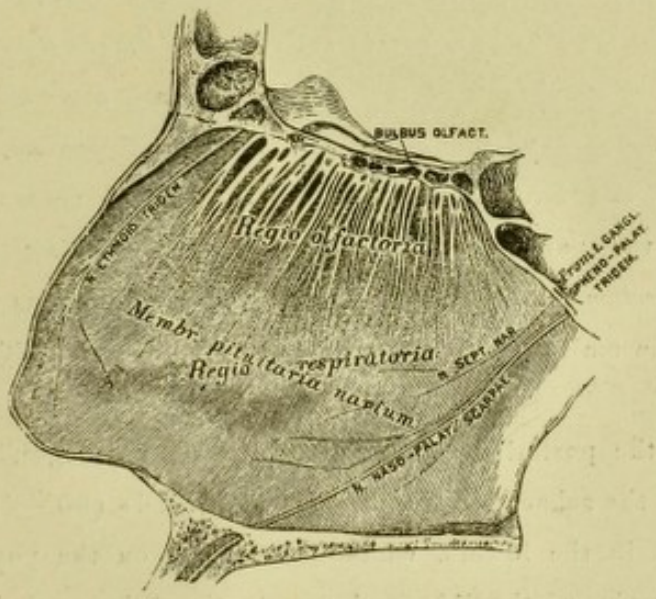
After E. Zuckerkandl.



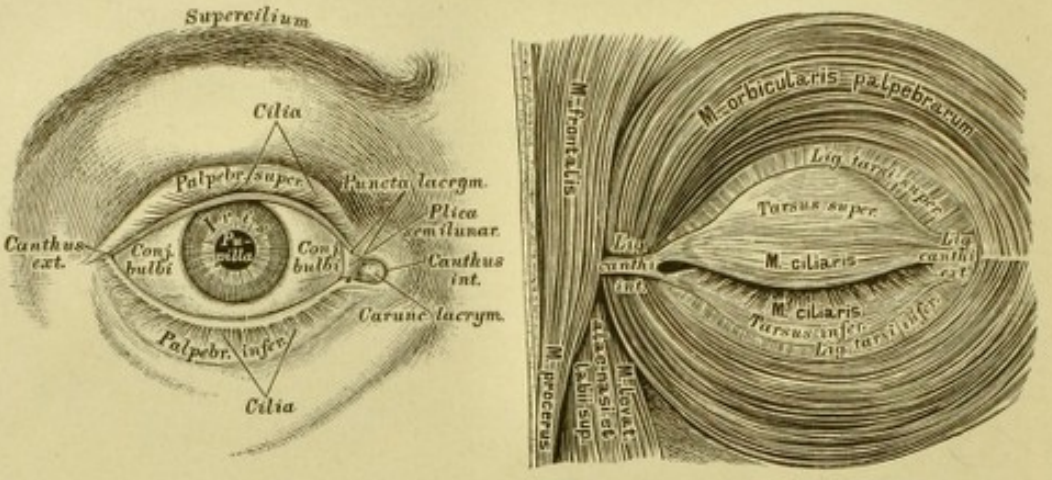
291. The Cartilages of the Nose. Lateral View.



292. The Cartilages of the Nose. View from below.



293. The Pituitary Membrane, *Membrana pituitaria narium (septi).*



294. The Eye and the Muscles of the Eyelid.

The eyelids, *Palpebrae*, are moveable portions of integument, whose free margins limit the *Rima palpebrarum;* this latter ends in an acute outer angle, *Canthus externus*, and a rounded inner angle, *Canthus internus*. The eyelashes, *Cilia*, are attached to the free edges of each eyelid. The tarsi, *Tarsus superior* and *Tarsus inferior*, are placed in the mucous membrane of the eyelids, and are attached to the upper and lower margins of the orbit by the strong *Ligamenta tarsi superioris et inferioris;* the thick *Ligamentum canthi internum* runs from the inner canthus to the nasal process of the superior maxillary bone, and the broad *Ligamentum canthi externum* from the outer canthus to the frontal process of the malar bone. The ciliary muscle, *M. ciliaris*, lies upon the tarsus.

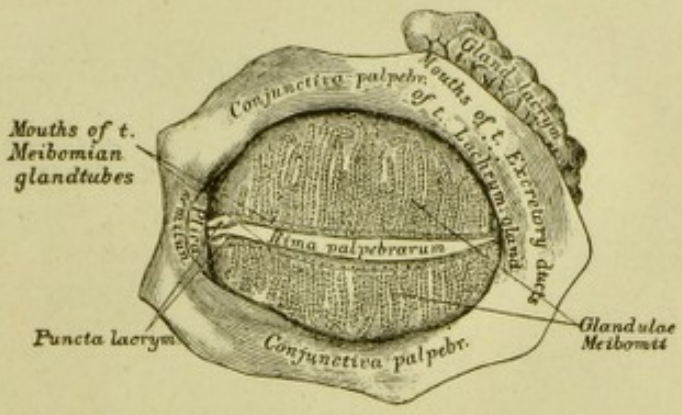
Upon the posterior surface of the tarsal cartilages, or surrounded by them, are the sebaceous Meibomian glands (30—40 in the upper lid, 25—35 in the lower), whose ducts open on the posterior part of the free margin of the lids, and secrete the *Sebum palpebrale seu Lema* (Fig. 295, 296).

The eyebrows, *Supercilia*, are the arched eminences of integument, along the upper circumferences of the orbits, which support numerous short, thick hairs.

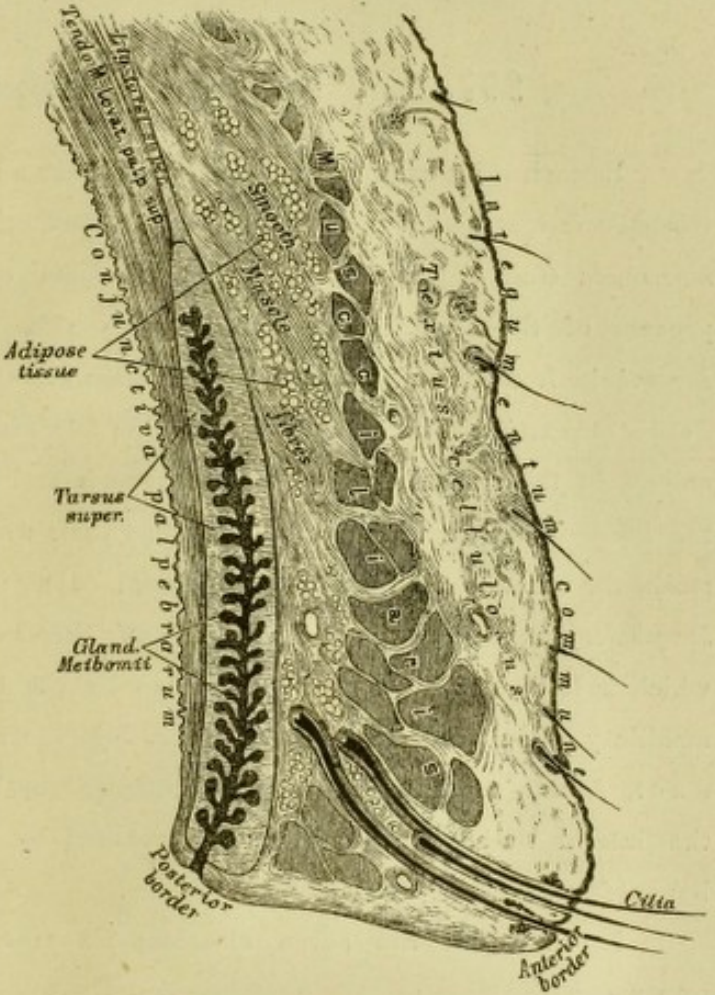
The conjunctiva is a mucous membrane, which, as continuation of the *Integumentum commune* covers the posterior surface of the eyelids, where it is called *Conjunctiva palpebrarum*, is reflected from the lid ou to the globe of the eye, which portion is named *Fornix conjunctivae*, and then surrounds the anterior surface of the eyeball, being there called *Conjunctiva bulbi*.

Upon the sclerotic coat, the conjunctiva changes its character, becoming thinner and loosely connected to the globe; upon the cornea it is extremely thin and closely adherent.

At the inner angle of the eyelid the conjunctiva forms a semilunar fold, *Plica semilunaris*, at the anterior side of which is a small, reddish body, the *Caruncula lacrymalis*.

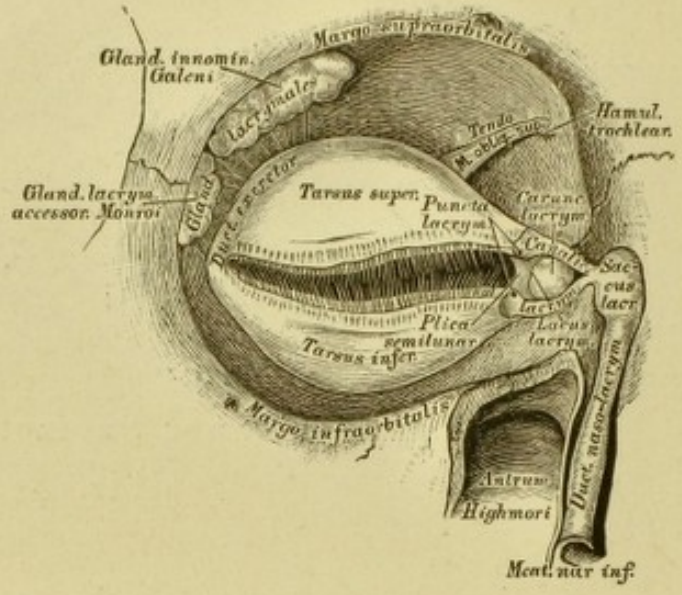


295. The Inner Surface of the Eyelids.



296. Vertical Section through the Upper Eyelid.

(Diagrammatic.)

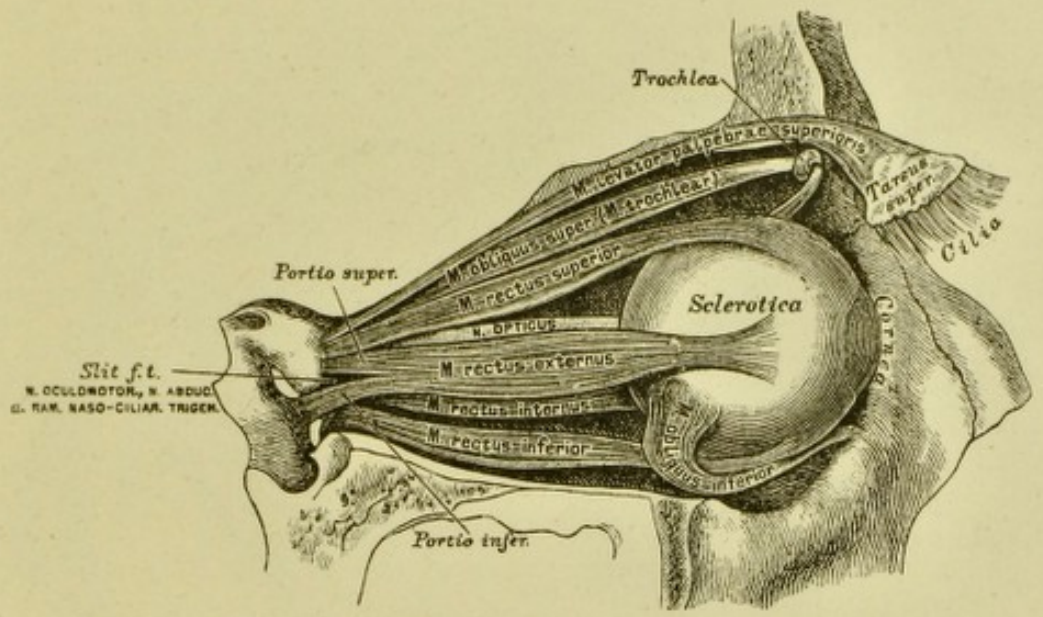


297. The Lachrymal Apparatus.

In each orbit are two compound racemose lachrymal glands, *Glandulae lacrymales*, not entirely distinct from each other; the larger, *Glandula innominata Galeni*, lies in the lachrymal fossa of the external angular process of the frontal bone; the smaller, *Glandula lacrymalis accessoria Monroi*, in front of and below it. The ten fine excretory ducts open at the *Fornix conjunctivae*. The tears, which, in the fornices are conveyed inwards, collect in the sinus between *Plica semilunaris* and *Caruncula lacrymalis*, in the *Lacus lacrymarum;* from here they find their way into the *Puncta lacrymalia*, the minute orifices of the lachrymal canals; then into the *Canaliculi lacrymales;* thence into the lachrymal sac, *Saccus lacrymalis s. Dacryocystis*, which is lodged in a deep groove formed by the lachrymal and superior maxillary bones. The lachrymal sac leads into the membranous nasal duct, *Ductus naso-lachrymalis*, which opens into the inferior meatus, at the lateral wall of the nasal cavity, covered by the inferior turbinated bone (see Fig. 291).

In the orbit are seven muscles; six move the eyeball, one the upper eyelid.

M. levator palpebrae superioris arises from the upper surface of the sheath of the optic nerve, and is inserted below the upper border of the orbit into the superior tarsal cartilage.

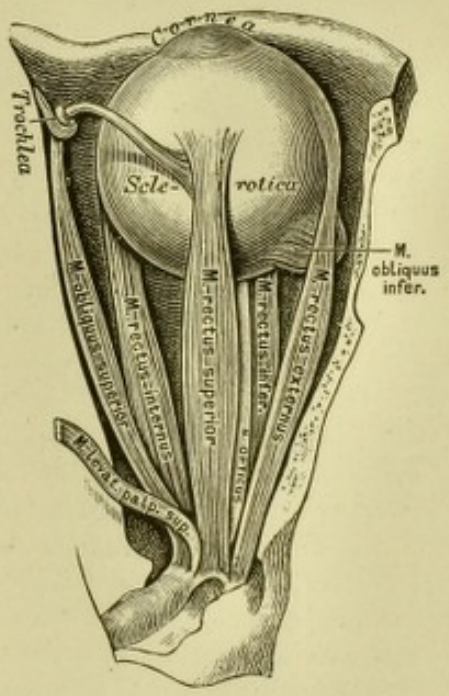


298. The Muscles of the Eye, from the outside.

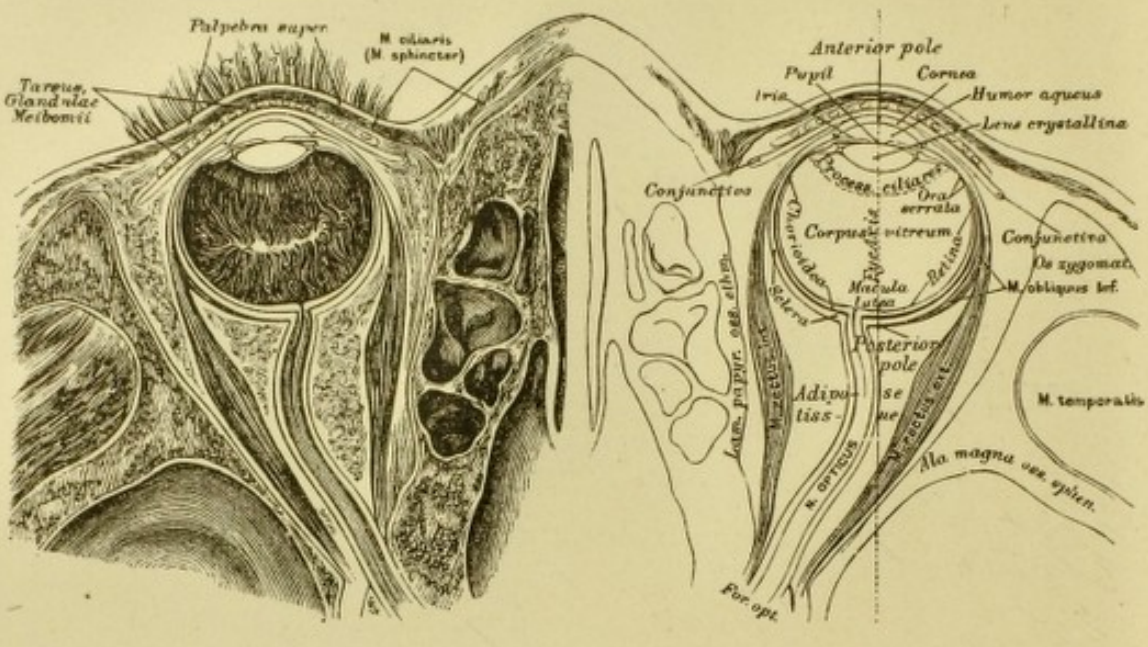
M. rectus internus, *M. rectus externus*, *M. rectus superior*, *M. rectus inferior* arise in the vicinity of the sheath of the optic nerve, run forwards, and are inserted by tendinous expansions at a distance of from 2 to 3 lines from the margin of the cornea into the sclerotica. The *M. rectus externus* arises by two heads.

M. obliquus superior s. M. trochlearis is placed at the upper and inner side of the orbit; its tendon passes through a fibro-cartilaginous ring or pulley, *Trochlea*, which is attached to the trochlear fossa, *s. Hamulus trochlearis* of the frontal bone, and passing outwards and backwards is inserted into the sclerotic coat.

M. obliquus inferior arises at the inner end of the lower margin of the orbit; it passes outwards, upwards and backwards and is inserted into the sclerotic coat.



299. The Muscles of the Eye, from above.



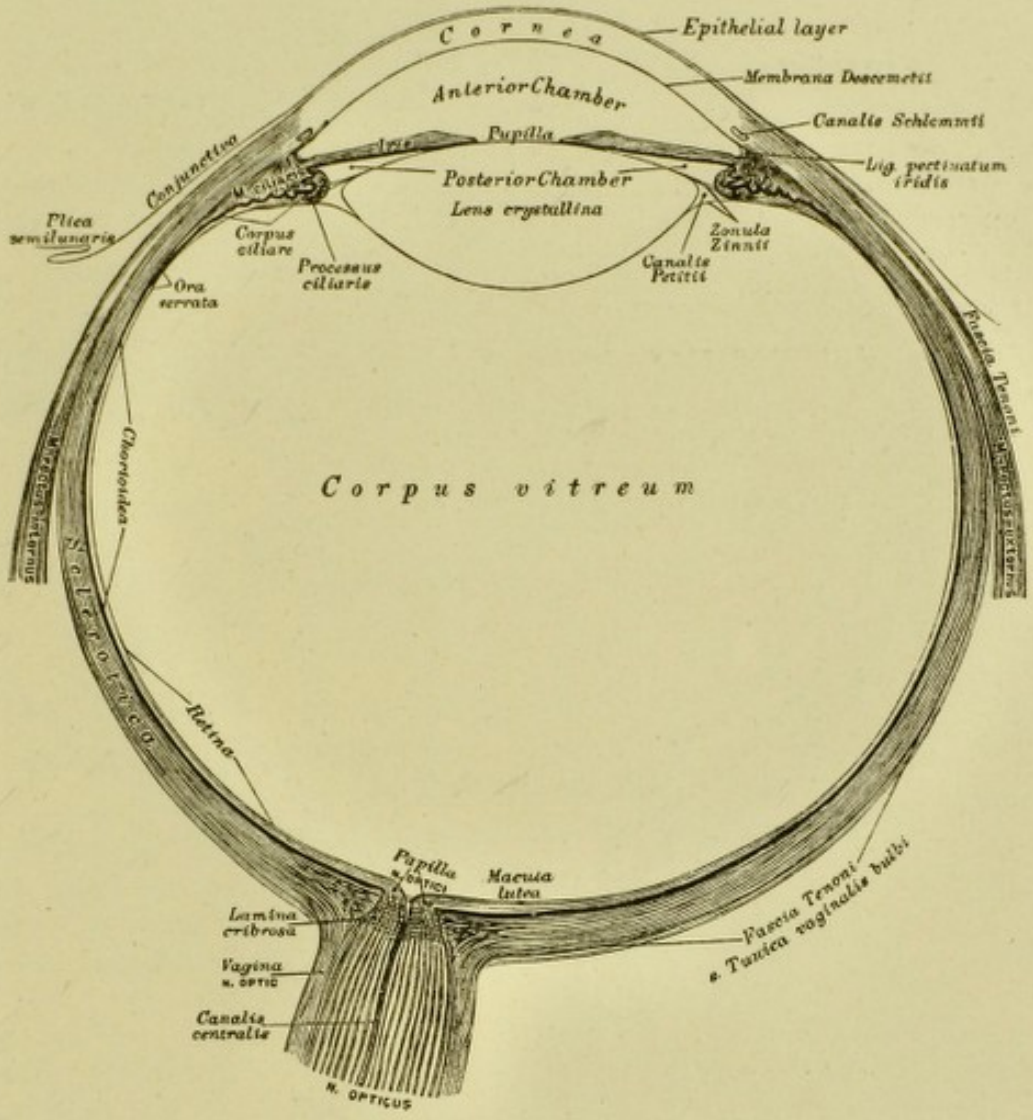
300. Horizontal Section through both Eyeballs.

After Ferdinand Arlt sen.

The eyeball, *Bulbus oculi*, consists of three concentric coats; these coats are: a) the white sclerotic coat, *Sclerotica s. Sclera*, and the transparent *Cornea;* b) the choroid, *Chorioidea*, and the *Iris;* c) the *Retina*. The cavity of the eyeball is filled out by the aqueous humor, *Humor aqueus*, the crystaline lens, *Lens crystallina*, and the vitreous body, *Corpus vitreum*.

The sclerotica is an opaque, fibrous coat, whose most anterior segment is joined with the cornea, and whose posterior part is pierced for the passage of the optic nerve; this perforation is not in the axis of the eye, but about a line internal to it. At the point where the optic nerve passes through the sclerotica, this membrane forms a thin, cribriform lamina, *Lamina cribrosa*. The inner surface of the sclerotic is covered with delicate pigmented bundles of connective tissue, the *Lamina fusca*.

The cornea projects forwards beyond the sclerotic; it is nearly circular, but a little broader in the transverse direction; the anterior surface is encroached upon by the sclerotic. Near the junction of the sclerotic and cornea is a venous, cavernous sinus, the canal of Schlemm (see Fig. 302, 303). The substance of the cornea consists of transparent connective tissue bundles, which cross one another at right angles in the alternate layers; the epithelium which covers the front of the cornea, consists of several layers of epithelial cells; beneath this is the structureless anterior elastic lamina of Bowman; the posterior surface consists of a single layer of epithelial cells, above which is the *Membrana Descemetii*.

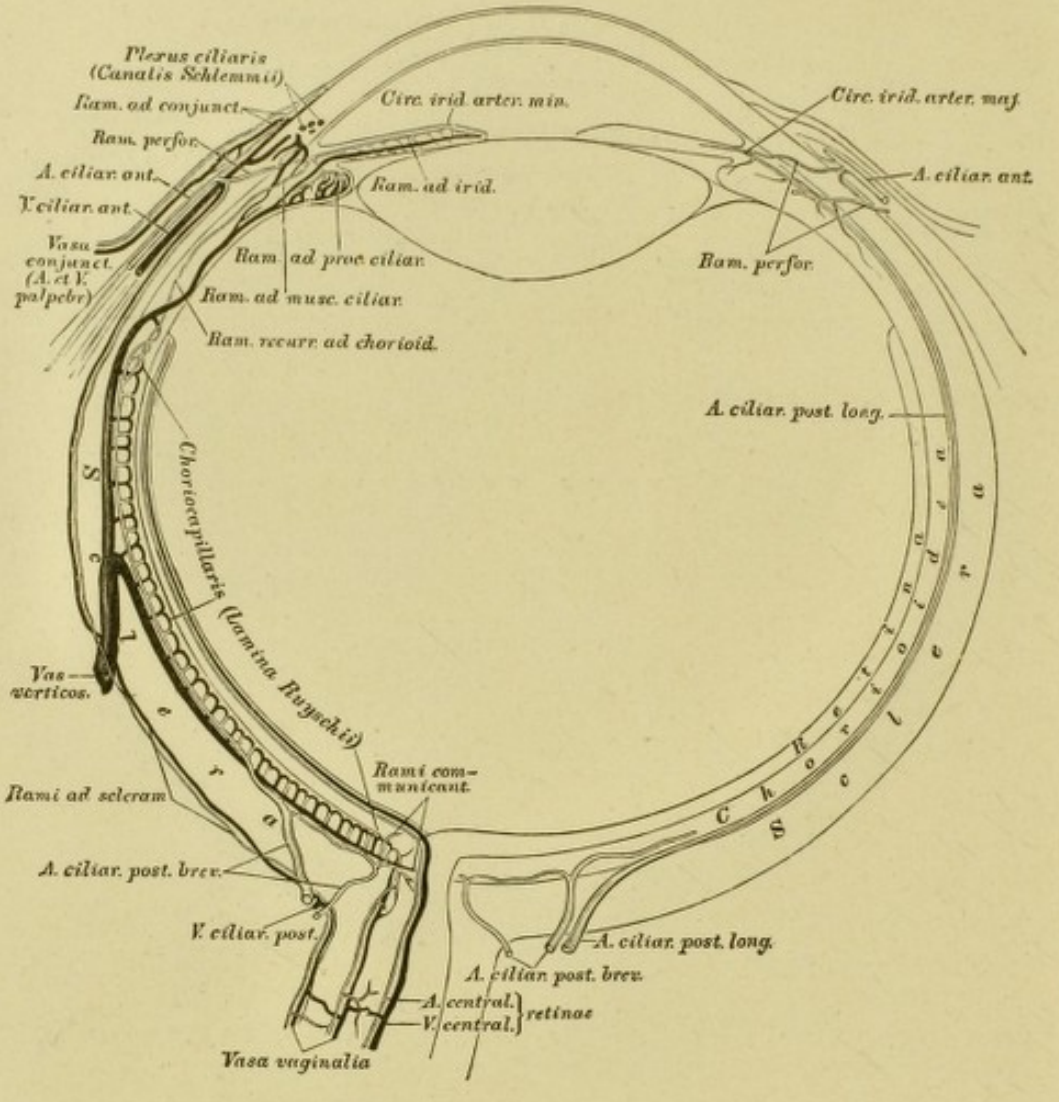


301. Section of the Eyeball. Magn. = 4.

After Ferdinand Arlt sen.

The choroid and iris form the second layer of the eyeball. The former lies on the inner surface of the sclerotic; its outer pigmented connective tissue layer is similar to the *Lamina fusca* of the sclerotic; the middle layer of the choroid is formed by the bloodvessels, whose network of capillaries was called *Lamina Ruyschii;* the inner surface, which is smooth, is covered by the hexagonal pigmented cells of the retina — *Tapetum nigrum.*

At the anterior margin of the sclerotic, the choroid becomes thickened, forming the *Corpus ciliare.* The superficial layer of the ciliary body is the *Musculus ciliaris s. Tensor chorioideae* (see Fig. 303), (meridional and radiating fibres); the deep layer, the *Corona ciliaris,* a circle of from 70—85 folds, each of which is called ciliary process, *Processus ciliaris.* The indented border between the folded and smooth part of the choroid is the *Ora serrata.*



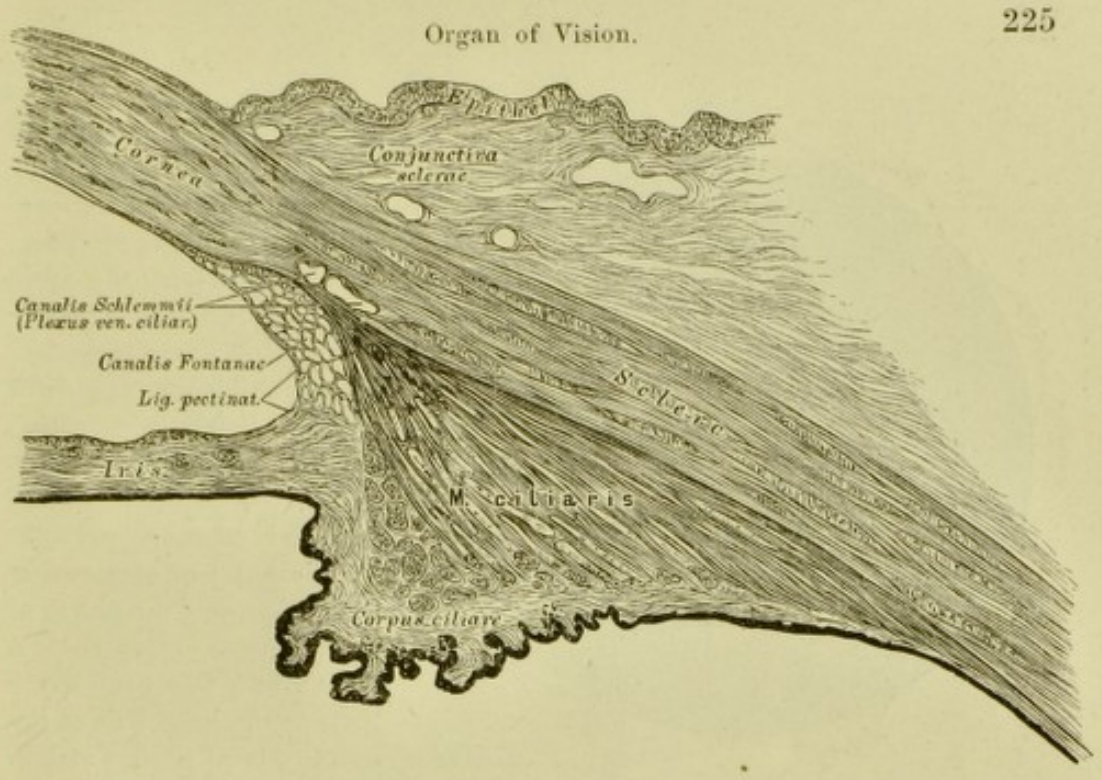
302. Diagram of the Bloodvessels of the Eyeball.

Magn. = 4.

After Theodor Leber.

The iris consists of muscular and connective tissue, besides numerous vessels and nerves; its inner edge, *Margo pupillaris*, forms the margin of the pupil, *Pupilla;* between it and the cornea is the anterior chamber of the eye, between it and the lense the posterior chamber; both chambers are filled with the aqueous humor. The outer margin of the iris, *Margo ciliaris,* is a direct continuation of the *Corpus ciliare* and is connected with the *Membrana Descemetii* by means of the *Ligamentum pectinatum* (see Fig. 303).

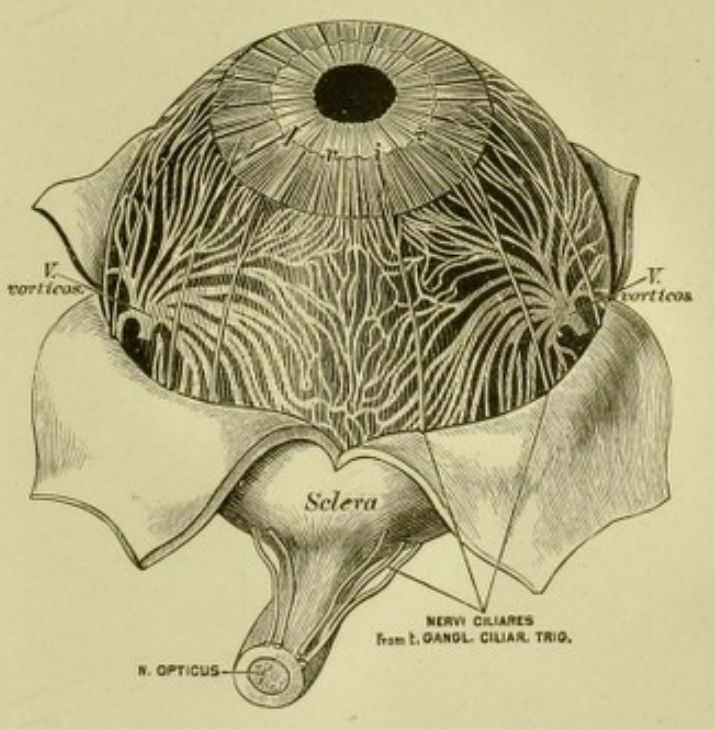
The structure of the iris is seen from Fig. 303; of its muscles the circular fibres, *Sphincter pupillae*, surround the margin of the pupil, while the radiating fibres, *Dilatator pupillae,* arise from the margin of the cornea.



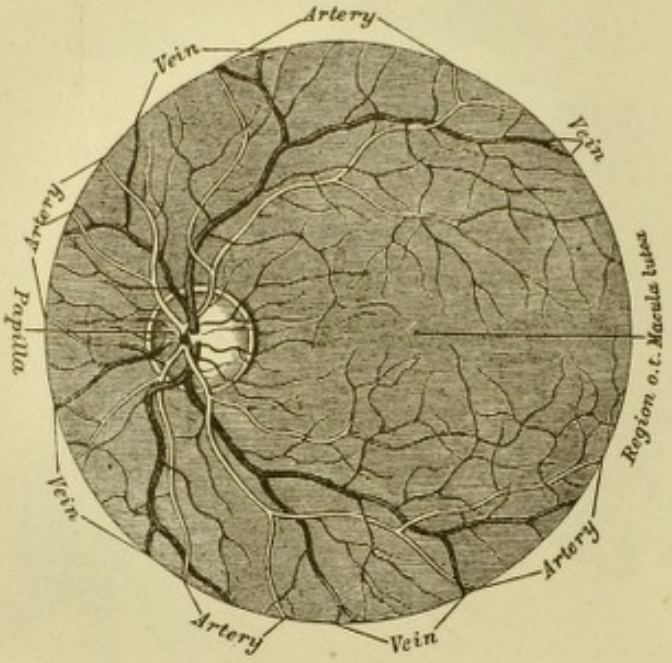
303. Section at the Place where the Sclerotic is continued into the Cornea. Magn. = 100. After a Specimen of Alex. Iwanoff.

The choroid is supplied with blood by three or four short ciliary arteries, *Arteriae ciliares posticae breves*, the iris and the ciliary muscle by the two long ciliary arteries, *Arteriae ciliares posticae longae* and the anterior ciliary, *Arteriae ciliares anticae*, whose number differs (all are branches of the ophthalmic artery). The veins, *Vasa vorticosa*, four or five in number, developed from the capillaries, pierce the sclerotic about half way between the cornea and place of entrance of the optic nerve. The blood also flows through the *Venae ciliares anticae et posticae*.

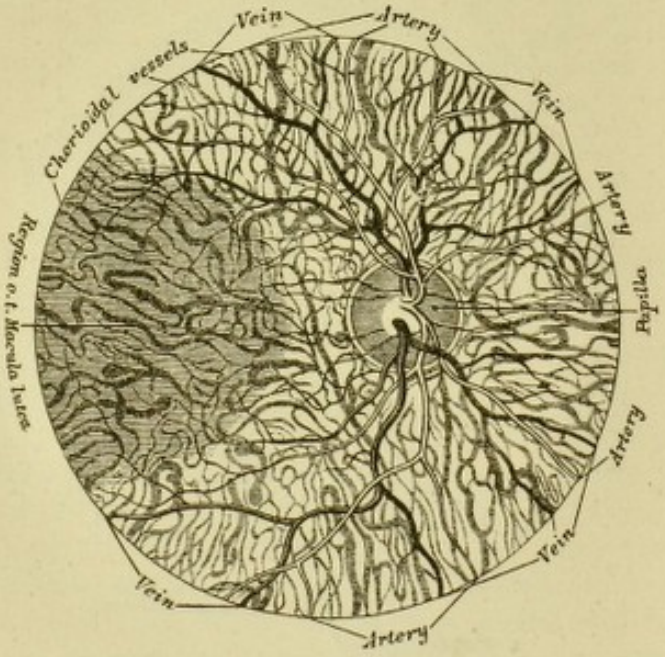
The iris, choroid and ciliary muscle are supplied by the ciliary nerves, which, ten to sixteen in number, pierce the sclerotic at its posterior portion; also by fibres from the *Nervus sympathicus*.



304. The Nerves of the Iris and Chorioidea.
Magn. = 2.



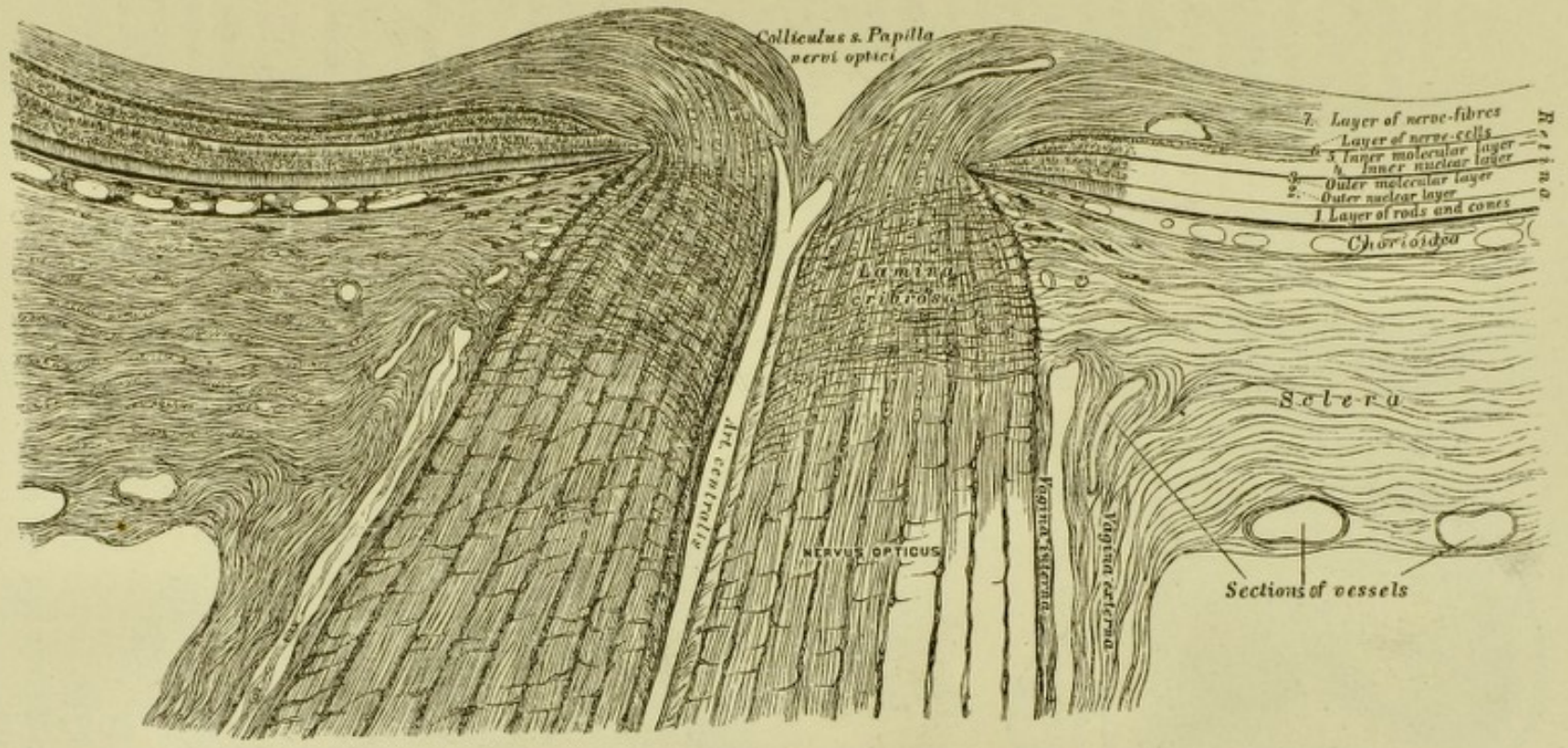
305. The View with the Ophthalmoscope of the Pigmented *Fundus Oculi.* Magn. = 7. After Ed. v. Jaeger.



306. The View with the Ophthalmoscope of the Unpigmented (albinotic) *Fundus Oculi.*
Magn. = 7. After Ed. v. Jaeger.

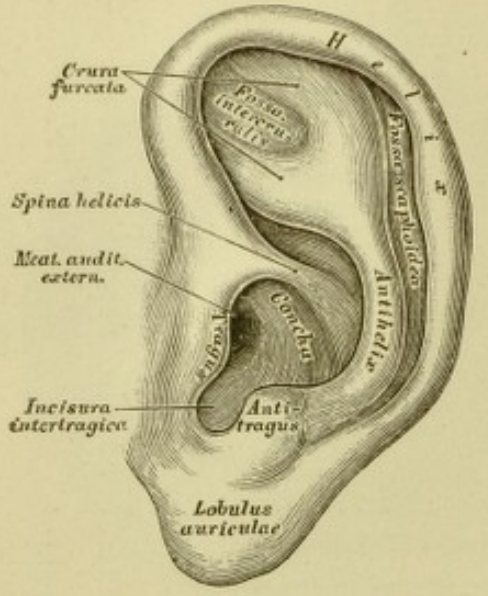
The retina, expansion of the optic nerve, is the innermost layer of the eyeball, the real organ of vision. The place where the optic nerve pierces the sclerotic and choroid coats, is marked by an eminence, the *Colliculus seu Papilla nervi optici;* here the bloodvessels, *Art.* and *Vena centralis retinae,* find their entrance and exit. At the point of entrance of the optic nerve the power of vision is absent (blind spot), and this part lies a little to the inner side of the point of most perfect vision. This latter point has a slight central depression, *Fovea centralis;* in the eye of the cadaver it is seen as a yellow spot, *Macula lutea,* and only there it is connected by two eminences, *Plicae centrales,* with the papilla. The layers of the retina (see Fig. 307) are distinct up to the region of the *Ora serrata;* from here on only the structureless *Membrana limitans,* lying between the layer of rods and cones and innermost layer of the choroid, remains.

The vitreous body, *Corpus vitreum,* occupies the greater portion of the eyeball; it is covered by a thin glassy membrane, the *Hyaloidea,* which, in front, where it passes forwards to the margin of the crystaline lens, is known as the *Zonula Zinnii.* Between the anterior and posterior fibres of the zonula is the *Canalis Petiti* (see Fig. 301).

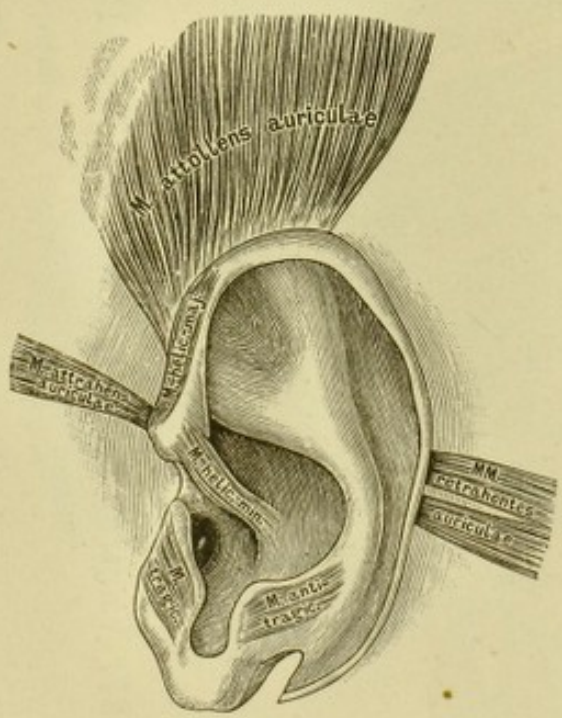


307. Vertical Section through the Place of Entrance of the Optic Nerve.

After a Specimen of Alex. Iwanoff.



308. The Auricle, *Auricula.*

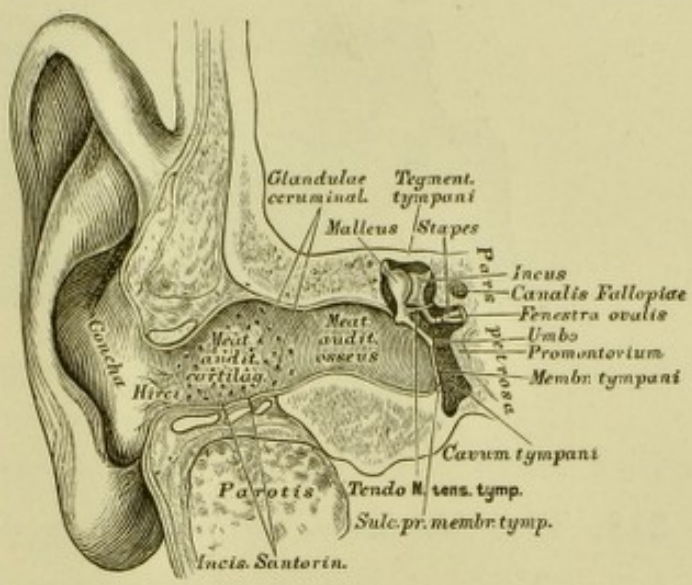


309. The Muscles of the Auricle.

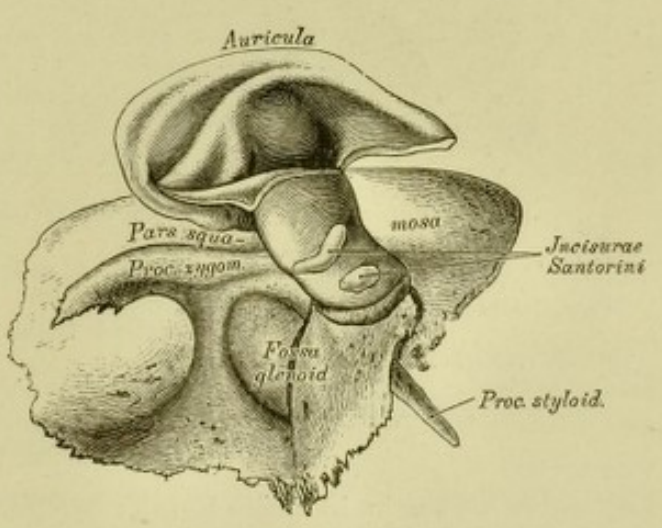
The pinna or auricle is formed by a layer of fibro-cartilage; its external rim is called the helix, which commences as *Spina helicis;* to the inner side of the helix is the fossa of the helix or *Fossa scaphoidea;* internal to that, the curved antihelix, the commencement of which is formed by two ridges, the *Crura furcata.* The deepest concavity of the pinna, surrounding the entrance to the external auditory meatus is called concha. In front of the concha, and projecting backwards over the meatus is the tragus; opposite it the antitragus; between both is a deep notch, the *Incisura intertragica.* Below the notch is the lobule, *Lobulus auriculae,* devoid of the firmness and elasticity of the rest of the pinna.

The muscles of the auricle are: the *M. attollens (levator) auriculae,* the *M. attrahens auriculae* and the *MM. retrahentes auriculae.* Between the projections of the cartilage of the ear are: the *M. helicis major,* which arises from the *Spina helicis,* and is inserted into the anterior border of the helix where it is about to curve backwards; the *M. helicis minor* at the commencement of the *Spina helicis;* the *M. tragicus* upon the anterior surface of the tragus; the *M. antitragicus* from the lower end of the antihelix to the antitragus. The *M. transversus auriculae* lies at the convex posterior surface of the cartilage of the ear, between the tubercles of the concha and the fossa of the helix.

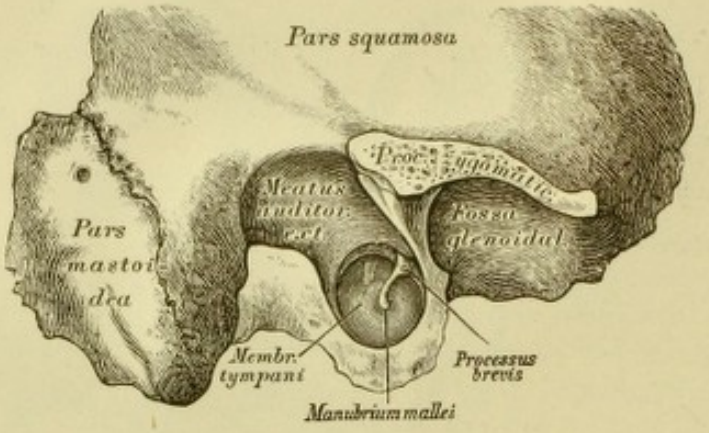
The external auditory canal consists of a cartilaginous portion, *Meatus auditorius cartilagineus*, which is a prolongation of the cartilage of the ear, and through which several shallow fissures, *Incisurae Santorinianae*, extend transversely; and of a bony portion, *Meatus auditorius osseus*, which is part of the temporal bone. At the inner end of the latter is a groove for the insertion of the *Membrana tympani*, *Sulcus pro membrana tympani*. — The skin of the external meatus is continuous with that covering the pinna, and possesses fine hairs — *Hirci;* in the thick subcutaneous tissue of the cartilaginous portion of the meatus are small oval glands, similar to the sweat glands, *Glandulae ceruminales*, which secrete the ear wax, *Cerumen*.



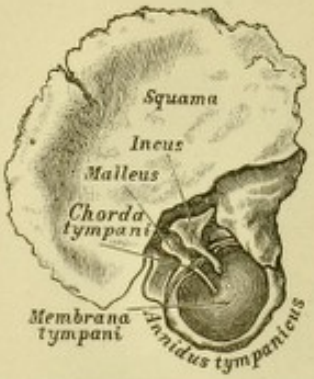
310. The External Auditory Canal and the Tympanic Cavity in section.



311. The *Incisurae Santorini* of the Cartilaginous Auditory Canal.

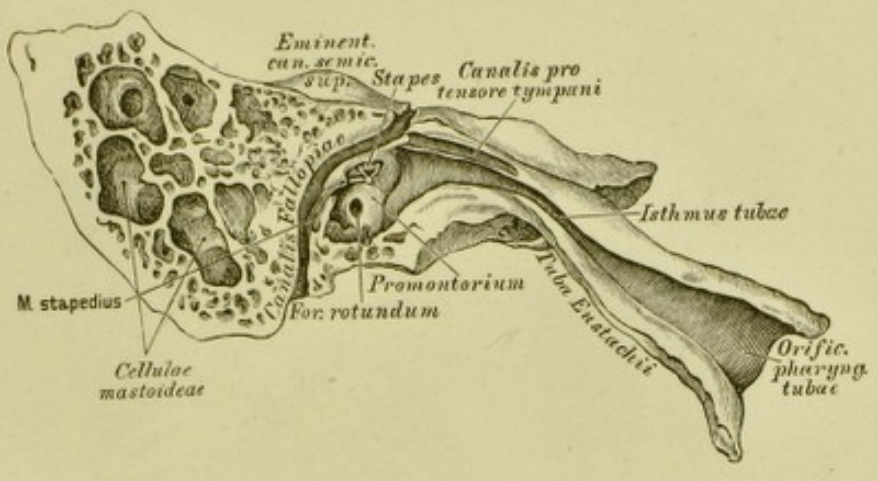


312. The *Membrana tympani,* from the outside, after partial removal of the bony meatus.

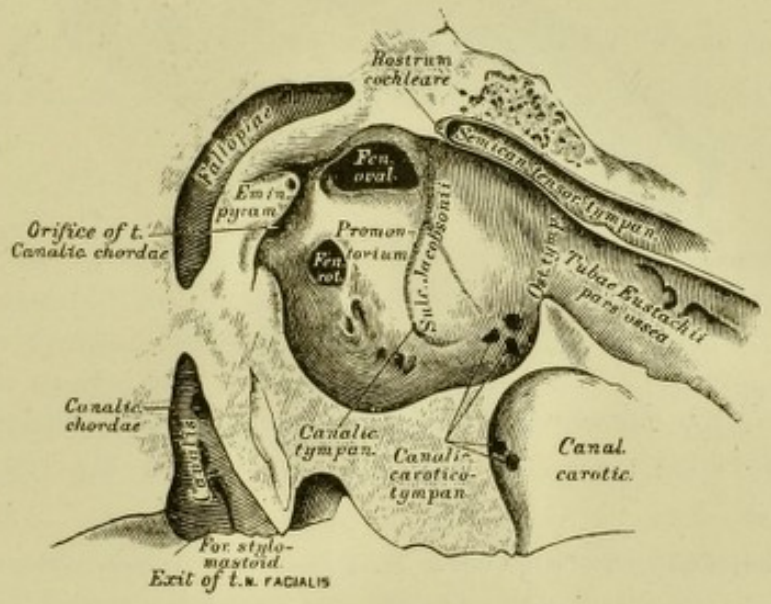


313. The *Membrana tympani* and the *Ossicula auditus* of a child, from the inner side.

The *Membrana tympani* is situated between the external meatus and cavity of the tympanum, and is directed obliquely inwards and downwards; its external surface appears concave, its internal surface connex, and its form is oval. The most depressed part of the outer surface, corresponding to the end of the handle of the malleus, is called *Umbo.* At the upper and anterior part the short process of the malleus projects; the handle of the malleus is visible in its entire length; exceptionally also the long process of the incus. The *Membrana tympani* is composed of three layers: the external is derived from the integument lining the meatus; the middle consists of fibrous and elastic tissues; the internal is the mucous membrane.

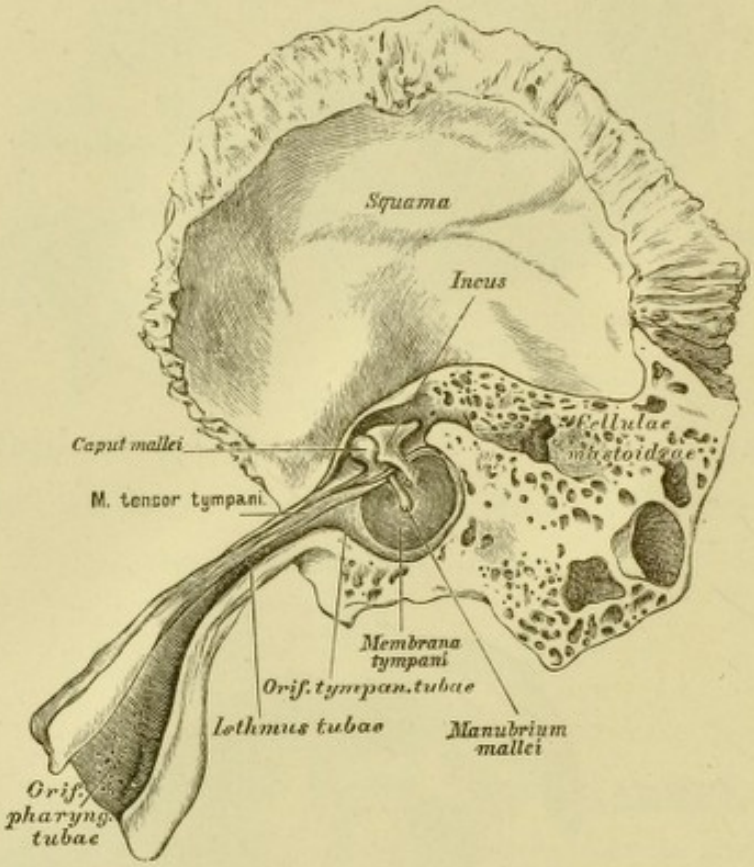


314. The Tympanic Cavity and Eustachian Tube in section.



315. The Inner Wall of the Tympanic Cavity.
Magn. = 3.

The tympanic cavity, *Cavum tympani*, lies to the inner side of the *Membrana tympani*, is lined by mucous membrane, and communicates by means of the Eustachian tube with the pharynx. At the inner wall of it are: the *Fenestra ovalis*, leading into the vestibule of the labyrinth; the *Fenestra rotunda*, into the cochlea (closed by a thin membrane, *Membrana tympani secundaria*); between both fenestrae, the promontory, *Promontorium*, marked by a groove, *Sulcus Jacobsonii*; behind the *Fenestra ovalis* the hollow pyramid, *Eminentia pyramidalis*, whose summit projects forwards towards the *Fenestra ovalis*; above the *Fenestra ovalis* the lower wall of the *Canalis Fallopiae*; above the promontory the *Semicanalis tensoris tympani*, ending with the conical *Rostrum cochleare*.

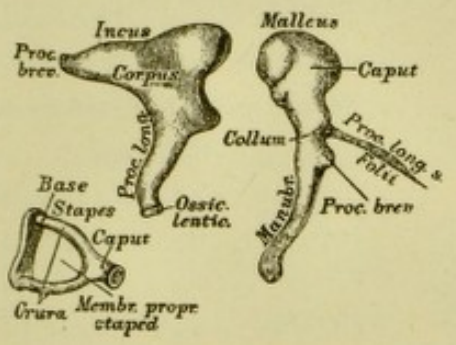


316. The *Membrana tympani* and Eustachian Tube from the inner side. After a specimen of A. Politzer.

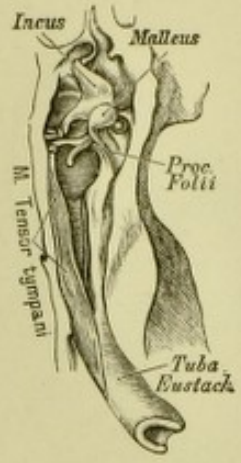
The Eustachian tube, *Tuba Eustachii*, commences at the anterior wall of the tympanic cavity, below the *Semicanalis tensoris tympani* with the *Ostium tympanicum*, runs obliquely forwards, inwards and downwards, and terminates at the side of the pharynx, with the *Ostium pharyngeum*. The tube consists of an osseous and a cartilaginous portion.

The small bones of the ear, *Ossicula auditus*, are three in number:

The *Malleus*, or hammer bone, is divided into a head, neck, handle, short and long process. The handle or *Manubrium* is connected with the *Membrana tympani;* the short process, *Processus brevis*, is situated at the root of the handle and projects outwards toward the *Membrana tympani;* the long process, *Processus Folii seu gracilis* lies in the *Fissura Glaseri*.



317. The *Ossicula auditus,* from the outside. Magn. = 3.

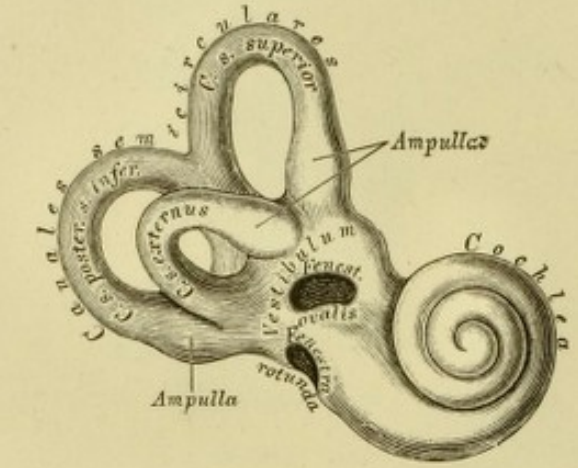


318. The Tympanic Cavity and *Ossicula auditus,* from above.

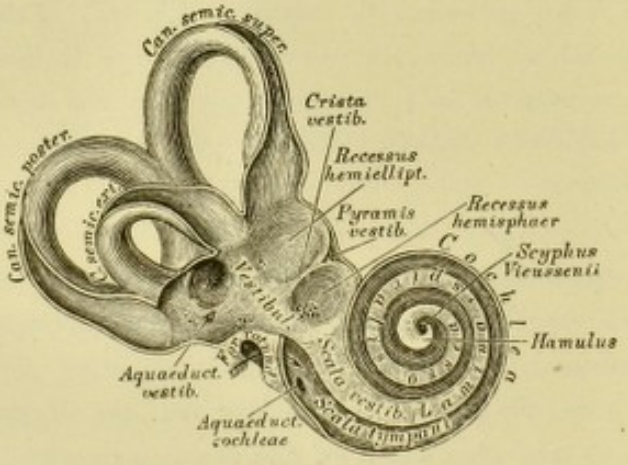
b) The *Incus* or anvil has a body, a short and a long process. The short process is articulated with the posterior wall of the tympanum by means of ligamentous fibres; the long process is bent inwards at its extremity and terminates in a rounded projection, the lenticular process or *Ossiculum lenticulare Sylvii.* With the latter the head of the stapes articulates.

c) The stapes or stirrup consists of a head, from which diverge the two curved crura; these are connected at their extremities by the base, which fits into the *Fenestra ovalis,* and the space between them is filled out by a membrane, the *Membrana propria stapedis.*

The muscles which move the *Ossicula auditus* are: the *M. tensor tympani,* which heightens the tension of the *Membrana tympani,* and arises from the Eustachian tube and under surface of the petrous bone; it lies in the *Semicanalis,* its tendon bends around the *Rostrum cochleare,* and is inserted into the neck of the malleus. — *M. laxator tympani,* which relaxes the *Membrana tympani,* arises from the spinous process of the sphenoid bone, and, passing through the Glaserian fissure is inserted into the long process of the malleus. — *M. stapedius,* the muscle of the stirrup (Fig. 314) lies in the hollow of the *Eminentia pyramidalis;* its tendon emerges from the orifice at the apex of the pyramid, and is inserted into the head of the stapes.



319. The Osseous Labyrinth, from before. Magn. = 3.



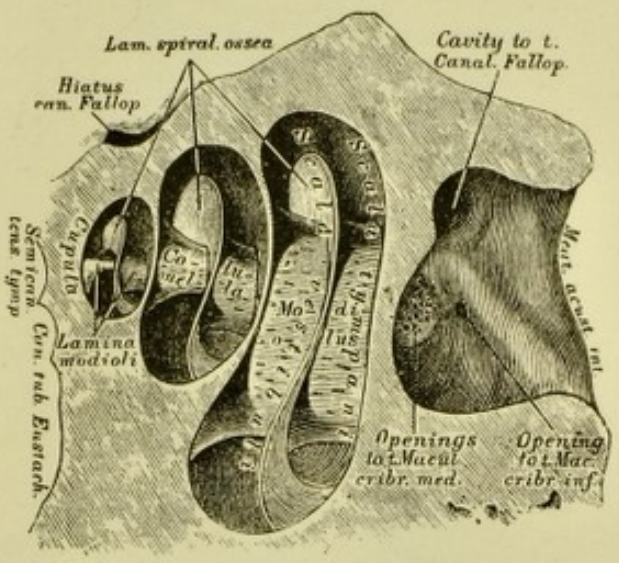
320. The Osseous Labyrinth, laid open from before. Magn. = 3.

The internal ear, the labyrinth, consists of the vestibule, *Vestibulum*, the three semicircular canals, *Canales semicirculares*, and the *Cochlea*.

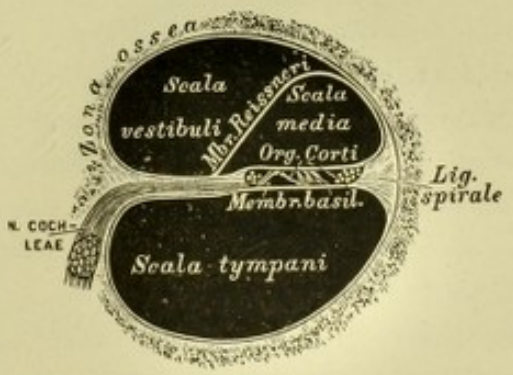
The vestibule is the central cavity of communication between the semicircular canals and the cochlea. Its boundaries are: Externally the tympanic cavity (the *Fenestra ovalis*, by means of which the tympanum and vestibule communciate, is closed by the base of the stapes); internally the internal auditory meatus; anteriorly the cochlea; posteriorly the semicircular canals; superiorly the commencement of the Fallopian canal (Fig. 327). The anterior portion is called *Recessus hemisphaericus;* the posterior *Recessus hemiellipticus;* between both is the *Crista vestibuli*, which ends superiorly with the *Pyramis vestibuli*. The three semicircular canals open into the *Recessus hemiellipticus* by five orifices, two canals at the inner wall of the vestibule having one common orifice; in front of the latter is the orifice of the *Aquaeductus vestibuli*. The *Scala vestibuli* of the cochlea opens into the *Recessus hemisphaericus*. The three *Maculae cribrosae* are seen in Fig. 321.

The three semicircular canals are: a superior, an inferior or posterior and an external; each stands at right angles to the other two. There are three orifices at one extremity, which are dilated, the enlargement being known as ampulla, but only two orifices at the opposite extremity, the superior and posterior canals joining together and opening by a common aperture. The external canal is the shortest, the posterior the longest.

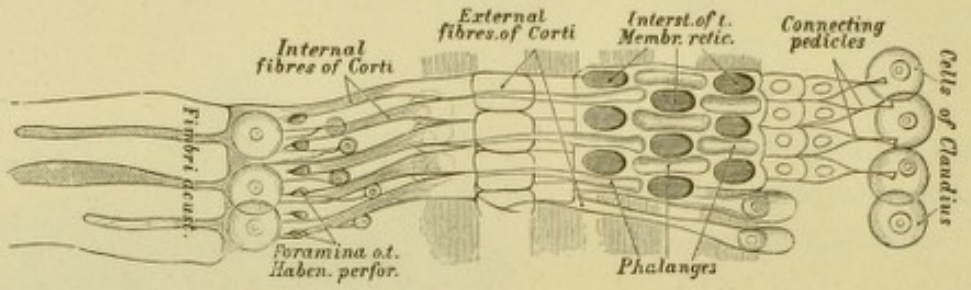
The cochlea consists of a canal wound spirally around a central axis for $2^1/_2$ turns; this central axis is called, for the first turn, *Modiolus*, for the second *Columella*, and for the uppermost half turn *Lamina modioli*. The apex of the cochlea is directed forwards towards the inner wall of the tympanum, its base is turned towards the internal auditory meatus. — The spiral canal terminates in a cul-de-sac, the *Cupula;* here the *Scyphus Vieussenii* or infundibulum of the cochlea is formed (Fig. 320).



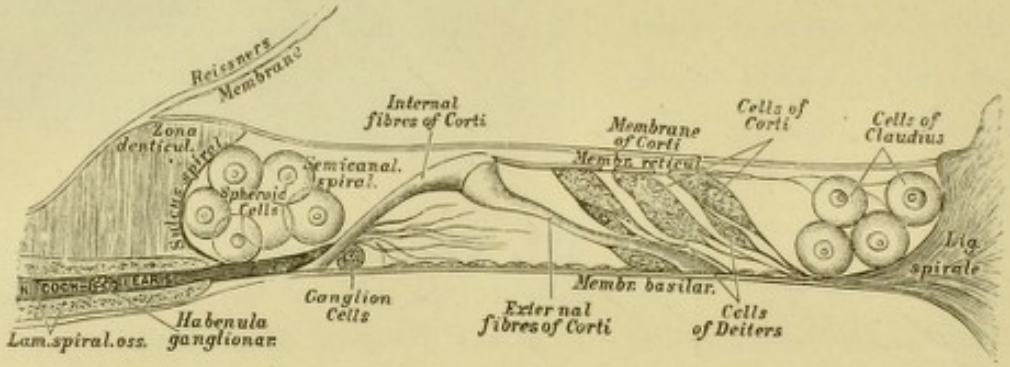
321. The Cochlea, laid open vertically to the axis of the Petrous Portion of the Temporal Bone. Magn. = 5.



322. Section of a Spiral Canal. (Diagrammatic.)



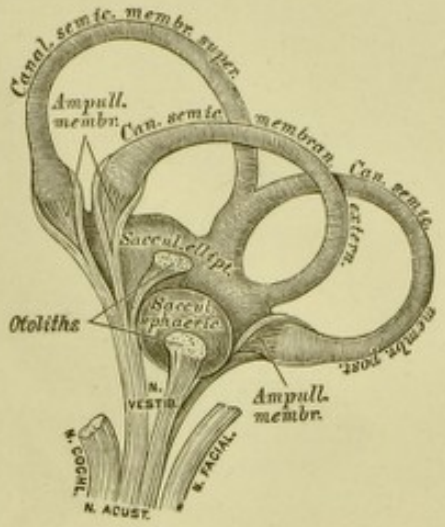
323. The Organ of Corti seen from above. (Diagrammatic.)



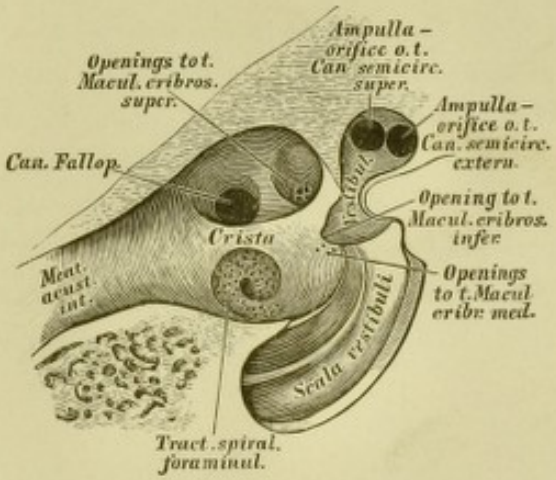
324. The Organ of Corti in Section. (Diagrammatic.)

The spiral canal is divided by the bony spiral lamina, *Lamina spiralis ossea*, which projects into it from the modiolus, into two passages; of these, the lower, *Scala tympani*, communicates with the tympanum by means of the *Fenestra rotunda*, while the upper, *Scala vestibuli*, opens into the *Recessus hemisphaericus vestibuli* (Fig. 320). In the *Scala tympani*, behind the *Fenestra rotunda*, is the orifice of a small canal, the *Aquaeductus ad cochleam*. The osseous spiral lamina ends at the last half turn in a hook-like process, *Hamulus*, turned towards the *Scyphus* (Fig. 320); it reaches only about half way towards the outer wall of the spiral canal; the two *Scalae* are closed by means of a membrane, the *Lamina spiralis membranacea*. Between the two layers of this membrane is a canal, the *Scala media s. canalis cochleae;* upon that layer which lies in the plane of the osseous spiral lamina, usually called the *Membrana basilaris*, the Organ of Corti lies. The *Lamina spiralis membranacea* reaches in the cupola of the cochlea beyond the *Hamulus* and surrounds an opening, *Helicotrema Brescheti*, by means of which *Scala vestibuli* and *Scala tympani* communicate with each other.

The membranous labyrinth consists of two membranous sacs, the *Sacculus sphaericus* or saccule (lying in the *Recessus hemisphaericus vestibuli*) and the *Sacculus ellipticus* or utricle (lying in the *Recessus hemiellipticus*), in which latter, the membranous semicircular canals, corresponding to the bony, and also containing ampullae, open. Between the sacs, which do not communicate with each other, and the inner surface of the bony labyrinth lined by a thin periosteal membrane, is a fluid, the *Perilympha;* the membranous semicircular canals do not entirely fill out the bony, in which they are lodged, but lie only on the convex side of the latter. The sacs and membranous semicircular canals also contain a fluid, the *Endolympha*. Corresponding to the three *Maculae cribrosae* and the *Pyramis vestibuli* (places of entrance of the *N. acusticus*) are rounded bodies consisting of minute crystalline grains of carbonate of lime (otoliths). The *Nervus vestibuli* passes through the foramina of the three *Maculae cribrosae*, and its fibres are distributed to the wall of the membranous labyrinth, not to its cavity.

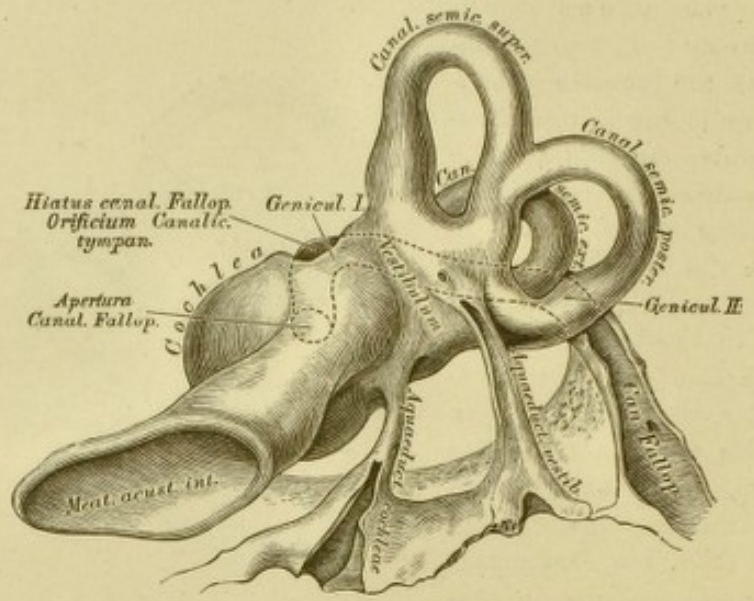


325. The Membranous Labyrinth. (Diagrammatic.)



326. The End of the Internal Auditory Meatus.
Magn. = 3.

The internal auditory meatus, commencing at the posterior surface of the petrous portion of the temporal bone, ends by a blind pouch, being separated from the vestibule by a thin bony plate. The blind pouch is divided by a bony ridge into an upper and a lower fossa. The upper has two depressions, the anterior leading to the *Canalis Fallopiae*, the posterior to the *Macula cribrosa superior;* the lower has the *Tractus spiralis foraminulentus*, behind this the openings to the *Macula cribrosa media* and a larger opening to the *Macula cribrosa inferior.*

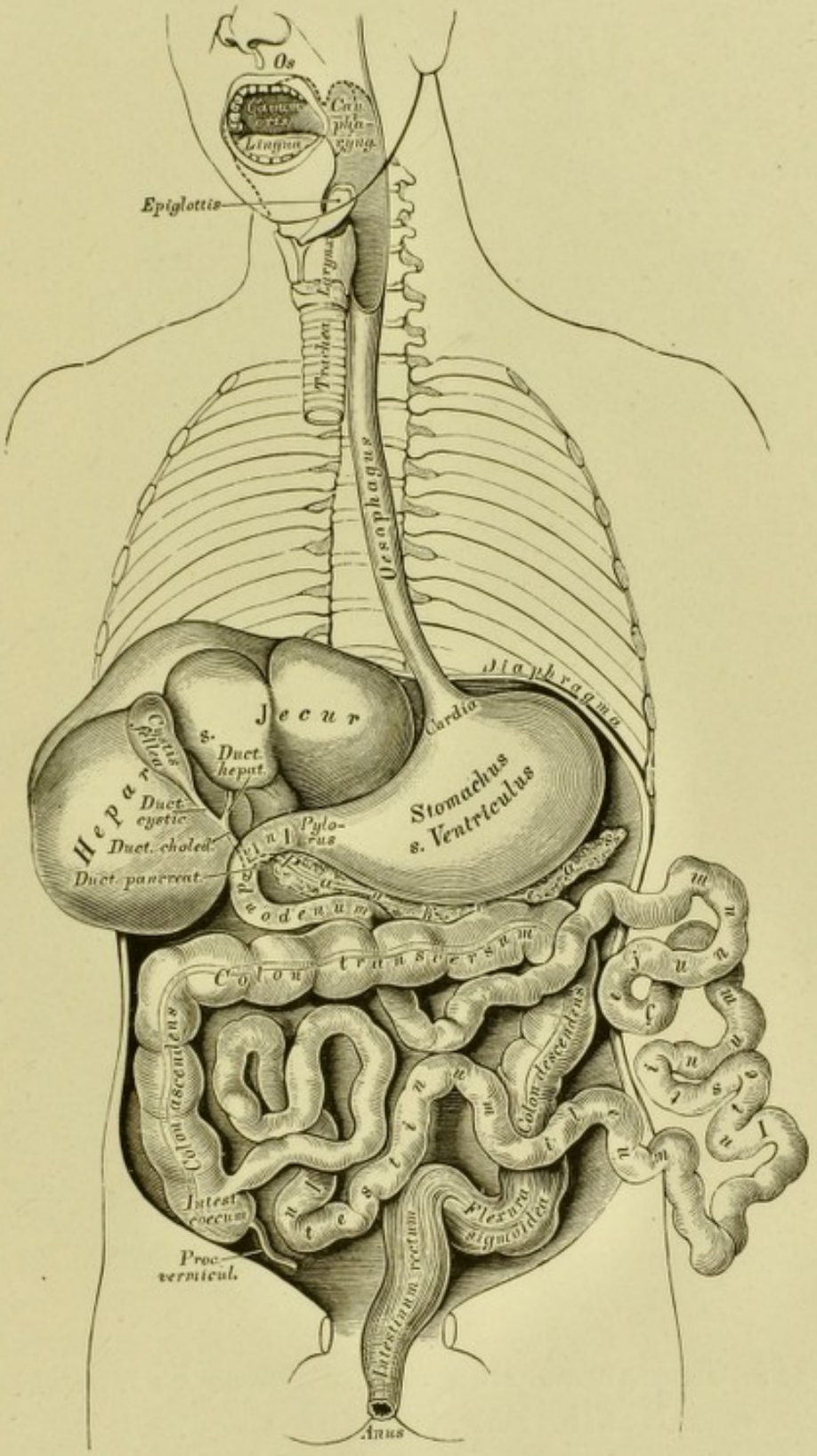


327. The Bony Labyrinth from behind. Magn. = 3.

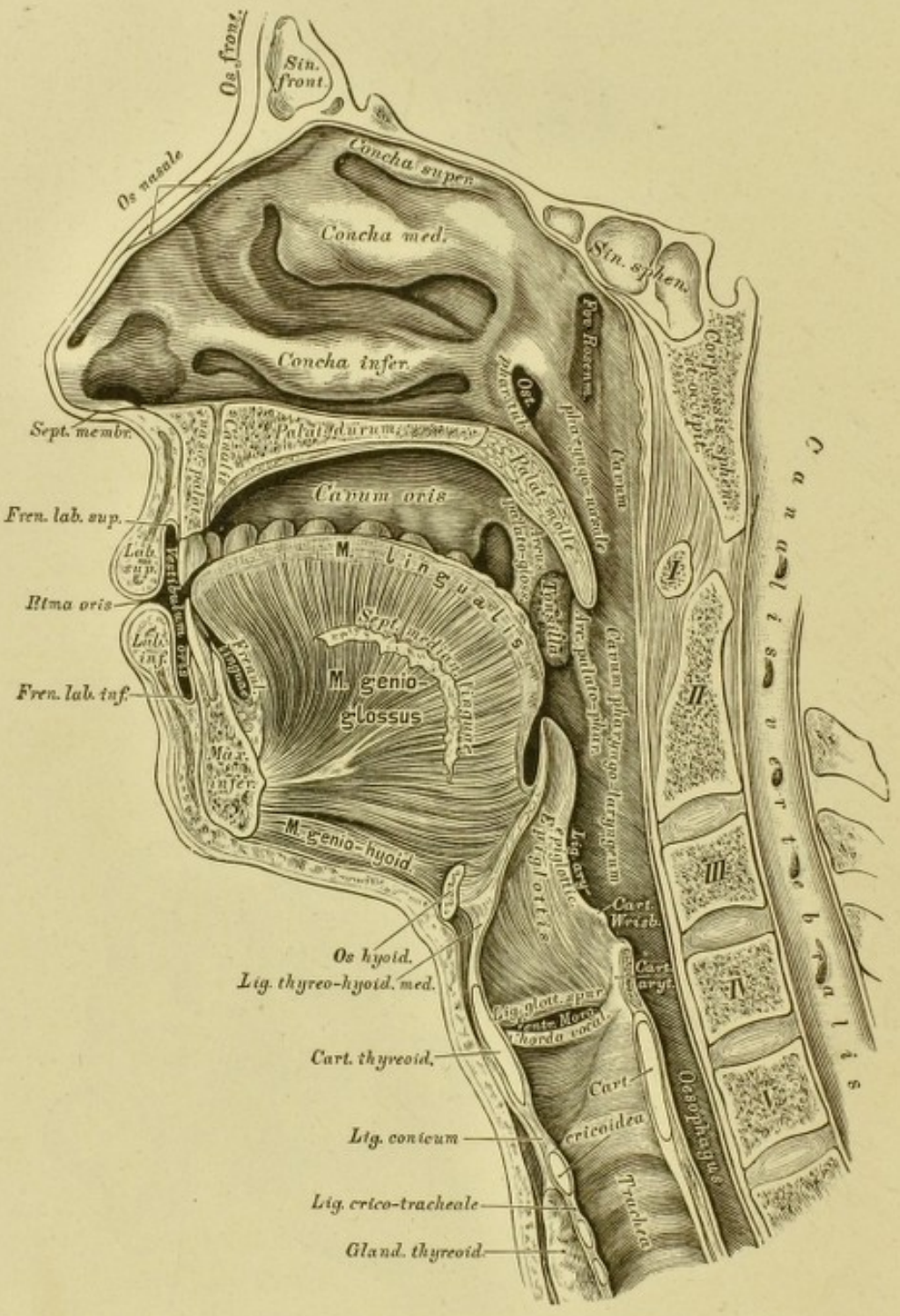
The *Canalis s. Aquaeductus Fallopiae* for the facial nerve, commencing at the blind pouch of the internal auditory meatus, runs in the petrous portion first to the outside, then above the *Fenestra ovalis* posteriorly, and finally to the *Foramen stylo-mastoideum* downwards; the two angles thus formed are called *Genicula*. In the first geniculum is the *Hiatus s. Apertura spuria Canalis Fallopiae;* here the *Canaliculus tympanicus* opens. Below the second geniculum the *Canalis Fallopiae* runs behind the *Eminentia pyramidalis;* it communicates here with its cavity, then with the *Canaliculus mastoideus* und with the tympanum through the *Canaliculus chordae* (Fig. 315). Both *Aquaeductus cochleae et vestibuli* have veins.

IV.

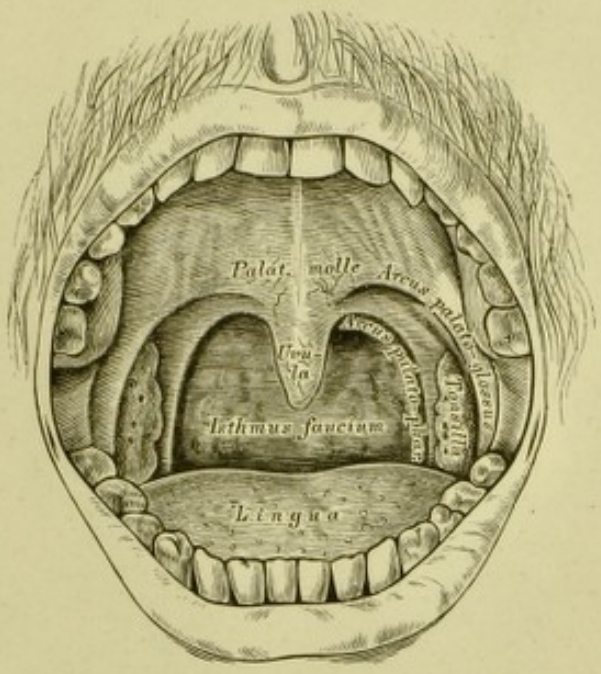
VISCERA. TOPOGRAPHY.



328. Diagram of the Digestive Apparatus.



329. Median Section of the Nasal Fossa, the Mouth, Pharynx and Larynx.

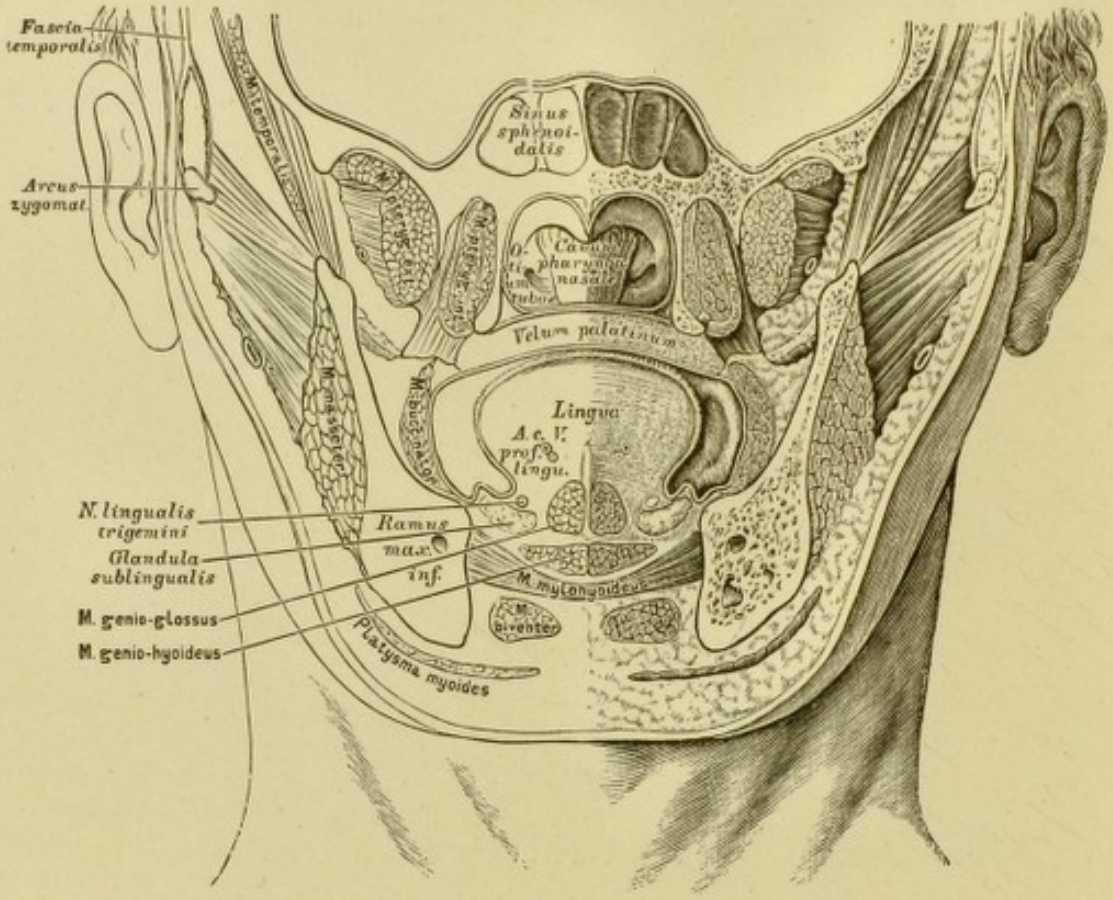


330. Frontal View of the Opened Oral Cavity.

The oral cavity is divided by the closed rows of teeth into the *Vestibulum oris* and the *Cavum oris* proper. The anterior opening forms the *Rima oris,* bounded by the lips, *Labia,* which are connected at their inner surfaces to the gums, *Gingivae,* by folds of mucous membrane, the *Fraenulum labii superioris et inferioris.*

The lips and inner part of the oral cavity are lined by mucous membrane, which becomes continuous with the tongue, on both sides, and on the under surface from the *Fraenulum linguae,* and which separates the mouth from the pharynx at the border of the hard palate, by means of a pendent fold, the soft palate, *Palatum molle.*

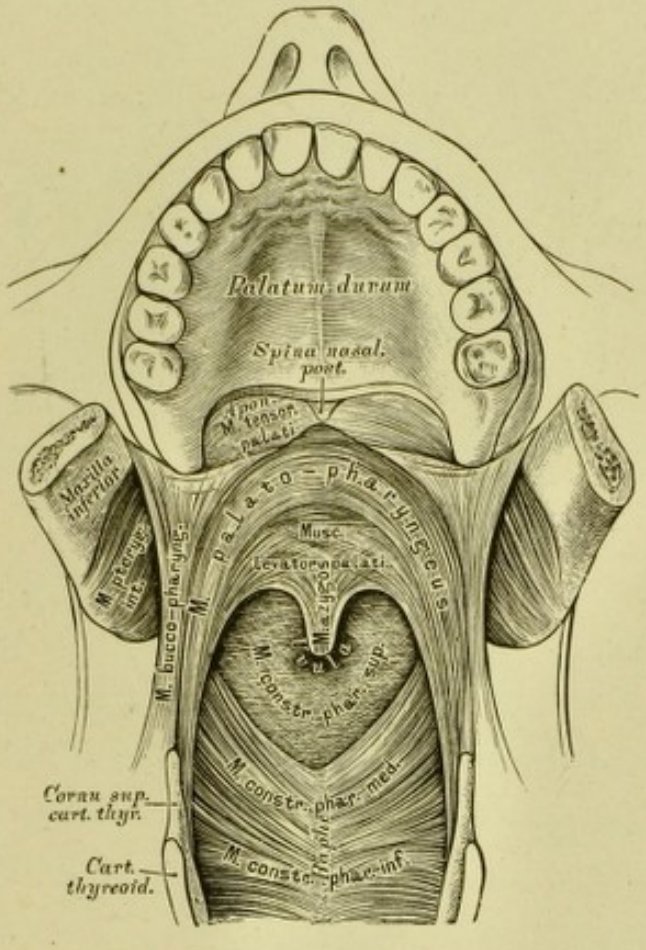
The soft palate *(Velum pendulum palati)* constitutes a moveable partition between the mouth and pharynx, directed obliquely downwards and backwards; hanging from the middle of its lower free border is the *Uvula,* and arching outwards and downwards from the base of the uvula on each side are the arches or pillars of the soft palate, *Arcus palatini,* the anterior of which, running downwards, outwards and forwards to the tongue, is called *Arcus palato-glossus,* the posterior, downwards, outwards and backwards to the sides of the pharynx, *Arcus palato-pharyngeus.*



331. Frontal Section of the Base of the Cranium and the Face immediately behind the posterior border of the *Septum narium*. After H. v. Luschka.

The tonsils, *Tonsillae s. Amygdalae*, which are conglomerates of follicular glands, lie in the triangular space between the anterior and posterior pillars of the soft palate. The space between the lower margin of the palatine arches, the base of the tongue and between both tonsils, leading from the mouth into the pharynx, is called isthmus of the fauces, *Isthmus faucium* (see Fig. 330).

The isthmus of the fauces changes in shape; the muscles of the soft palate contract and expand, elevate and depress it; with each act of deglutition the soft palate is raised and made tense, the posterior pillars of the fauces brought together, thus forming a narrow slit, which is entirely closed by the uvula; this prevents the passage of food towards the upper part of the pharynx or the posterior nares.

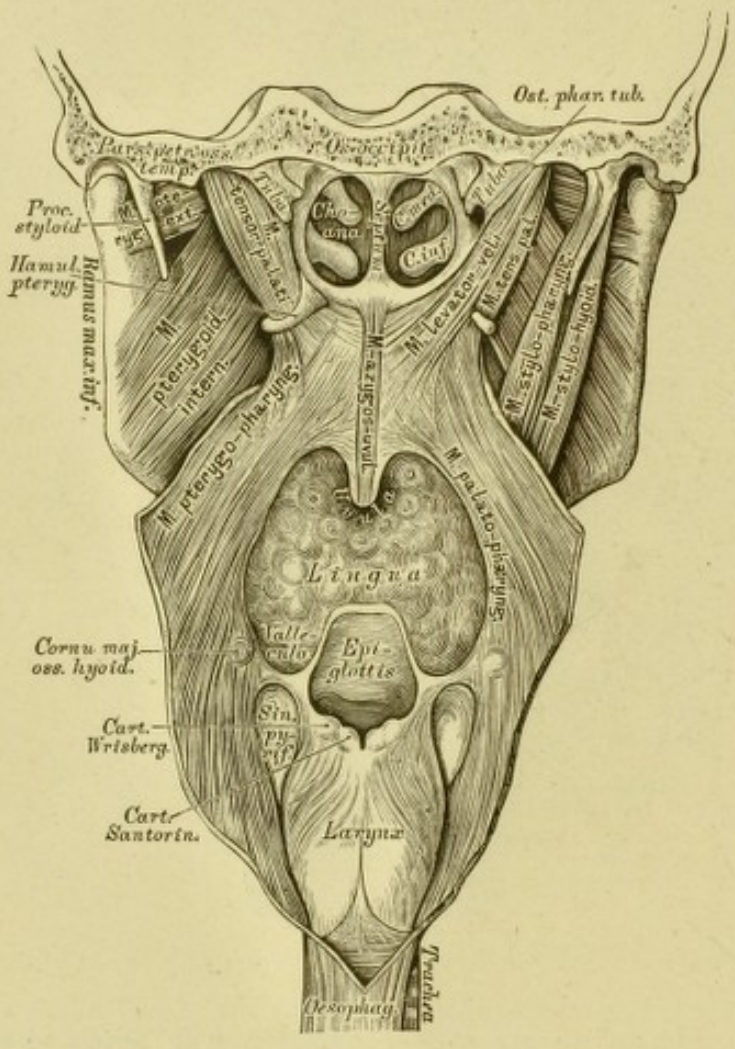


332. The Muscles of the Soft Palate; view from before.

The *M. azygos uvulae* arises from the posterior nasal spine of the palate bone, *Spina palatina*, and descends in the middle line of the uvula to its apex. It consists of two slips, which lie close together.

The *MM. levatores veli palatini (M. petro-salpingo-staphylinus)* arise from the under surface of the petrous portion of the temporal bone and the cartilage of the Eustachian tube on both sides; passing to the middle line of the uvula, they partly blend with the *M. azygos*, and partly with each other.

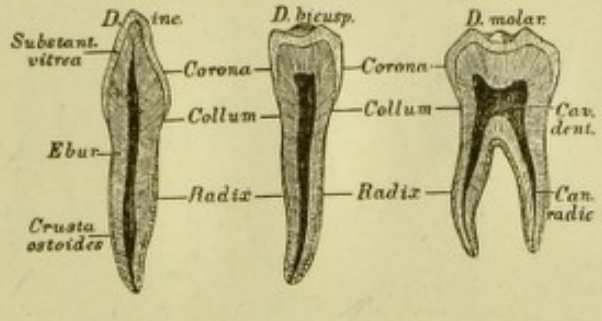
The *MM. tensores palati (M. spheno-salpingo-staphylinus)* are flat muscles, which arise from the spine of the sphenoid and the cartilage of the Eustachian tube, and terminate in broad tendons which wind around the hamular process; they form together the broad aponeurosis of the soft palate.



333. The Muscles of the Soft Palate; view from behind.

The *MM. palato-glossi* occupy the anterior pillars of the fauces; they are narrow muscles, which, in the soft palate blend with each other, and by their contraction narrow the isthmus of the fauces; they are also called *Constrictores isthmi faucium.*

The *MM. palato-pharyngei* occupy the posterior pillars of the fauces; they arise in the aponeurosis of the *M. tensor palati,* consisting of two layers and are inserted into the posterior border of the thyroid cartilage and into the fibrous layer of the lower part of the pharynx, reaching as far as, or even crossing, the middle line behind.



334. Incisor, Bicuspid and Molar Teeth, in section.

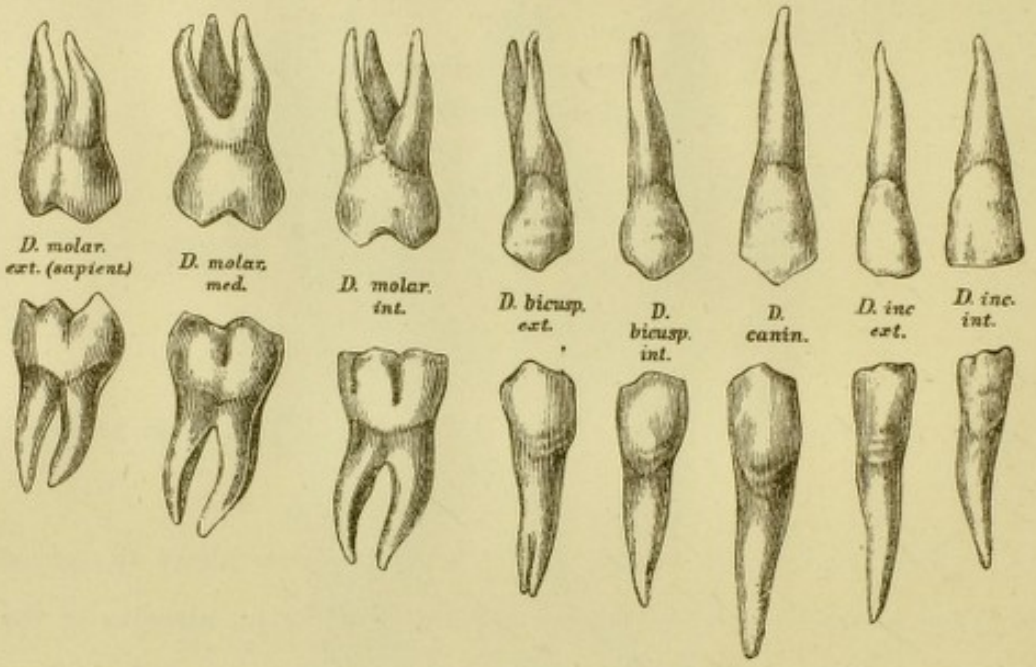
That part of the teeth, *Dentes*, which projects above the gums, is called body or crown, *Corona;* the part fixed in an alveolus of the upper or lower jaw, the root, *Radix;* between the crown and the root is the constricted portion, the neck, *Collum*, covered by the gums. Corresponding to the crown and neck of the tooth, a hollow cavity, *Cavum dentis*, is found in its interior; this is continuous with a canal, *Canalis radicis*, which opens by a minute orifice at the extremity of the root. The cavity is occupied by a soft, highly vascular and sensitive substance, the dental pulp, *Pulpa dentis.*

The tooth is composed of three substances:

a) The enamel, *Substantia adamantina s. vitrea*, encrusts and protects the crown; it is thickest on the grinding surface of the crown, and becoming gradually thinner, ends at the neck; it consists of hard and dense hexagonal fibres, which pursue a more or less wavy course.

b) The ivory or dentine, *Ebur s. Substantia propria*, forms the body of the tooth; it consists of a structureless mass, which has numerous, very fine tubes, opening at their inner ends into the pulp cavity, and pursuing a wavy and undulating course towards the periphery.

c) The cement, *Crusta ostoides radicis*, covers the external surface of the root, and has the structure of bone.



335. The Right Permanent Teeth, *Dentes permanentes.*

Each jaw has sixteen permanent teeth, namely:

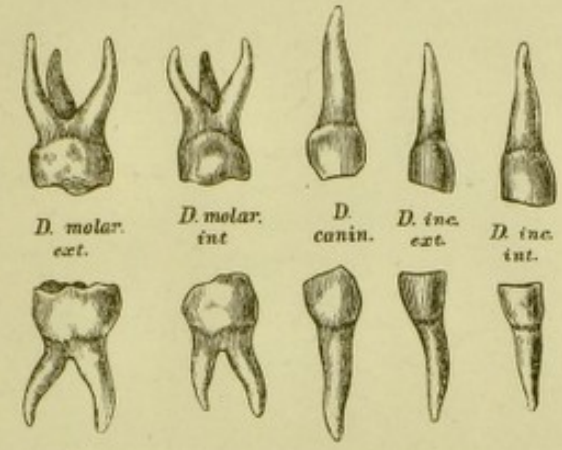
Four incisor teeth, *Dentes incisivi,* with chisel-shaped crowns and single conical roots.

Two canine teeth, *Dentes angulares s. canini,* with conical crowns, tapering to a blunted point or cusp (on the inner side of these are two facets) and single conical roots.

Four bicuspid teeth, *Dentes buccales;* the crown is compressed antero-posteriorly, and surmounted by two pointed tubercles, an external and an internal; the roots bifid or single, compressed, and deeply grooved.

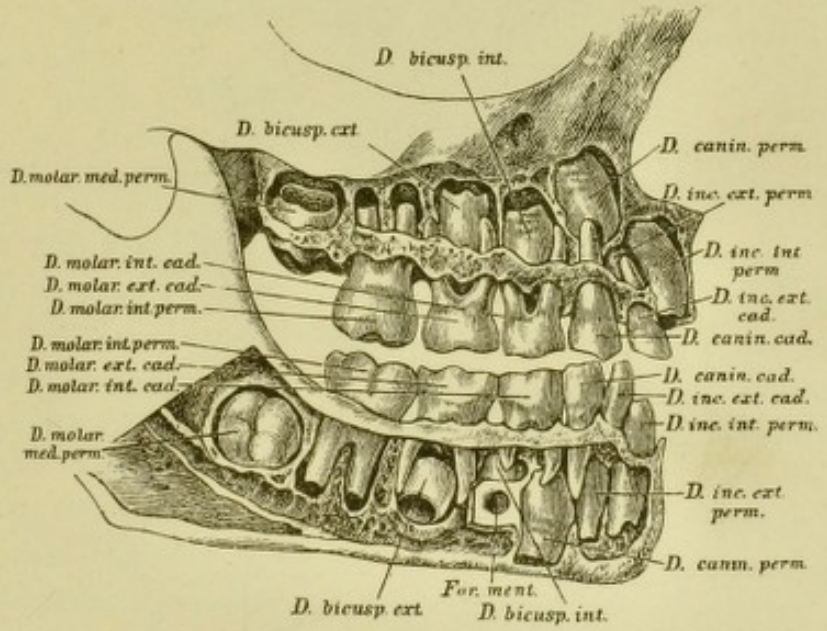
Six molar teeth, *Dentes molares;* the grinding surfaces surmounted by four or five tubercles; in the upper jaw the root consists of three fangs, of which two are external, and one internal; in the lower jaw it has two fangs, one placed in front, the other behind, each of which is grooved. The last molar or wisdom tooth, *Dens serotinus, Dens sapientiae* (so called on account of its late appearance, usually between 20 and 25 years), has a smaller crown, shorter and more converging roots, which may also blend and form a single fang.

The periods of eruption of the temporary and permanent teeth are evident from Fig. 338a and 338b.



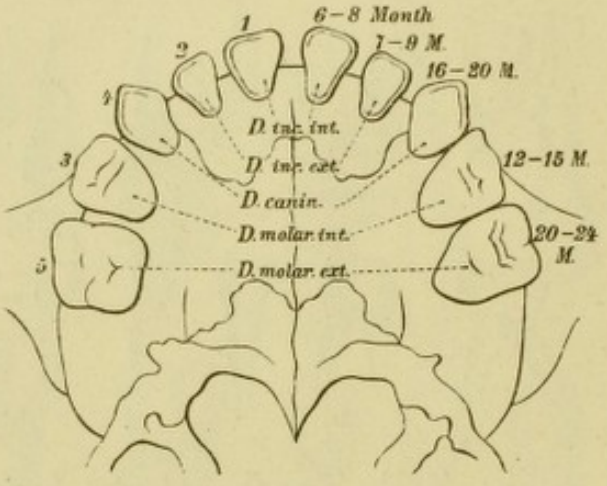
336. The Right Milk Teeth, *Dentes lactei s. caduci.*

The eruption of the temporary or milk teeth commences in the sixth or seventh month after birth; at the end of the second year of life the child has twenty teeth, ten in each jaw, namely, four incisors, two canines, and four molars. In the seventh year the milk teeth begin to fall out and make room for the permanent set.

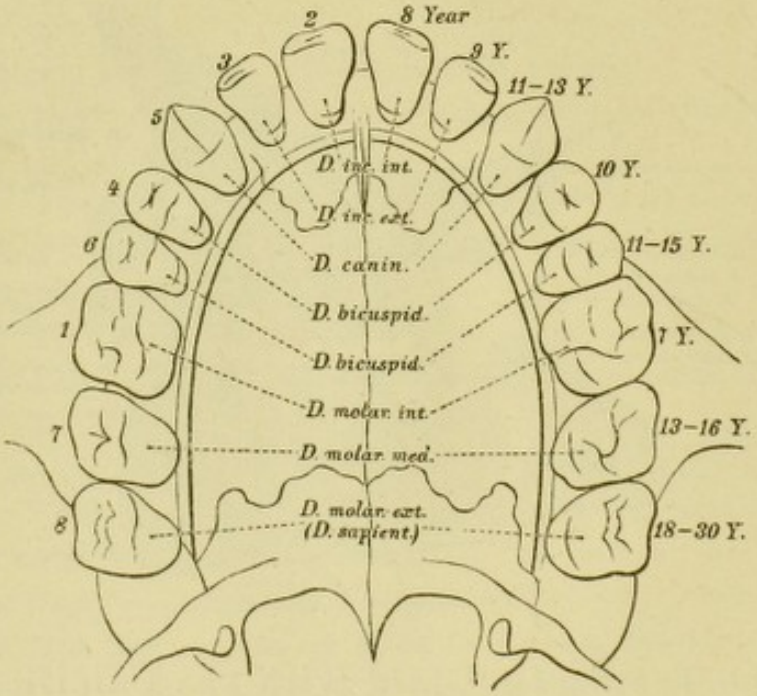


337. The Teeth of a Child with the Calcified Parts of the Permanent Teeth Exposed.

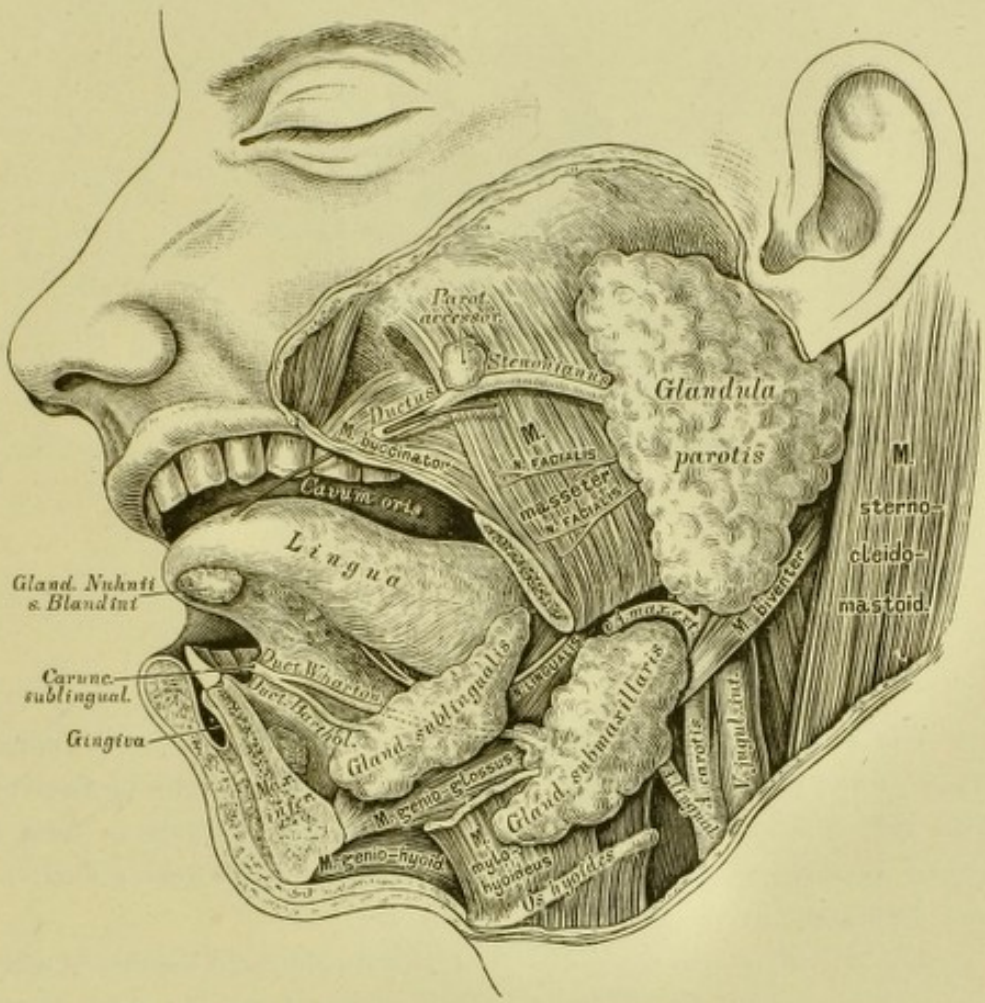
The anterior wall of the upper and lower jaw cut out, to show the relation between the temporary and permanent teeth.



338 a. Diagram of the Eruption of the Milk Teeth. After H. Welcker.



338 b. Diagram of the Eruption of the Permanent Teeth. After H. Welcker.

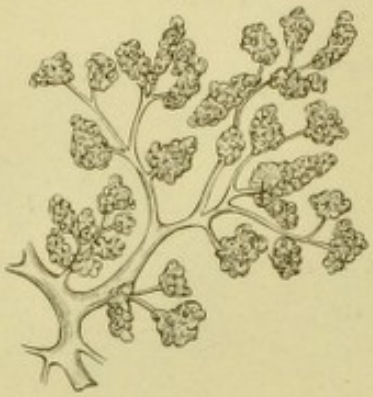


339. The Salivary Glands, *Glandulae salivales.*

On each side there are three salivary glands, namely:

The parotid gland, *Glandula parotis*, lying in front of and below the ear, fills out the angle between the ramus of the lower jaw, the mastoid process and the external auditory meatus, and extends over the anterior surface of the Masseter muscle. Its chief excretory duct, Stenson's duct, *Ductus Stenonianus*, runs forwards parallel to the zygomatic arch, pierces the buccinator muscle, and opens on the inner surface of the cheek, opposite the first or second upper molar tooth. Frequently an isolated small *Parotis accessoria* lies upon Stenson's duct.

The submaxillary gland, *Glandula submaxillaris*, lies partly beneath the mylo-hyoid muscle in the triangular space between the lower border of the inferior maxilla and the digastric muscle *(M. biventer maxillae)*. Its excretory duct, Wharton's duct, *Ductus Whartonianus*, opens at the side of the *Fraenulum linguae* on the summit of a small papilla, *Caruncula sublingualis*.



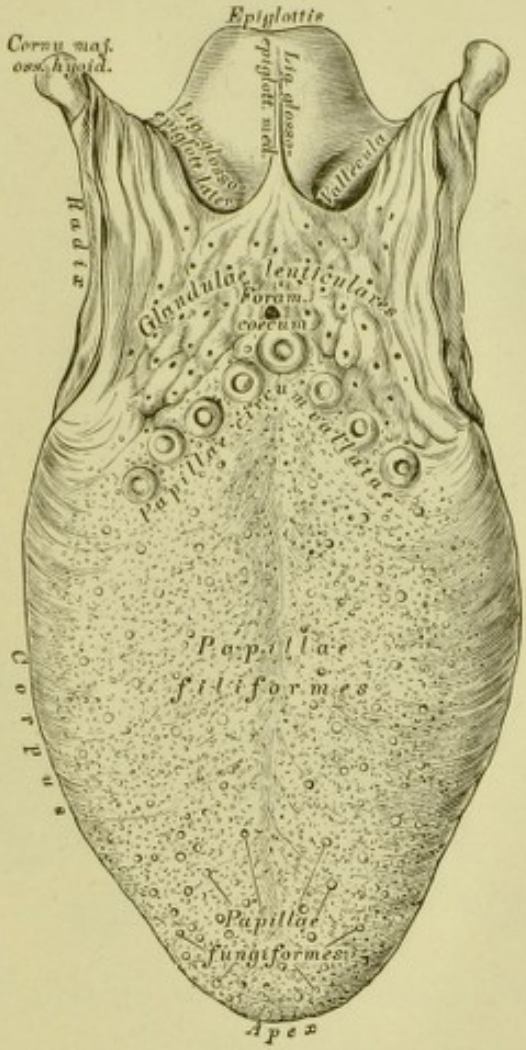
340. Lobules of the Parotid Gland, natural size.
After a specimen of Ilg.

The sublingual gland, *Glandula sublingualis,* rests on the upper surface of the mylo-hyoid muscle; its excretory ducts (eight to twelve), *Ductus Rivini,* open behind the *Caruncula sublingualis,* or join to form a common duct, the *Ductus Bartholini,* which blends with Wharton's duct, or opens separately at the caruncula.

The salivary glands are compound racemose glands; a number of acini form a lobule, which has a very small excretory duct; the small ducts unite to form larger ones, these again form the chief excretory duct.

The tongue, *Lingua* (Fig. 341), is a muscular organ situated in the floor of the mouth; it has an upper surface or dorsum, an under surface, two lateral borders, an apex or tip, a body, and a base or root. The upper convex surface contains numerous gustatory papillae, which are found as far back as the region of the isthmus of the fauces; from here to the hyoid bone there are mucous and follicular glands. On the under surface, which has no papillae, the mucous membrane forms a fold, the *Fraenulum linguae;* at the sides the *Arcus palato-glossi* are attached. The base or root of the tongue is attached to the hyoid bone; from it a middle and two lateral folds of mucous membrane, the glosso-epiglottic folds, *Ligamenta glosso-epiglottica medium et lateralia,* pass to the epiglottis.

The tongue is divided into two halves, by a fibrous septum, the *Septum medianum linguae* (see Fig. 329); at the tip of the lingual muscle the acinous *Glandula Nuhnii s. Blandini* about the size of a bean (see Fig. 339) is imbedded; its excretory ducts open at the *Crista fimbriata,* a fold of mucous membrane, which runs obliquely backwards and outwards.



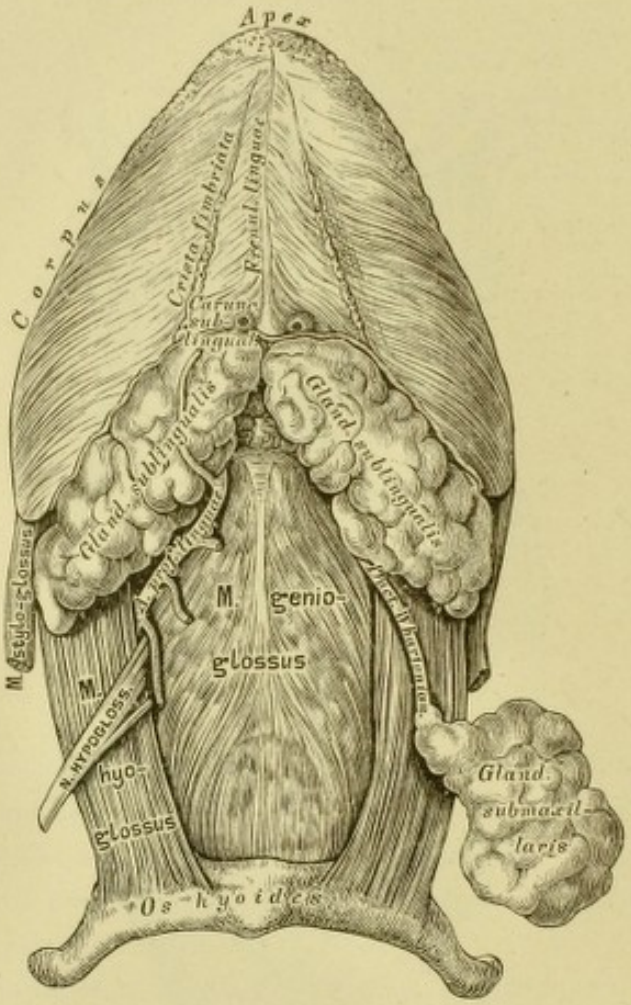
341. The Upper Surface of the Tongue.

At the dorsum of the tongue are three kinds of papillae, *Papillae gustatoriae* (see Fig. 343):

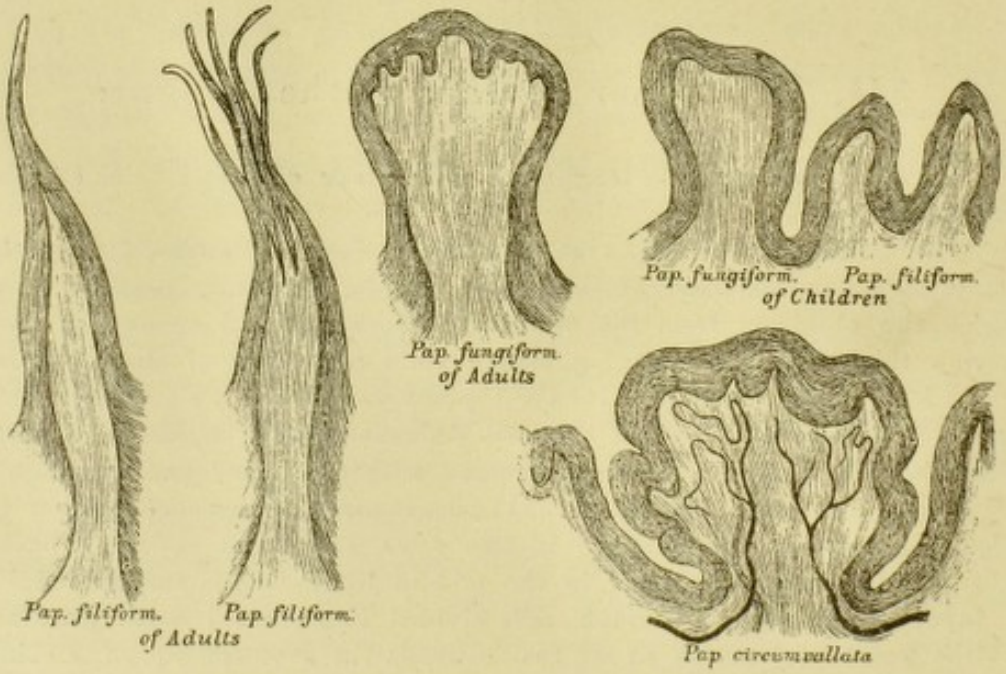
a) Conical or filiform papillae, *Papillae filiformes*, are densely set over the greater part of the dorsum of the tongue, in parallel rows, which run obliquely from the middle line forwards and outwards; they have a thick epithelial covering, and contain a number of elastic fibres.

b) Fungiform papillae, *Papillae fungiformes*, are scattered between the filiform as large, rounded eminences; their epithelial investment is very thin and they are covered with secondary papillae.

c) Circumvallate papillae, *Papillae circumvallatae*, eight to fifteen in number, are arranged in two rows, which run obliquely backwards and inwards and meet in the middle line; each is surrounded by a layer of mucous membrane, and divided into several small papillae. At the point of junction of the two rows, is the *Foramen coecum*. Behind the circumvallate papillae are follicular glands, *Glandulae lenticulares linguae*.

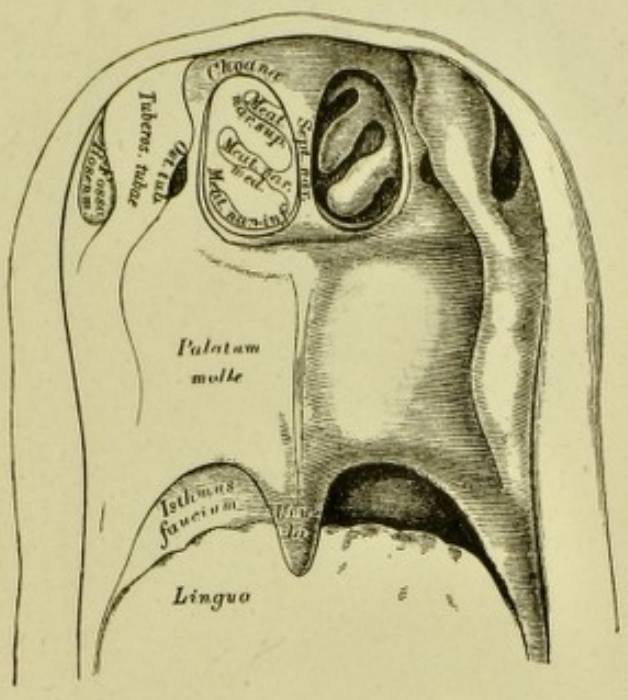


342. The Under Surface of the Tongue.

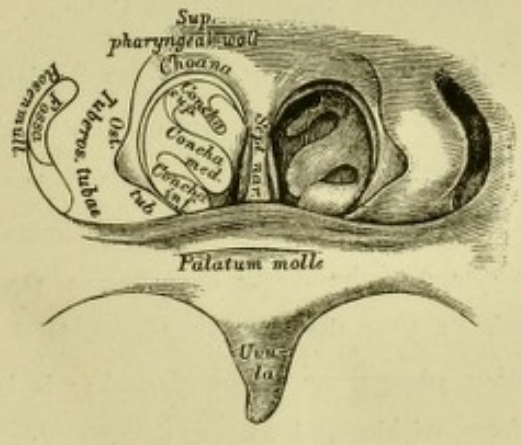


343. The Papillae of the Tongue.

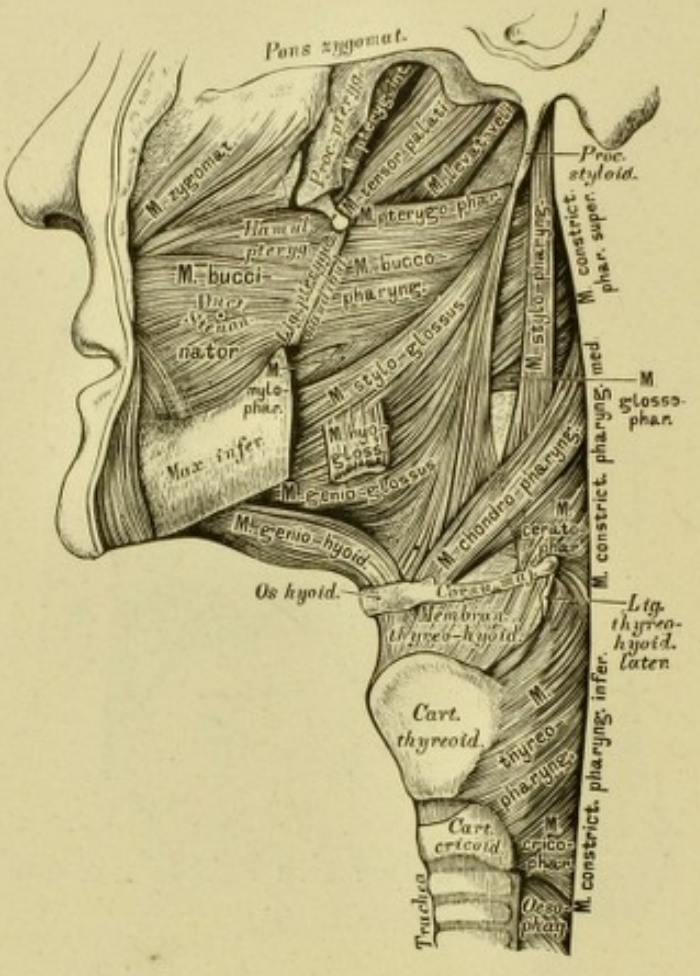
After specimens of E. Klein.



344. The Anterior Wall of the Pharynx, seen from behind.

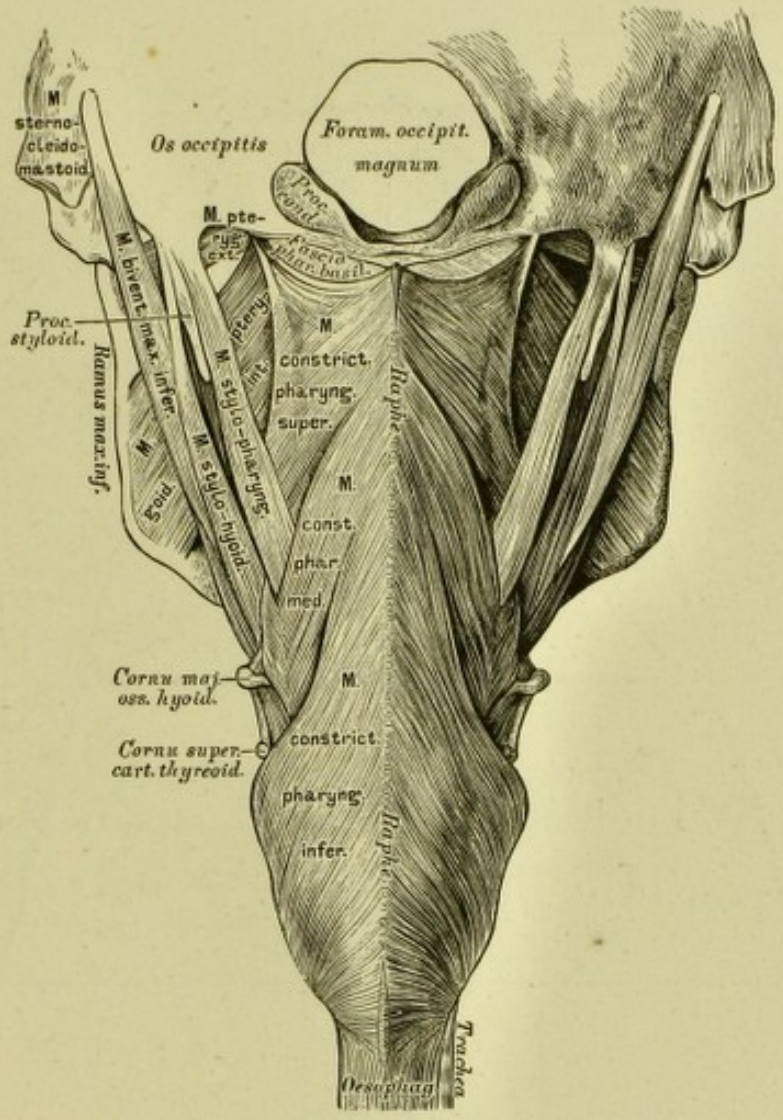


345. The Rhinoscopic View, natural size.



346. The Muscles of the Pharynx, side view, after removal of the Vertebral Column.

The cavity behind the mouth, nose and larynx is called pharynx; below, it is continuous with the oesophagus. The anterior wall of the pharynx communicates with the nasal cavity by means of the two posterior nares, *Choanae*, with the mouth by means of the isthmus of the fauces and with the larynx by means of the *Aditus ad laryngem*. On each side of the pharynx, at the back part of the inferior meatus, is the opening for the Eustachian tube, *Ostium pharyngeum Tubae Eustachii;* it is four lines long, directed obliquely from within and above, externally and inferiorly, and has irregular borders; between this opening and the posterior wall of the pharynx, the mucous membrane is deepened, forming Rosenmüller's fossa. By means of the soft palate, when it comes in contact with the posterior pharyngeal wall, the pharynx is divided into two cavities, the *Cavum pharyngo-nasale* and *Cavum pharyngo-laryngeum*.



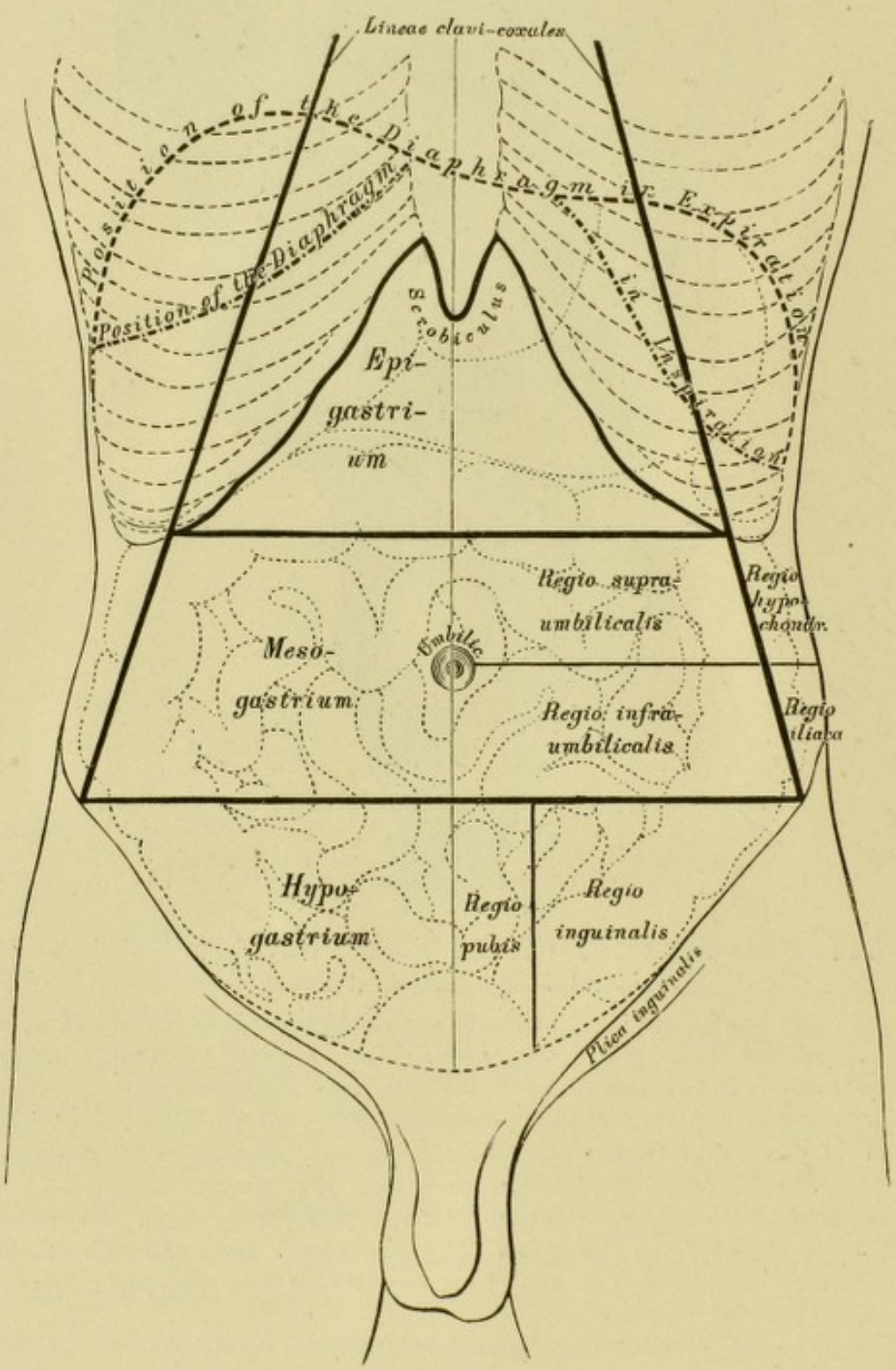
347. The Muscles of the Pharynx, from behind, after removal of the Vertebral Column.

The longitudinal muscles of the pharynx are: the two *M. stylo-pharyngei*, and the single *M. azygos pharyngis*, which latter is often wanting. The constrictor muscles of the pharynx, *Constrictores pharyngis*, form the lateral and posterior walls of the pharynx, and are all inserted into the fibrous raphé in the posterior median line. They form three pairs:

The *M. constrictor superior* arises from the hamular process of the pterygoid plate of the sphenoid *(Pterygo-pharyngeus)*, from the mylo-hyoidean line of the lower jaw *(Mylo-pharyngeus)*, from the side of the tongue *(Glosso-pharyngeus)* and from the *Fascia bucco-pharyngea (Bucco-pharyngeus)*.

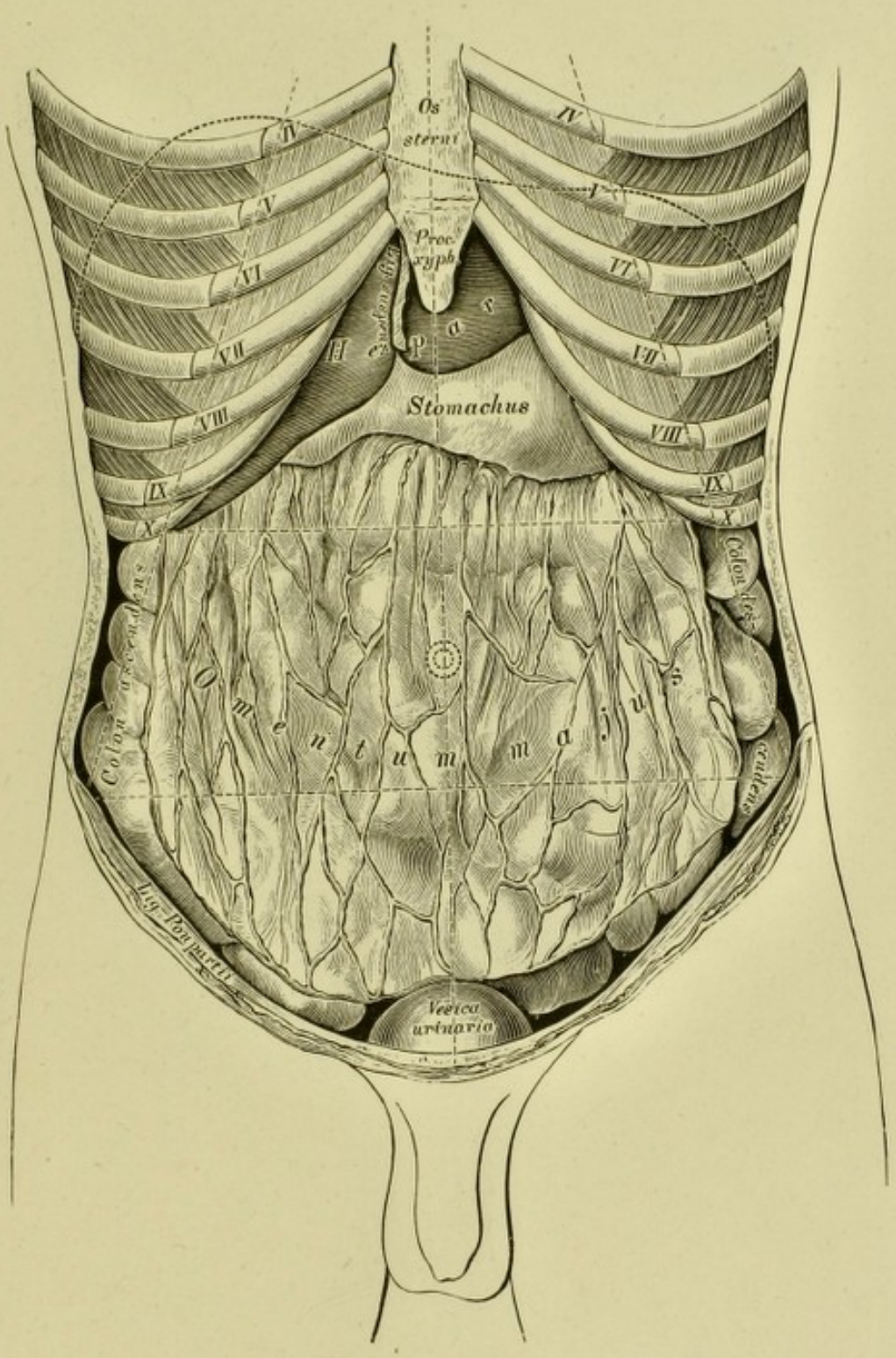
The *M. constrictor medius* arises from the greater cornu of the hyoid bone *(Cerato-pharyngeus)*, and from the lesser cornu *(Chondro-pharyngeus)*.

The *M. constrictor inferior* arises from the outer surface of the thyroid cartilage *(Thyreo-pharyngeus)* and the cricoid cartilage *(Crico-pharyngeus)*. The constrictors are so arranged, that the inferior partially covers the middle and the middle the superior.



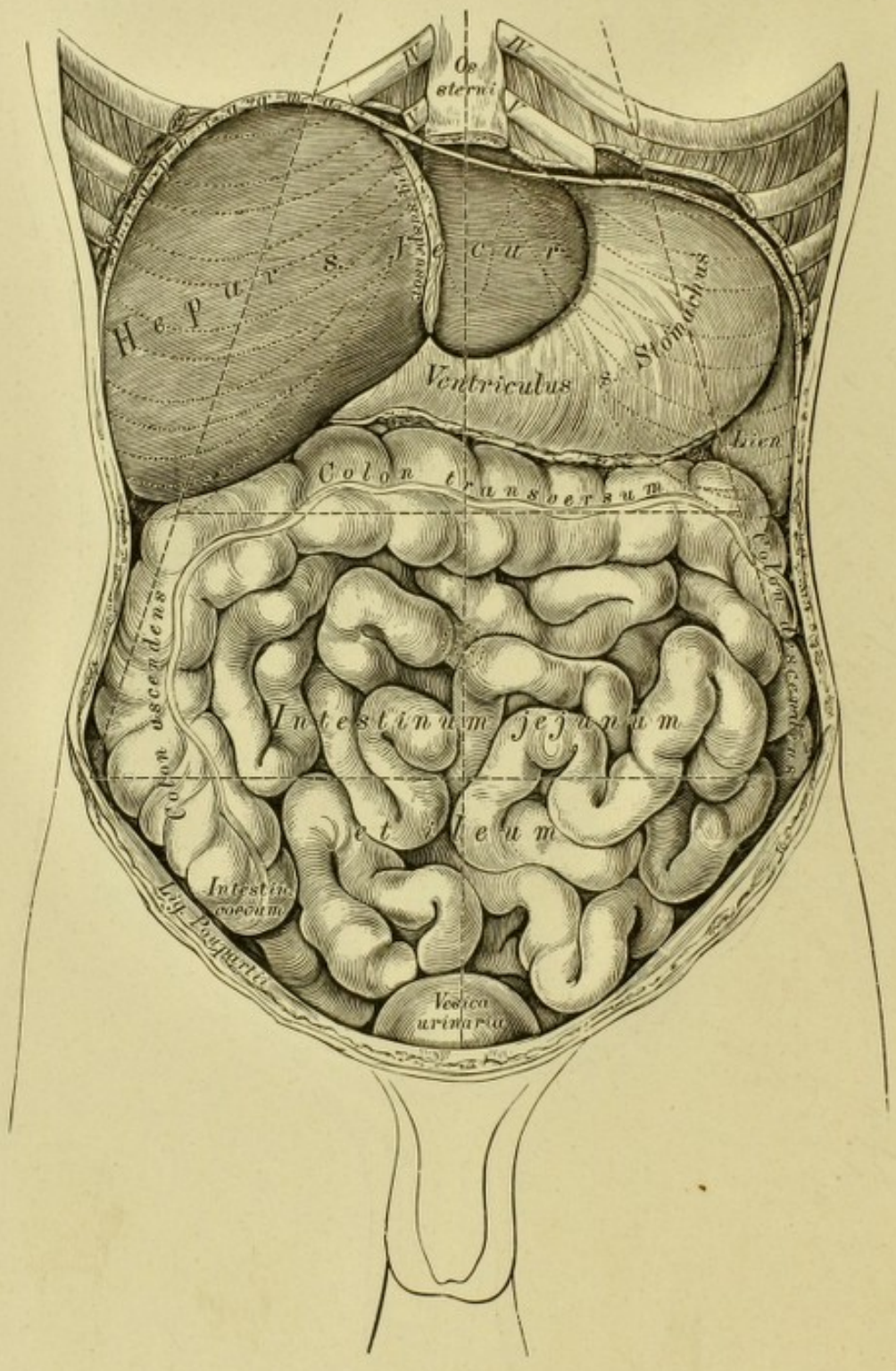
348. Topography of the Abdominal Viscera. I.

The Regions of the Abdomen.



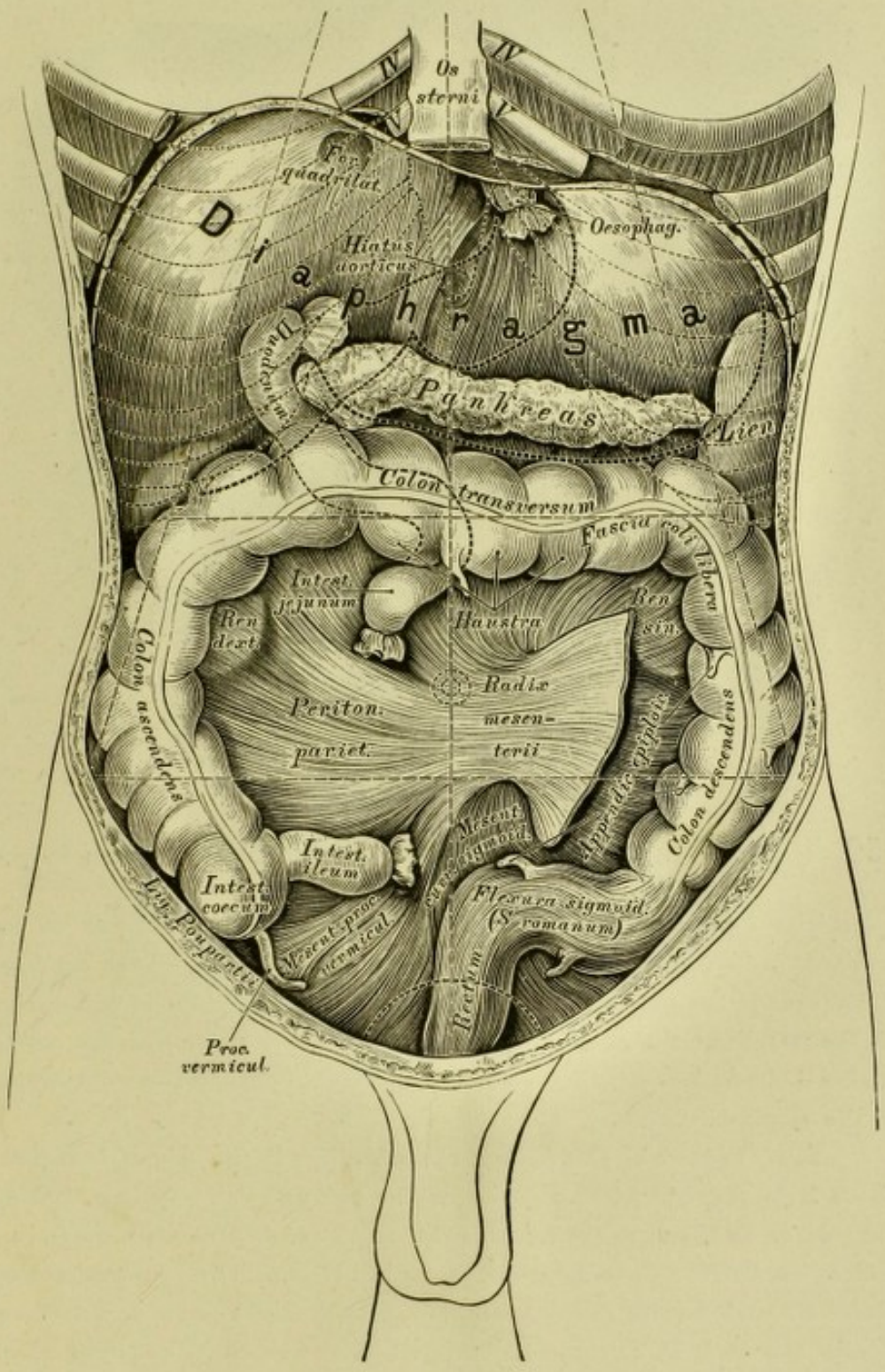
349. Topography of the Abdominal Viscera. II.

View of the Great Omentum after removal of the anterior abdominal wall.



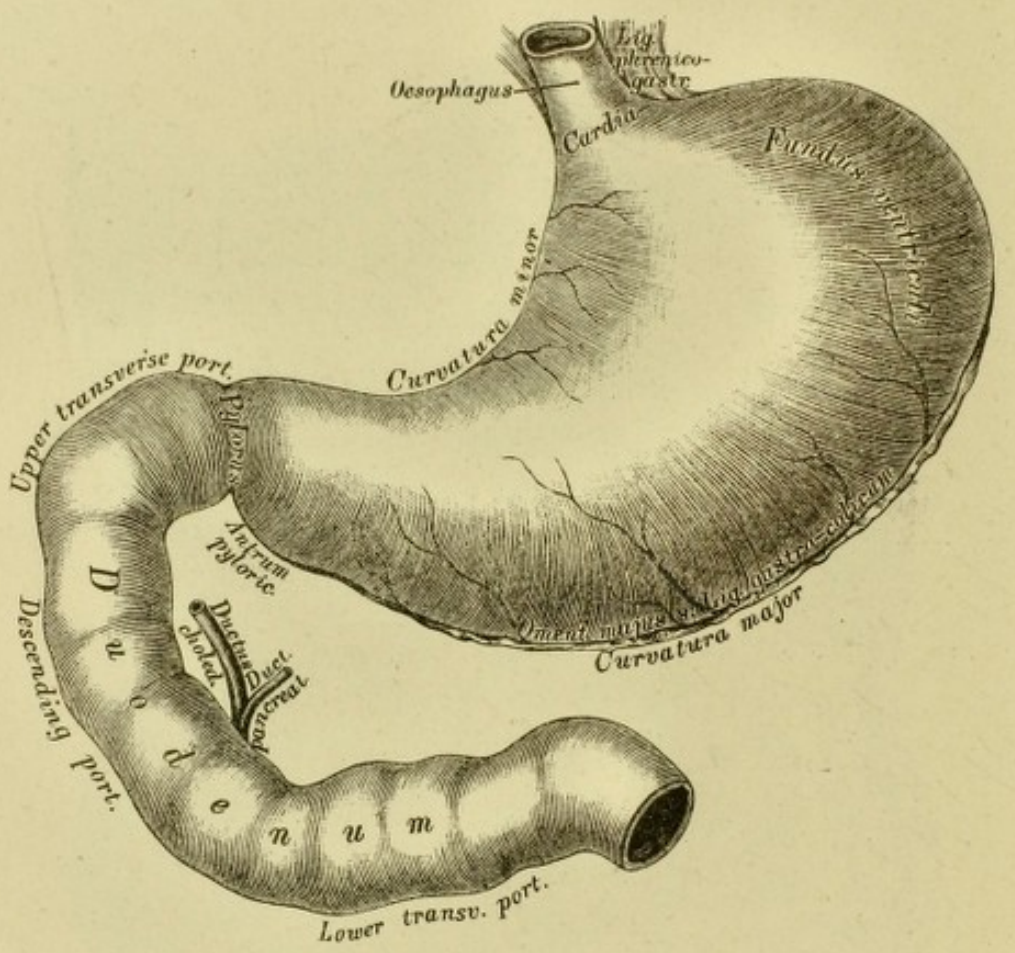
350. Topography of the Abdominal Viscera III.

View of the Liver, Stomach and Intestines after removal of the Great Omentum and Lower Ribs.



351. Topography of the Abdominal Viscera. IV.

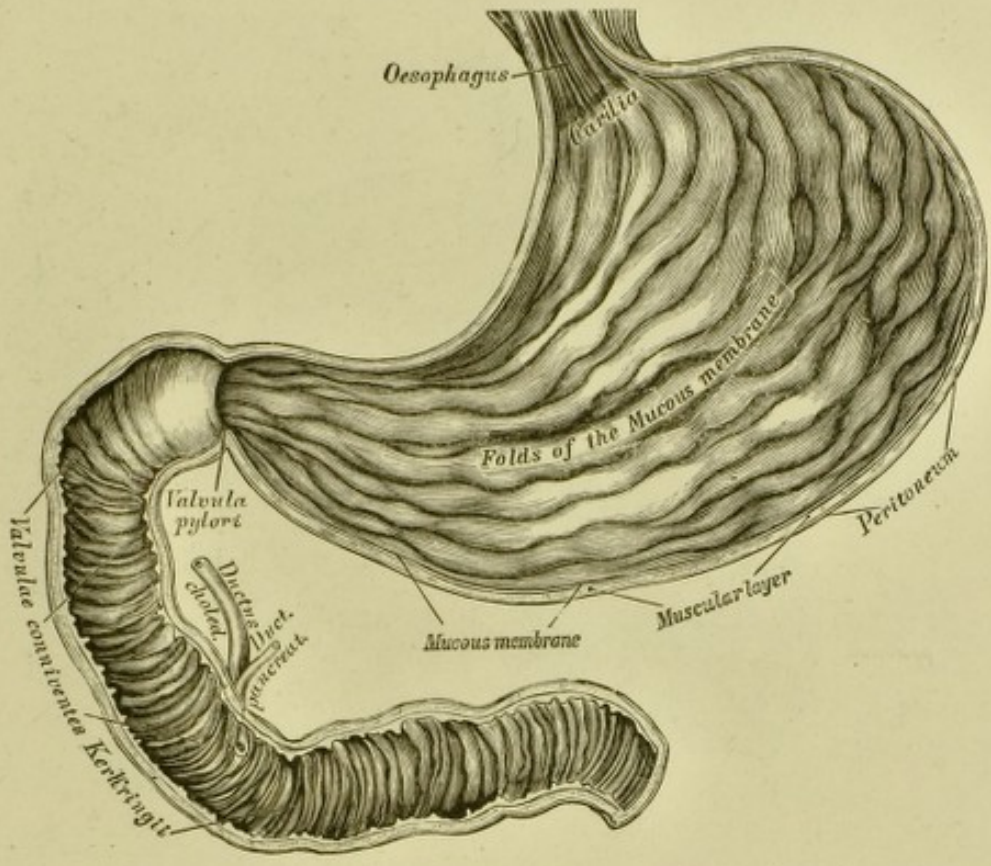
View after removal of the Liver, the Stomach and the Small Intestines.



352. The Stomach and the Duodenum, view from before.

The oesophagus or gullet extends from the pharynx to the stomach. In the neck it lies behind and a little to the left of the trachea; it descends in the posterior mediastinum, opposite the place of bifurcation of the trachea, along the right side of the aorta, crosses the artery further down and passes through the oesophageal opening of the diaphragm to the stomach.

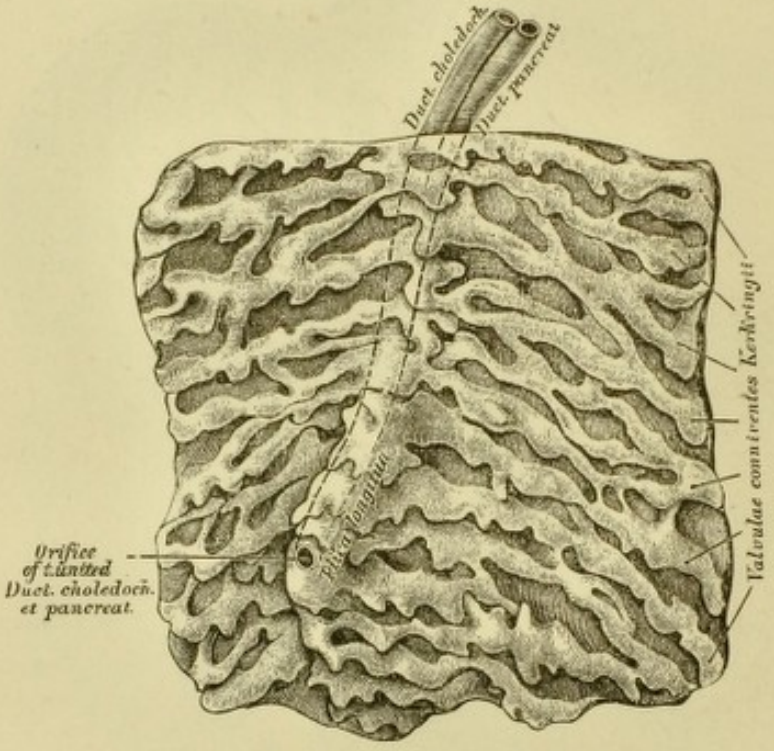
The stomach, *Ventriculus s. stomachus*, lies in the epigastric region; above it is the diaphragm, below the transverse colon, behind the pancreas, and to the left side the spleen. It presents a cardiac orifice, *Cardia (Ostium oesophageum)* a pyloric orifice, *Pylorus (Ostium duodenale)*, and an expanded part, the great cul-de-sac or fundus, *Fundus ventriculi*. This is the largest part of the stomach, and from there it gradually narrows towards the pylorus, in front of which is a prominence or bulging, called the small cul-de-sac or *Antrum pyloricum Willisii*. At the pylorus, between the stomach and duodenum is a distinctly visible, slight constriction.



353. The Stomach and the Duodenum,

after removal of the anterior wall.

Between the cardiac and pyloric orifices the outline of the stomach is curved along its upper and lower borders; the upper concave border forms the lesser curvature, *Curvatura minor*, and the lower convex, the greater curvature, *Curvatura major*. The two surfaces of the organ, the anterior, and the posterior, are limited by these two curvatures. If the stomach is filled, the anterior surface becomes an upper, and the posterior surface a lower. The peritoneal covering of the stomach is continued from it to the neighbouring organs by means of duplicatures; where the membrane passes from the cardia to the diaphragm, it forms the gastro-phrenic ligament, *Ligamentum-phrenico-gastricum;* where it passes from the fundus of the stomach to the spleen, it forms the gastro-splenic ligament, *Ligamentum gastro-lienale;* from the lesser curvature of the stomach to the transverse fissure of the liver it forms the lesser omentum, *Ligamentum hepato-gastricum, s. Omentum minus.* The great omentum, *Ligamentum gastro-colicum s. Omentum majus*, passes down from the greater curvature of the stomach, covering the small intestines; it is a duplicature of the peritoneum, which then ascends to the transverse colon, and thence extends back to the pancreas (see Fig. 368 and 369). The layers of the stomach from without inwards are: the peritoneum (serous coat), the muscular coat (longitudinal, circular and oblique fibres), and the mucous membrane rich in glands.



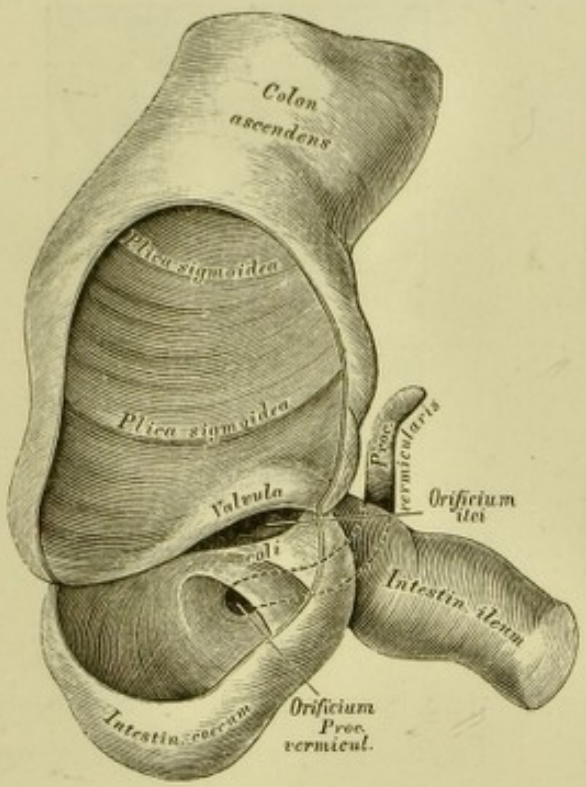
354. The Inner Surface of the Duodenum,

at its descending portion.

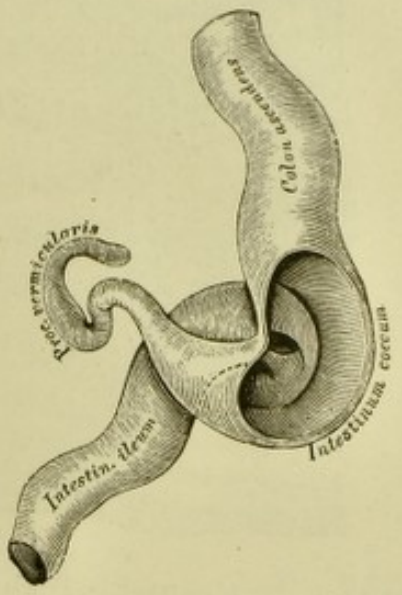
The duodenum presents a curve, embracing the head of the pancreas; it is divided into a superior or superior transverse, a descending, and an oblique or inferior transverse portion. The superior portion is nearly completely invested by peritoneum; the inferior transverse portion lies between the two layers of the transverse mesocolon; the descending portion is covered by peritoneum only on its anterior surface.

The jejunum and ilium form numerous convolutions in the abdominal and pelvic regions; they present no characteristic marks to distinguish the termination of the one and the commencement of the other; they are attached to the mesentery, *Mesenterium*, and by its root, *Radix mesenterii*, to the lumbar portion of the vertebral column.

The layers of the small intestine are the same as those of the stomach: peritoneum (serous coat), muscular coat (consisting of external longitudinal and internal circular fibres), and the mucous membrane, which consists of a layer of muscular tissue, of folds called *Valvulae conniventes*, of villi and of glands.



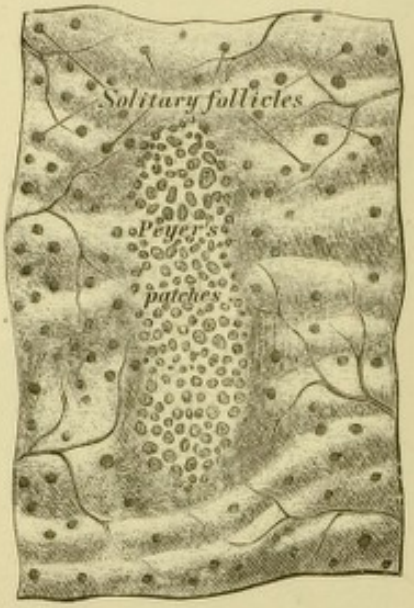
355. Termination of the Ileum into the Coecum, in an Adult. ½ nat. size of an inflated and dried intestine, the anterior wall being partially removed.



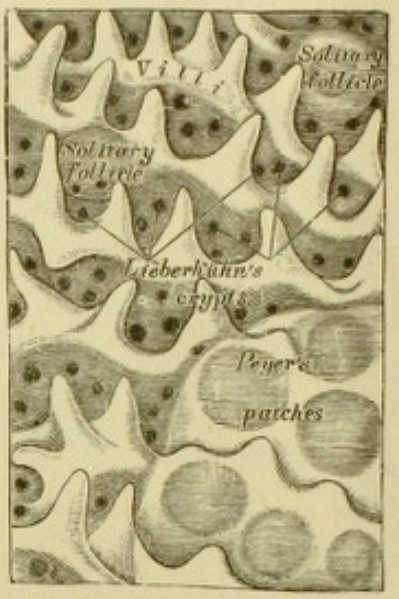
356. Termination of the Ileum into the Coecum, in a Foetus of 7 months. Natural size of an inflated and dried intestine, the posterior wall being partially removed.

The mucous membrane of the small intestine contains transverse folds, *Valvulae conniventes Kerkringii*, which begin at the descending portion of the duodenum and are thence present throughout the rest of the small intestine; in the duodenum they are largest and most numerous, and from there they diminish gradually in size and number. In the descending portion of the duodenum, near the inner margin of the posterior wall, is a vertical projection, *Plica longitudinalis*, formed by the mucous membrane raised up by the united *Ductus choledochus* and *pancreaticus*, before they open into the intestine. Where the ileum opens into the coecum, the mucous membrane forms the ileo-coecal valve, *Valvula coli*, which consists of two folds.

Throughout the whole extent of the mucous membrane of the small intestine there are numerous minute processes, *Villi intestinales;* each villus has abundant bloodvessels and one or more lymphatic vessels, being supported and held together by retiform lymphoid tissue.



357a. Segment of the Inner Surface of the Small Intestine, natural size.



357b. Segment of the Inner Surface of the Small Intestine, somewhat magnified.

In the small intestine there are four kinds of glands:

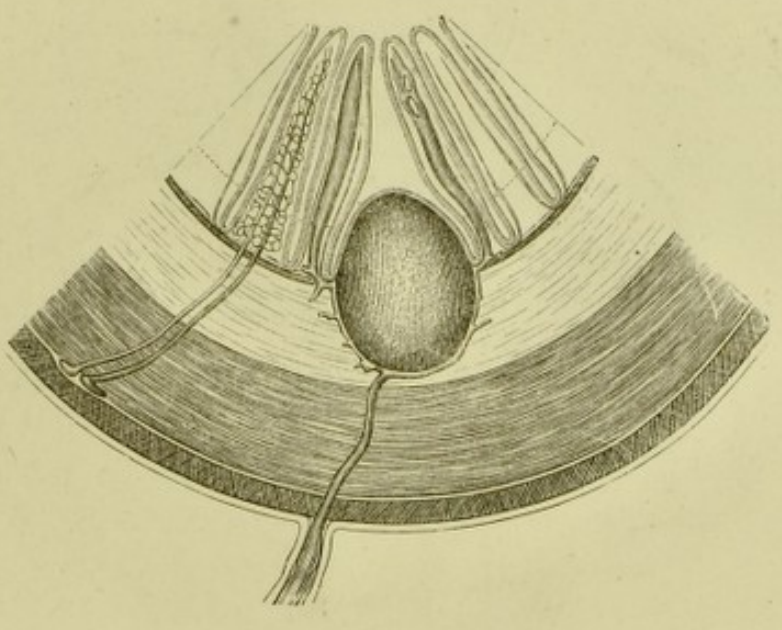
a) The crypts of Lieberkühn are minute tubular depressions, scattered between the villi.

b) Brunner's glands are acinous glands found only in the duodenum, especially numerous at its commencement.

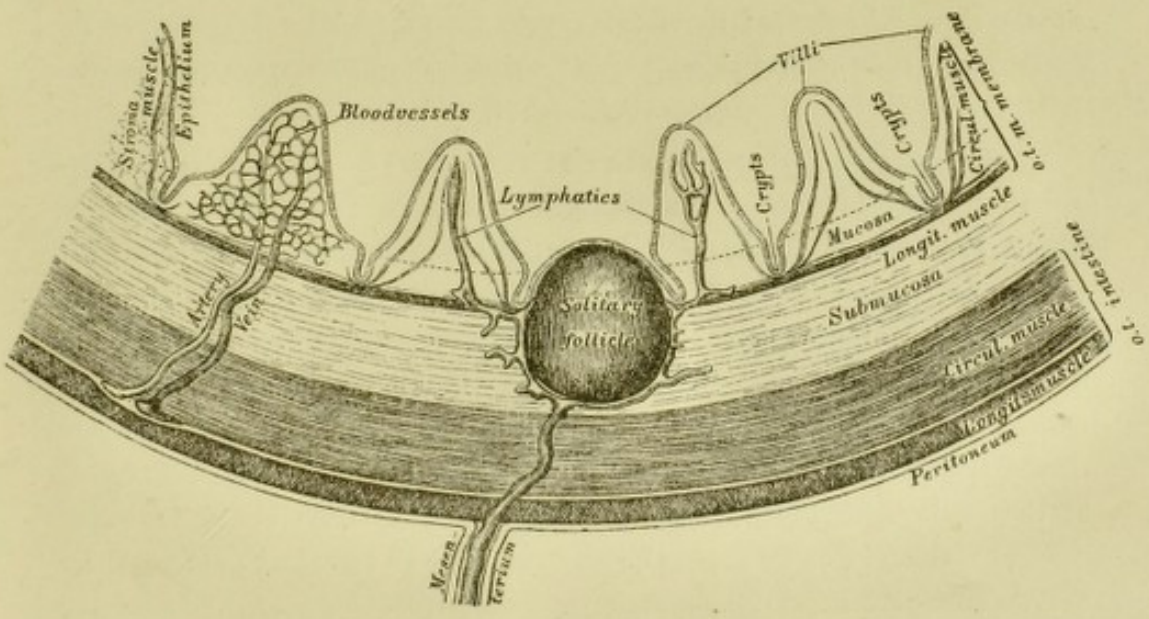
c) The solitary follicles are scattered throughout the mucous membrane of the small intestine; they are of different size and similar in structure to the lymphatic glands.

d) The agminated glands or glands of Peyer are aggregations of solitary glands, usually found only in the ileum; they are placed lengthwise in the intestine, at that part of the tube most distant from the mesentery.

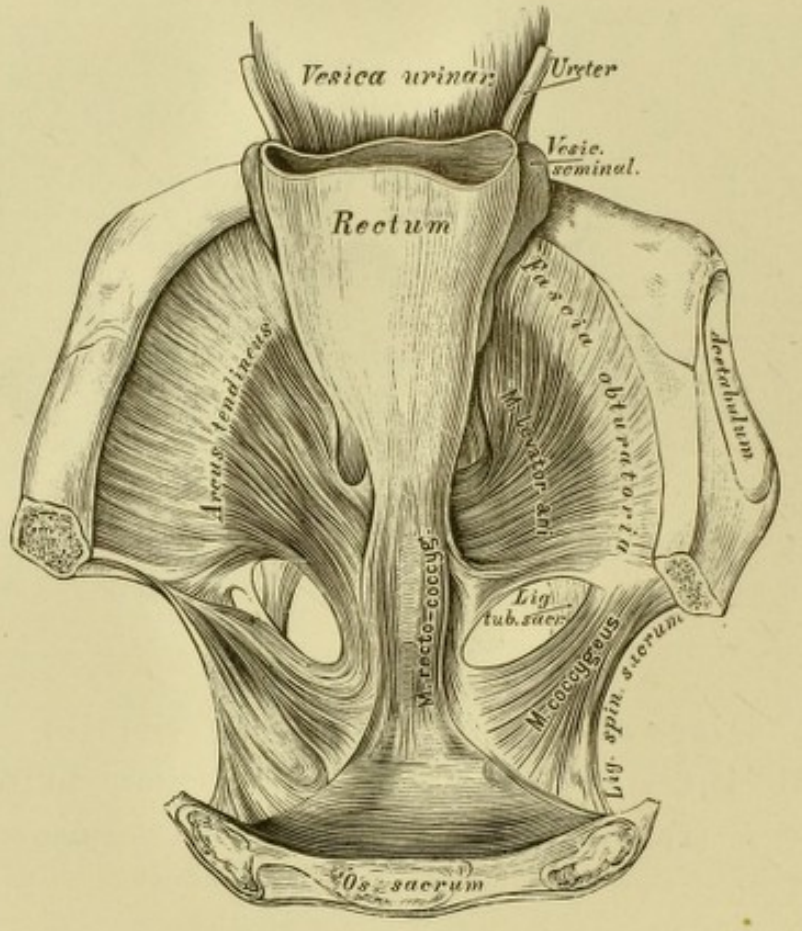
The large intestine commences at the coecum, to the lower part of which the vermiform appendix, *Processus vermicularis*, from 2—3 inches in length, is attached; the portion succeeding the coecum is the colon, divided into an ascending, *Colon ascendens*, transverse, *Colon transversum*, descending, *Colon descendens*, and sigmoid flexure, *Flexura sigmoidea s. S romanum;* the last portion is the rectum, *Intestinum rectum*, which ends at the anus. Only the coecum with the vermiform appendix, transverse colon and sigmoid flexure are completely invested by peritoneum, which is more or less wanting on the posterior surface of the other parts of the large intestine.



358a. Diagrammatic Transverse Section of the Small Intestine, the Muscular Coat being contracted. Segment magnified about 25 times.



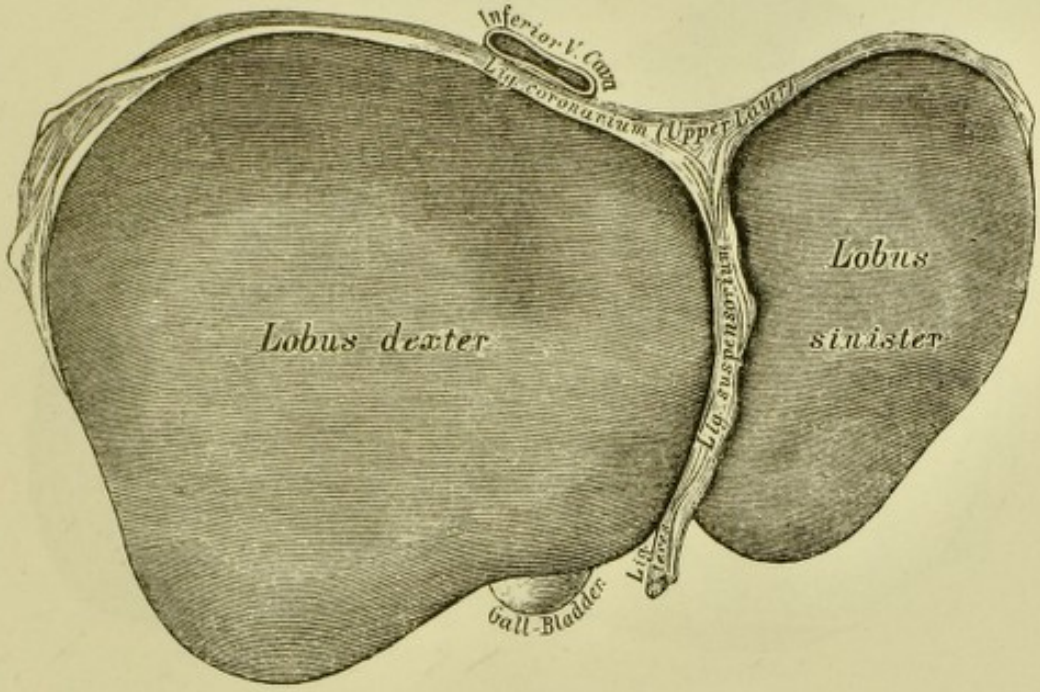
358b. Diagrammatic Transverse Section of the Small Intestine, the Muscular Coat being relaxed. Segment magnified about 25 times.



359. Horizontal Section through the Pelvis at the lower border of the third sacral vertebra. After removal of the peritoneum the urinary bladder and collapsed rectum were turned forwards. After J. Henle.

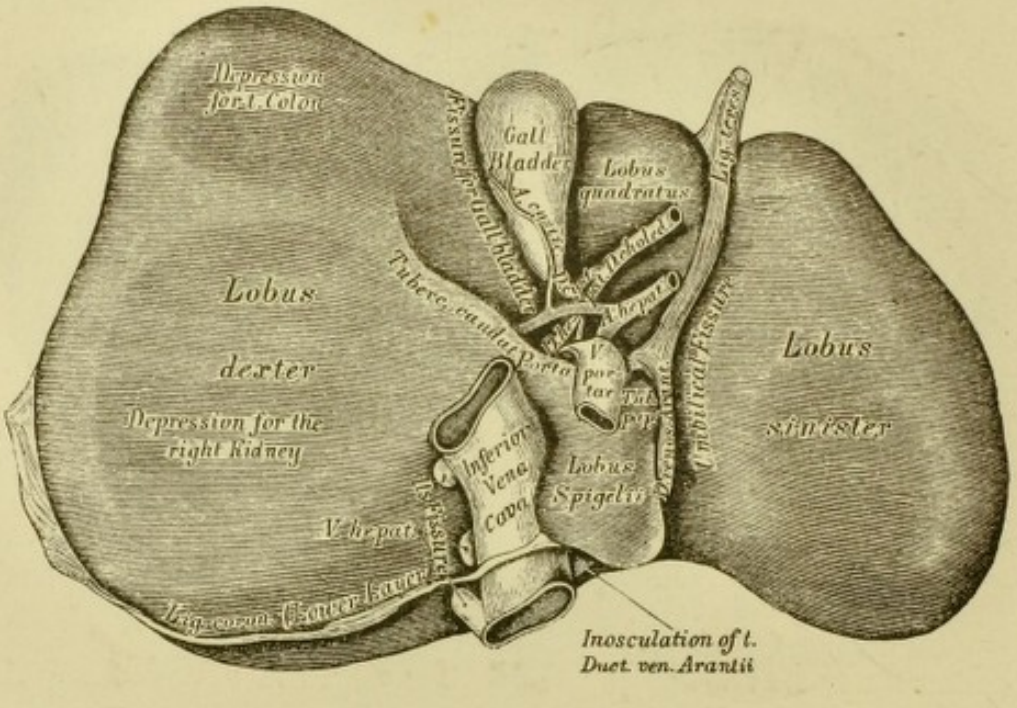
The longitudinal muscular fibres of the large intestine are in the coecum and colon collected into three flat bands, the *Fasciae, Taeniae Valsalvae s. Ligamenta coli* (see Fig. 351); these are the *Fascia omentalis, mesenterica* and *libera*. In the sigmoid flexure and rectum they are spread out into a uniform layer of longitudinal muscular fibres; the circular fibres form at the end of the rectum the internal sphincter muscle, *M. sphincter ani internus*. The other muscles at the end of the rectum are the *M. sphincter ani externus* and *M. levator ani;* the origin and connection of the latter with the *M. recto-coccygeus* is evident from the figure.

In the mucous membrane of the large intestine there are certain permanent folds, *Plicae sigmoideae* (see Fig. 355), containing circular fibres, the last of which lies about 3 inches above the anus; this mucous membrane has no villi, but there are crypts of Lieberkühn and solitary follicles. Towards the end of the rectum the folds of the mucous membrane form the *Sinus Morgagni*.



360. The Liver, *Hepar.* View from above.

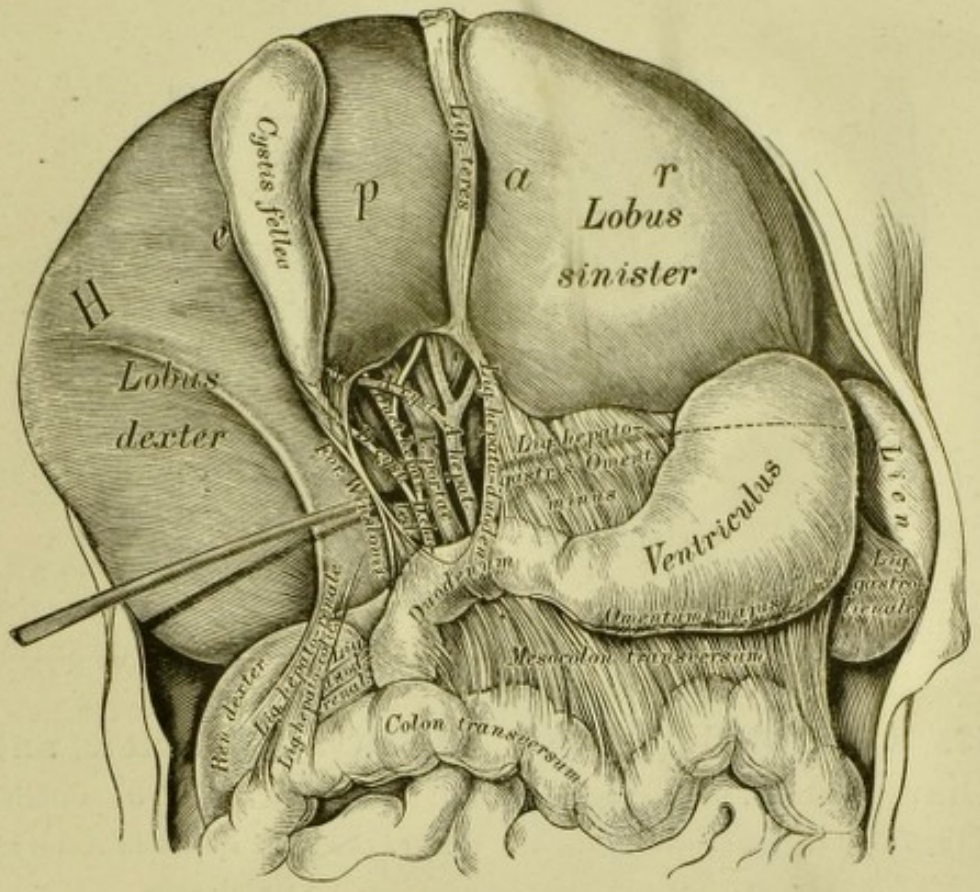
The liver lies in the right hypochondrium and extends across into the left. Its anterior border, thin and sharp, is marked by a deep notch for the attachment of the *Ligamentum suspensorium* (broad, falciform ligament); its posterior rounded border is higher than the anterior; the right border is also rounded, the left, sharp, lies in front of the cardia of the stomach. The upper surface is convex and exactly moulded to the under surface of the diaphragm; it is marked off into a large right and a small left portion by the line of attachment of the suspensory ligament. The under surface of the liver (see Fig. 361) is divided by four fissures into five lobes; the fissures are: the fissure for the gall-bladder, the longitudinal fissure (divided into umbilical fissure and fissure for the *Ductus venosus*), the transverse fissure and the fissure for the inferior *Vena cava*. To the right of the fissure for the gall-bladder is the right lobe of the liver, to the left of the longitudinal fissure the left lobe; in front of the transverse fissure is the *Lobulus quadratus*, behind it the *Lobulus Spigelii* with the conical *Tuberculum papillare*, and with a process, the *Tuberculum caudatum s. Lobulus caudatus*, which extends to the under surface of the right lobe.



361. The Liver, *Hepar*. View from below.

The longitudinal fissure is divided by the transverse fissure *(Porta hepatis)* into two parts; the anterior is called the umbilical fissure and lodges the round ligament, *Ligamentum teres*, the posterior, called the fissure of the *Ductus venosus*, lodges the *Ductus venosus Arantii*. The fissure for the gall-bladder lodges the gall-bladder, and the fissure for the *Vena cava*, the inferior *Vena cava*, *Vena cava ascendens*. The vessels and nerves of the liver enter the transverse fissure, only the hepatic veins, *Venae hepaticae*, terminate in the inferior *Vena cava*.

The peritoneal folds of the liver are: the suspensory ligament, *Ligamentum suspensorium*, attached by one margin to the under surface of the diaphragm and the anterior abdominal wall as far down as the umbilicus, and by its hepatic margin to the upper surface of the liver, and the coronary ligament, *Ligamentum coronarium*, attached to the posterior portion of the diaphragm and the posterior round border of the liver. The round ligament, *Ligamentum teres*, ascends from the umbilicus, enclosed in the longitudinal ligament, to the notch on the anterior border of the liver, and may be traced on the under surface of the liver, as far back as the inferior *Vena cava*.



362. The Peritoneal Ligaments of the Liver of a Child several weeks old.

The peritoneal folds of the liver are further:

a) between the liver and the lesser curvature of the stomach the *Ligamentum hepato-gastricum s. Omentum minus;*

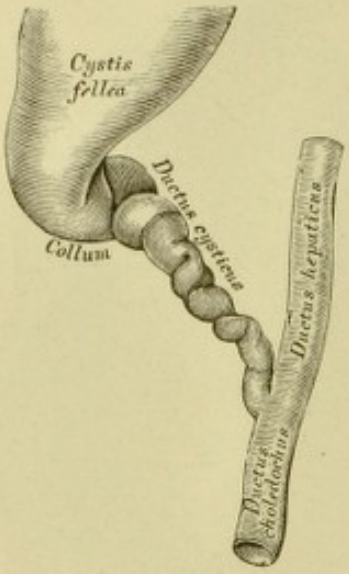
b) between the liver and duodenum the *Ligamentum hepato-duodenale;*

c) between the liver and upper part of the right kidney the *Ligamentum hepato-renale;*

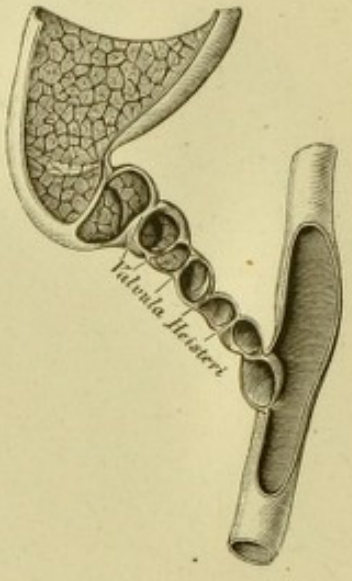
d) between the liver and colon the *Ligamentum hepato-colicum;* the two latter ligaments are not always well developed.

Between the *Ligamentum hepato-duodenale* and *Ligamentum duodeno-renale* is the oval *Foramen Winslowii,* through which a finger or probe will pass into a space behind the stomach and lesser omentum, which space is called *Saccus peritonei retroventricularis s. Bursa omentalis.*

The round ligament is a fibrous cord resulting from the obliteration of the umbilical vein; the *Ductus venosus Arantii,* also obliterates after birth, is in the foetus a continuation of the umbilical vein, and joins the left hepatic vein at the point of junction of that vessel with the inferior *Vena cava.*



363. Gall-Bladder and Biliary Ducts. From an inflated and dried specimen. Natural size.

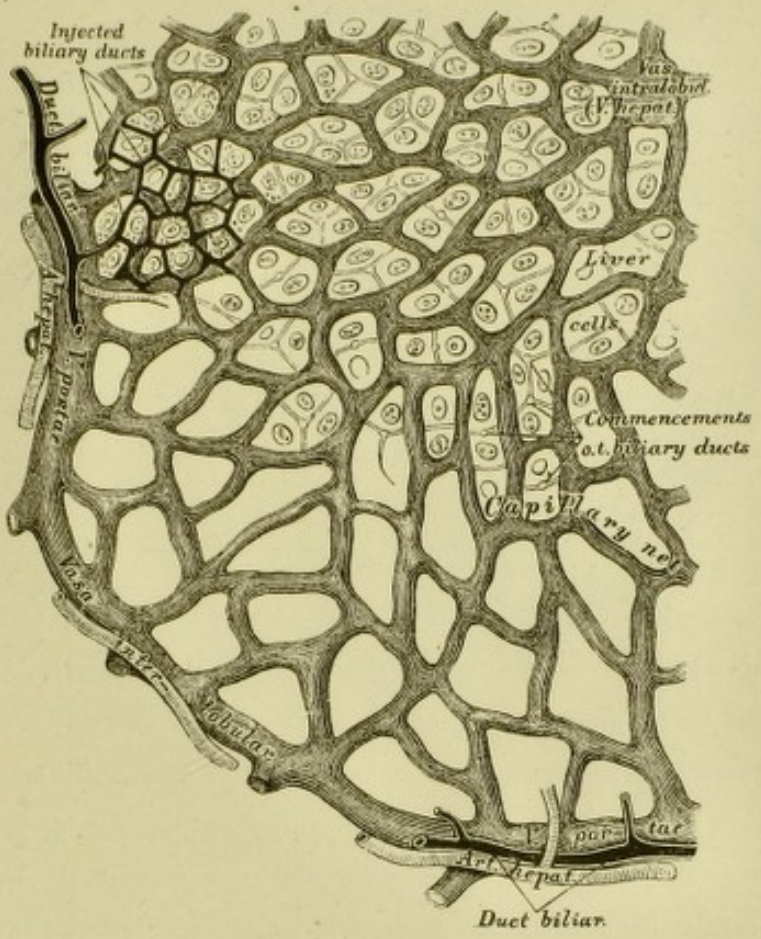


364. Gall-Bladder and Biliary Ducts. The anterior wall of the dried specimen removed. Natural size.

The gall-bladder, *Cystis fellea s. Cholecystis,* is lodged in a fossa on the under surface of the right lobe of the liver; it is pear-shaped; its fundus projects from the anterior border of the liver, its curved and constricted neck terminates in the cystic duct, *Ductus cysticus.* The mucous membrane is elevated into numerous small ridges; in the neck of the bladder and the cystic duct the mucous membrane is elevated into a series of folds, so as to present very much the appearance of a spiral valve, the *Valvula Heisteri.*

The cystic duct unites with the hepatic duct which issues from the transverse fissure of the liver to form the common bile duct, *Ductus communis choledochus;* this is about the diameter of a goose-quill. The *Ductus choledochus* unites with the *Ductus pancreaticus* and runs along the posterior wall of the descending portion of the duodenum; it forms an elevation beneath the mucous membrane and opens on the inner surface of the intestine.

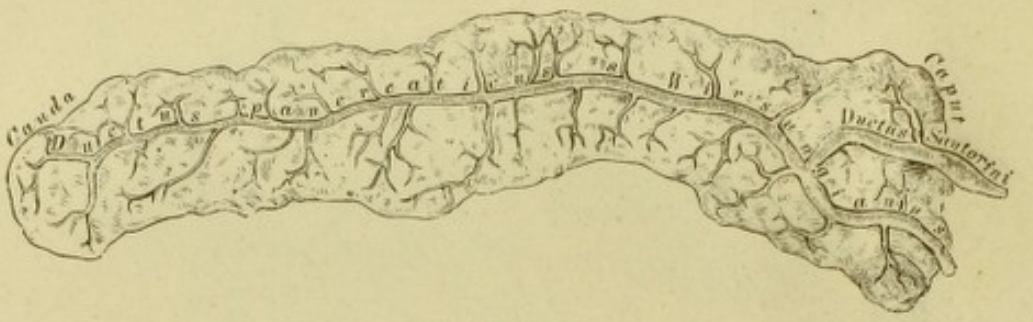
The gall-bladder has an external fibrous coat, a middle muscular coat (longitudinal and transverse fibres) and the internal mucous membrane; it is lined by peritoneum only on its under surface and its fundus.



365. Diagram of the Structure of the Liver.

Segment of an hepatic lobule.

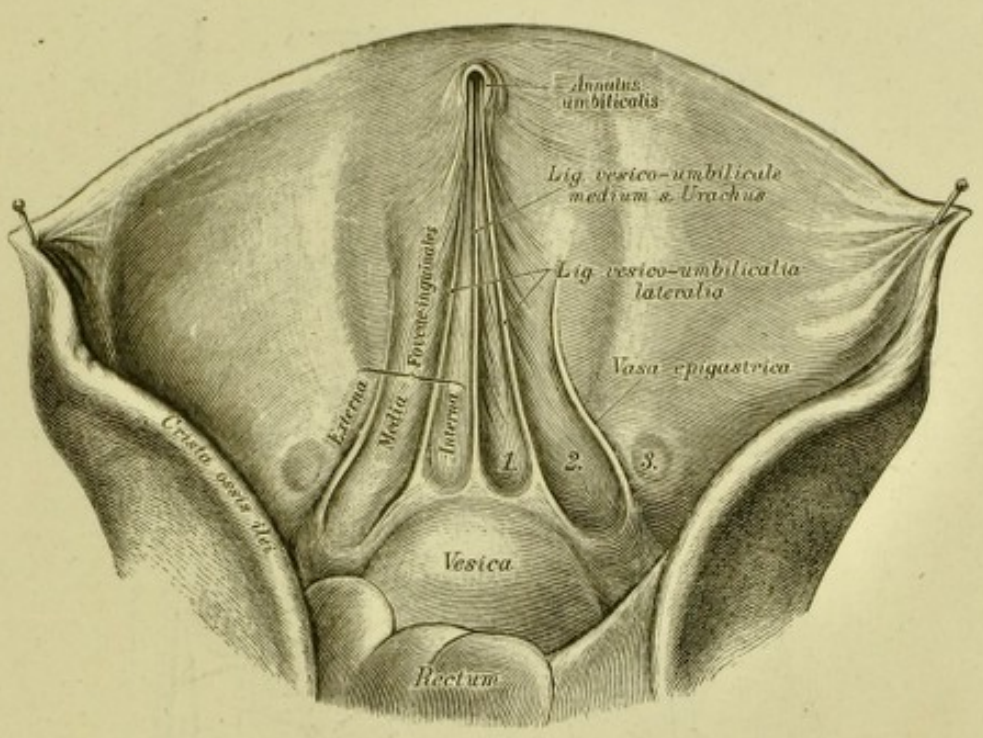
The liver is composed of a multitude of small lobules which are not completely insulated, being confluent in a part of their extent. The interlobular branches of the hepatic artery and of the portal vein ramify between the lobules (the former probably transmit no blood directly to the capillary network of the lobules); these vessels collectively are called *Vasa interlobularia*. The hepatic veins commence in the center of each lobule as intralobular or central veins, *Vasa intralobularia s. Venae centrales*. The *Vasa inter-* and *intralobularia* are connected with each other by a capillary network, in the interstices of which are the hepatic cells. Between the hepatic cells are the commencements of the biliary vessels, which unite to form the biliary ducts, *Ductus biliarii;* these biliary ducts accompany the *Vasa interlobularia*.



366. Pancreas, with Injected, Bifurcated Excretory Duct. View from behind, $^1/_2$ natural size.

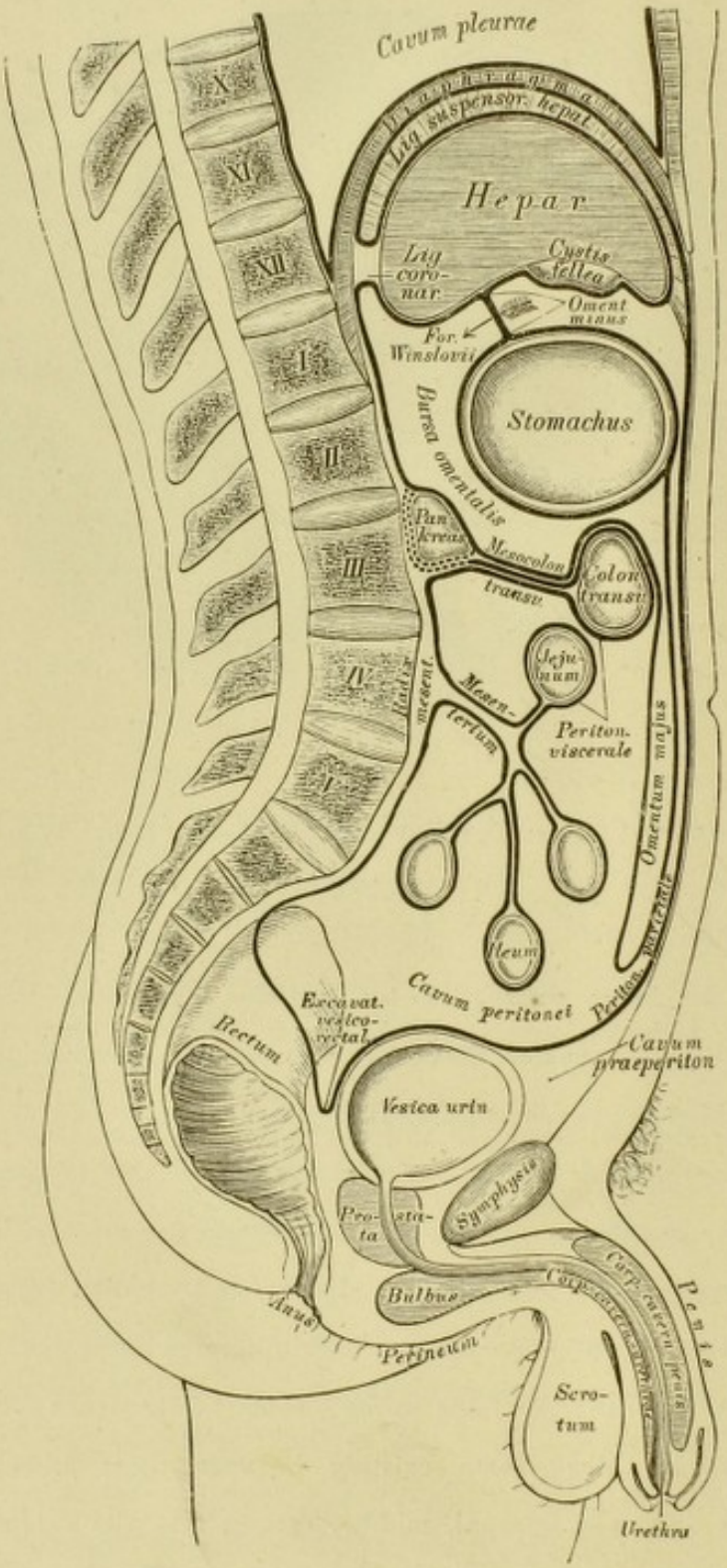
The pancreas lies behind the stomach, upon the lumbar portion of the diaphragm (see Fig. 351); the left extremity or tail, *Cauda*, is in contact with the spleen, while the right larger end, the head, *Caput*, is embraced by the curvature of the duodenum. Its excretory duct, the *Ductus pancreaticus s. Wirsungianus*, about the size of a quill, extends transversely from left to right through the substance of the pancreas, unites with the *Ductus communis choledochus*, and opens with it in the duodenum; rarely each duct has a separate opening. Often the pancreatic duct is bifurcated; then the lower branch unites with the common bile-duct, and the upper *(Ductus Santorini)* opens separately 1 inch or $1^1/_2$ inches above the lower.

The spleen, *Lien s. Splen* (see Fig. 351 and 362) is a highly vascular gland, lying in the left hypochondrium, near the fundus of the stomach. The external and upper surface is in relation with the concave surface of the *Pars costalis* of the diaphragm, the inner surface, containing the hilus, *Hilus lienis*, is in relation in front with the stomach, behind with the left crus of the diaphragm; the anterior border is often slightly notched, the posterior, rounded. The peritoneal covering is connected with that of the stomach by means of the *Lig. gastro-lienale*, with that of the diaphragm by means of the *Lig. phrenico-lienale;* the spleen is also invested with a *Tunica propria*, which is reflected into the interior of the spleen in the form of large *Trabeculae;* in the interstices of the connective tissue frame work is the red pulp, *Pulpa lienis*.

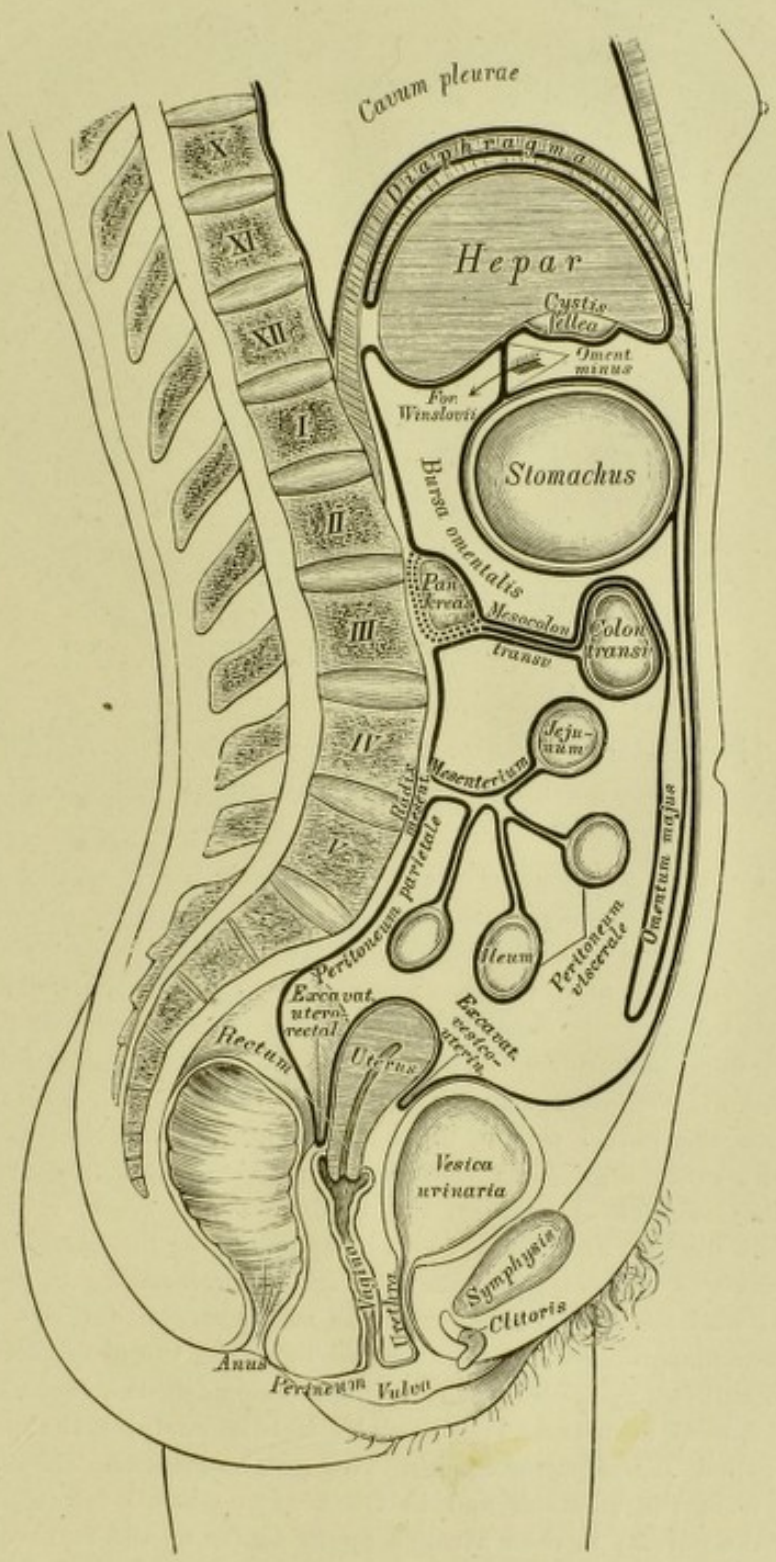


367. View of the Anterior Abdominal Wall, from inside.

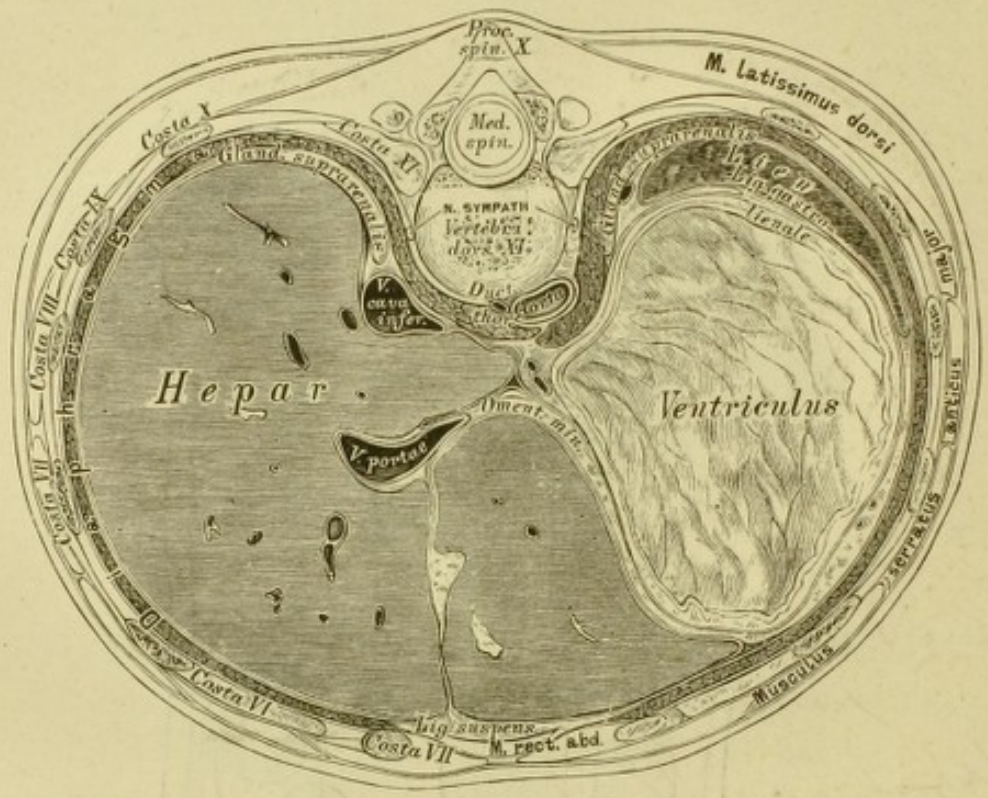
On the inner surface of the anterior abdominal wall are five folds of the peritoneum, which are caused by connective tissue bands running behind the peritoneum. The middle one of these folds is called *Ligamentum vesico-umbilicale medium*, and contains the remains of the urachus, which forms a tubular communication between the urinary bladder and allantoic vesicle; the folds on both sides of it are called *Ligamenta vesico-umbilicalia lateralia* and these contain the obliterated remains of the hypogastric arteries; the folds on both sides of these are formed by the *Vasa epigastrica*. The fossae existing between these folds are called inguinal fossae: internal, middle, external. In the external inguinal fossa a small foveola, *Foveola inguinalis*, is seen, or in its place may be only a whitish cicatrix: place of the obliterated *Processus vaginalis* (abdominal opening of the inguinal canal).



368. Diagram of the Reflections of the Peritoneum in the Male.



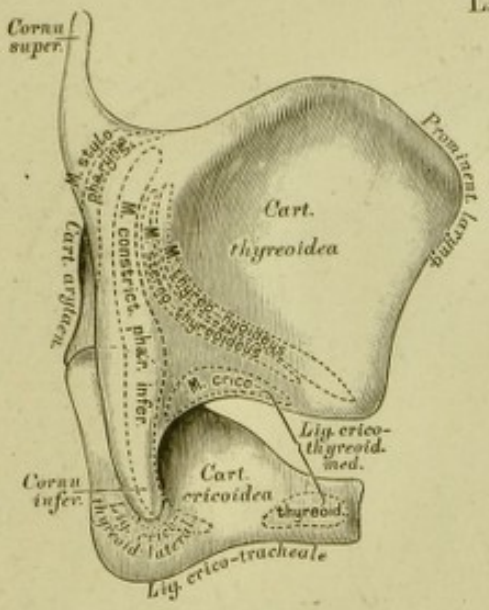
369. Diagram of the Reflections of the Peritoneum in the Female.



370. Horizontal Section through the Abdomen

below the xiphoid appendix in the pit of the stomach.
From a one year old child in natural size.

The peritoneum or serous membrane of the abdominal cavity, may be considered to form a shut sac, but in the female the two Fallopian tubes open at their free extremities into its cavity; it invests all the abdominal and pelvic viscera completely or partially, forming the visceral layer of the membrane, *Peritoneum viscerale;* then it is reflected upon the internal surface of the parietes of these cavities, forming the parietal layer, *Peritoneum parietale.* The reflections of the peritoneum are different in the pelvic organs of the male and female, but identical as regards the other organs. In the male the vesico-rectal fold or *Excavatio vesico-rectalis* is formed between the bladder and rectum; in the female between the bladder and uterus (with its appendages) the anterior *Excavatio vesico-uterina* and the posterior, deep *Excavatio utero-rectalis.* At the anterior abdominal wall the peritoneum forms the suspensory ligament of the liver, in the lower margin of which is the round ligament, the obliterated remains of the umbilical vein. Between liver and stomach the lesser omentum, *Omentum minus,* is attached; its right border contains the portal vein and is called *Lig. hepato-duodenale.* The great omentum, *Omentum majus,* descends from the stomach and in front of the small intestines as low down as the pelvis; it then ascends again as far as the transverse colon, and aids in the formation of the transverse meso-colon; further back it covers the pancreas and forms the posterior wall of the *Bursa omentalis.* The mesentery, *Mesenterium,* is the broad fold of peritoneum which connects the small intestines with the posterior wall of the abdomen.



371. The Cartilages of the Larynx.

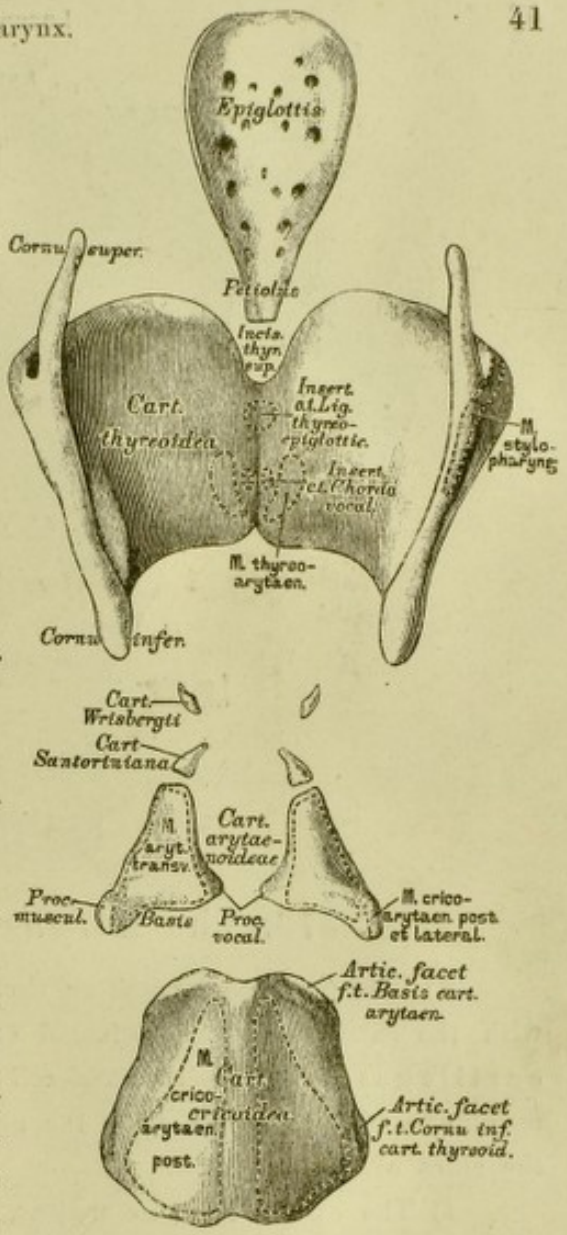
Lateral View.

The larynx is composed of the following cartilages:

a) The thyroid cartilage, *Cartilago thyreoidea*, consists of two lateral lamellae, quadrilateral in form, united at an acute angle; the upper border is deeply notched in the middle line, immediately above the *Pomum Adami (Prominentia laryngis)*, while on either side it is somewhat concave. The posterior border of each lamella terminates in the superior and inferior cornua, *Cornu superius (longum)* and *Cornu inferius (breve)*.

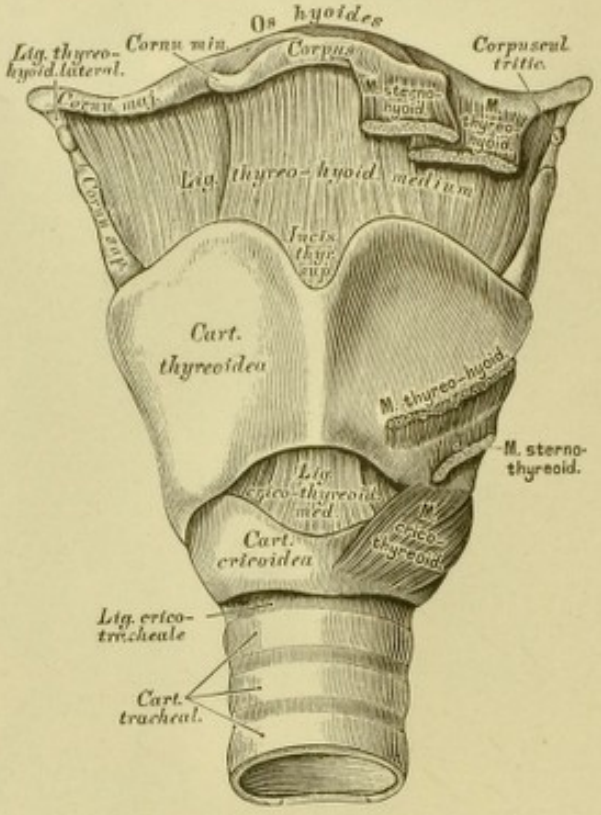
b) The cricoid cartilage, *Cartilago cricoidea*, lies below the thyroid cartilage, between its inferior cornua, with which it articulates; it is shaped like a signet ring and has a narrow anterior and a broad posterior portion. The upper border of the posterior portion has two oval facets for articulation with the bases of the arytenoid cartilages.

c) The arytenoid cartilages, *Cartilagines arytaenoideae* (a right and a left), are pyramidal in form, and rest by their bases on the posterior and highest part of the cricoid cartilage; the apex of each cartilage is pointed and curved backwards and each has three surfaces, an internal, external or anterior and a posterior, all covered by the laryngeal mucous membrane. The anterior angle of the base forms a horizontal projection, the vocal process, *Processus vocalis*, for the true vocal cord; the external, the muscular process, *Processus muscularis*, for the insertion of the posterior and lateral crico-arytenoid muscles.



372. The Cartilages of the Larynx.

View of the separate cartilages, from behind.



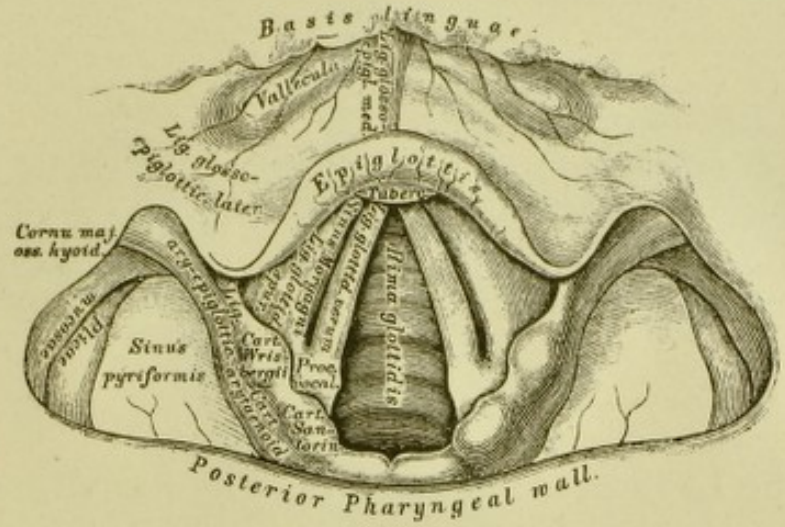
373. The Larynx. View from before.

d) The *Cornicula laryngis* or *Cartilagines Santorinianae* are articulated with the summits of the arytenoid cartilages, and e) the cuneiform cartilages or *Cartilagines Wrisbergii* are placed in the fold of mucous membrane which extends from the apex of the arytenoid cartilages to the sides of the epiglottis.

f) The epiglottis; its upper, free border looks upwards and backwards (see Fig. 377), its attached end *(Petiolus)* is long and narrow and connected to the thyroid cartilage by means of the *Ligamentum thyreo-epiglotticum*. Its anterior surface is curved forwards towards the tongue; its posterior surface concave from side to side, concavo-convex from above downwards; the convexity projecting backwards into the larynx is named the tubercle.

The true ligaments (extrinsic and intrinsic) of the larynx are:

a) Middle thyro-hyoid, *Ligamentum thyreo-hyoideum medium* (also called *Membrana obturatoria laryngis)*, between the hyoid bone and superior border of the thyroid cartilage, and the two lateral thyro-hyoid, *Ligamenta thyreo-hyoidea-lateralia*, between the superior cornua of the thyroid cartilage and the great cornua of the hyoid bone; the latter are two rounded yellowish cords and frequently enclose a fibro-cartilaginous nodule, *Corpusculum triticeum (cartilago-triticea)*.



374. The Laryngoscopic View in Quiet Breathing.

Double the natural size.

b) Crico-tracheal, *Ligamentum crico-tracheale*, between the lower border of the thyroid cartilage and the upper border of the first tracheal cartilage.

c) Lateral crico-thyroid, *Ligamenta crico-thyreoidea lateralia*, capsular ligaments between the inferior cornua of the thyroid cartilage and the lateral surfaces of the cricoid cartilage, with two strengthening bands, the *Ligamentum cerato-cricoideum posticum superius* and *Ligamentum cerato-cricoideum posticum inferius* (see Fig. 378 and Fig. 379).

d) Middle crico-thyroid, *Ligamentum crico-thyreoideum medium s. Ligamentum conicum*, between the lower border of the thyroid cartilage and upper border of the anterior portion of the cricoid cartilage, consisting chiefly of elastic tissue (see Fig. 373).

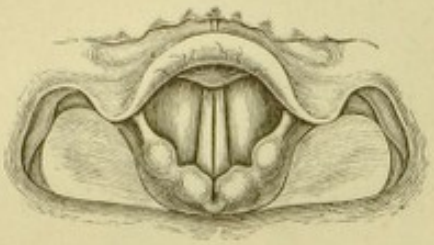
e) Crico-arytenoid, *Ligamenta crico-arytaenoidea*, capsular ligaments between the bases of the arytenoid cartilages and the articular facets on the posterior portion of the cricoid cartilage (see Fig. 379 and Fig. 381).

f) Thyro-epiglottic, *Ligamentum thyreo-epiglotticum*, between the apex of the epiglottis and the notch of the thyroid cartilage (see Fig. 383).

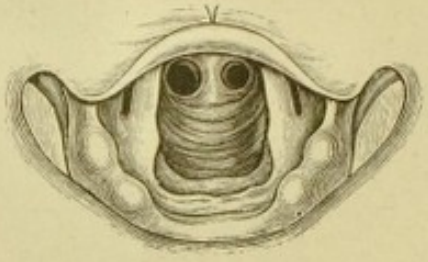
The folds of mucous membrane of the larynx are:

a) The middle and lateral glosso-epiglottic folds, *Ligamentum glosso-epiglotticum medium* and *Ligamenta glosso-epiglottica lateralia*, between the base of the tongue and epiglottis; the middle one is also called *Fraenulum epiglottidis*.

b) The aryteno-epiglottidean folds, *Ligamenta epiglottideo-arytaenoidea s. ary-epiglottica*, between epiglottis and arytenoid cartilages, which enclose the cartilages of Wrisberg.



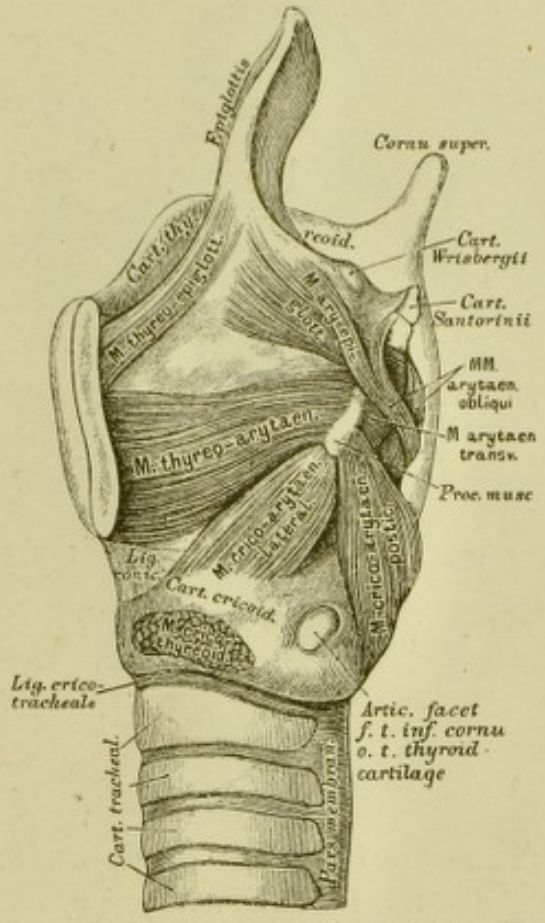
375. The Laryngoscopic View in the Production of Voice.
Natural size.



376. The Laryngoscopic View of the Posterior Laryngeal and Tracheal Wall and the Place of Bifurcation. Natural size.

The vocal cords are situated one above the other, in the interior of the larynx, between the inner surfaces of the lamellae of the thyroid cartilage and the arytenoid cartilages. The superior or false vocal cords, or *Ligamenta glottidis spuria*, are two folds of mucous membrane, enclosing a delicate fibrous band of elastic tissue, the superior thyro-arytenoid ligament, attached to the anterior margin of the arytenoid cartilage and angle of the thyroid. The inferior or true vocal cords, or *Ligamenta glottidis vera*, are two fibrous bands of elastic tissue, the inferior thyro-arytenoid ligaments, covered by mucous membrane, and attached to the vocal process of the arytenoid cartilage and depression between the alae of the thyroid. The slit between the false vocal cords is called *Glottis spuria*, that between the true vocal cords *Glottis vera;* between the true and false vocal cords on each side is a depression, the *Sinus s. Ventriculus Morgagni.*

The *Rima glottidis* between the true vocal cords has in quiet breathing a triangular shape, through which the anterior wall of the larynx (region of the thyroid cartilage, *Lig. conicum*, cricoid cartilage) and the trachea (tracheal cartilages) can be seen by means of the laryngoscope; by a corresponding position of the mirror, the posterior wall of the larynx (region between both arytenoid cartilages) and the trachea *(Pars membranacea)* down to the place of bifurcation of the latter, can also be seen. At the moment of phonation the *Rima glottidis* is completely closed.



377. Larynx after Removal of the Left Thyroid Lamella, lateral view.

The muscles of the larynx (all in pairs) are:

1. At the external portion of the larynx:

a) *M. crico-thyroideus* (see Fig. 373) arises from the front and lateral part of the cricoid cartilage and running obliquely upwards, is inserted into the lower border of the thyroid cartilage. Produces tension of the vocal cords.

b) *M. crico-arytaenoideus posticus* arises from a depression on the corresponding half of the posterior surface of the cricoid cartilage, and passing outwards and upwards, is inserted into the muscular process of the arytenoid cartilage. Rotates this cartilage and opens the glottis.

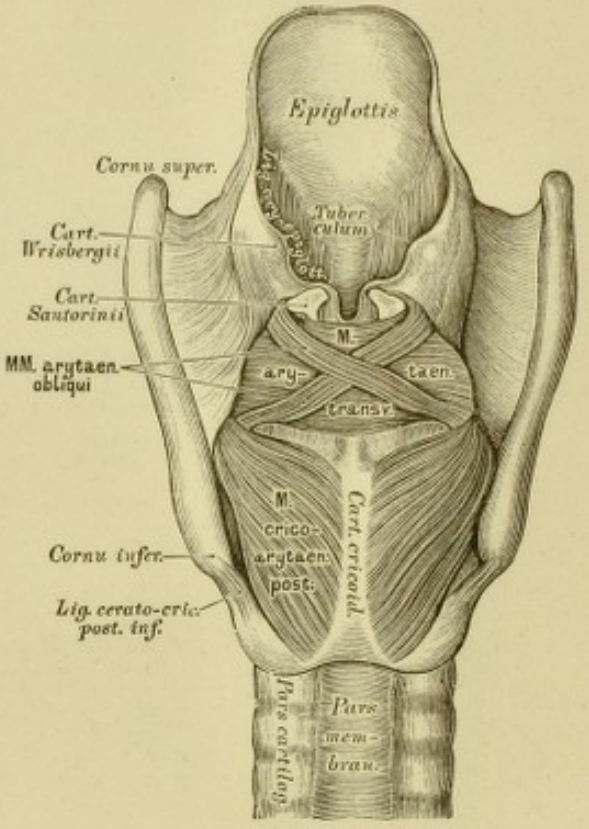
c) *M. crico-arytaenoideus lateralis* arises from the upper border of the side of the cricoid cartilage, covered by the lamella of the thyroid cartilage; passing obliquely backwards and upwards, it is inserted into the muscular process. Antagonist of the former.

d) *MM. arytaenoidei transversi et obliqui* (see Fig. 378) pass transversely and obliquely, from one arytenoid cartilage to the other, being inserted into its posterior concave surface. Approximate the vocal cords and narrow the opening of the glottis.

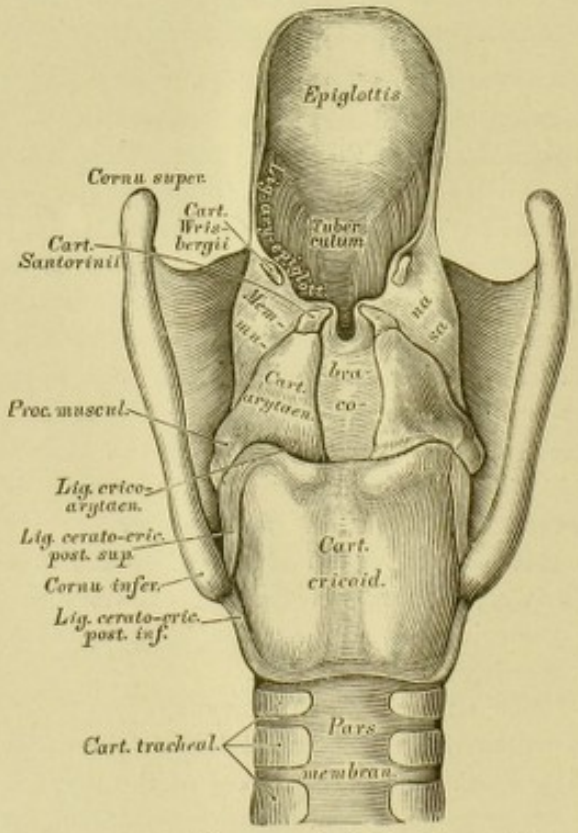
2. At the inner surface of the larynx:

a) *M. thyro-arytaenoideus* lies parallel with the outer side of the true vocal cord; it arises from the inner surface of the thyroid cartilage, and is inserted into the vocal process and anterior border of the arytenoid cartilage. Narrows the glottis.

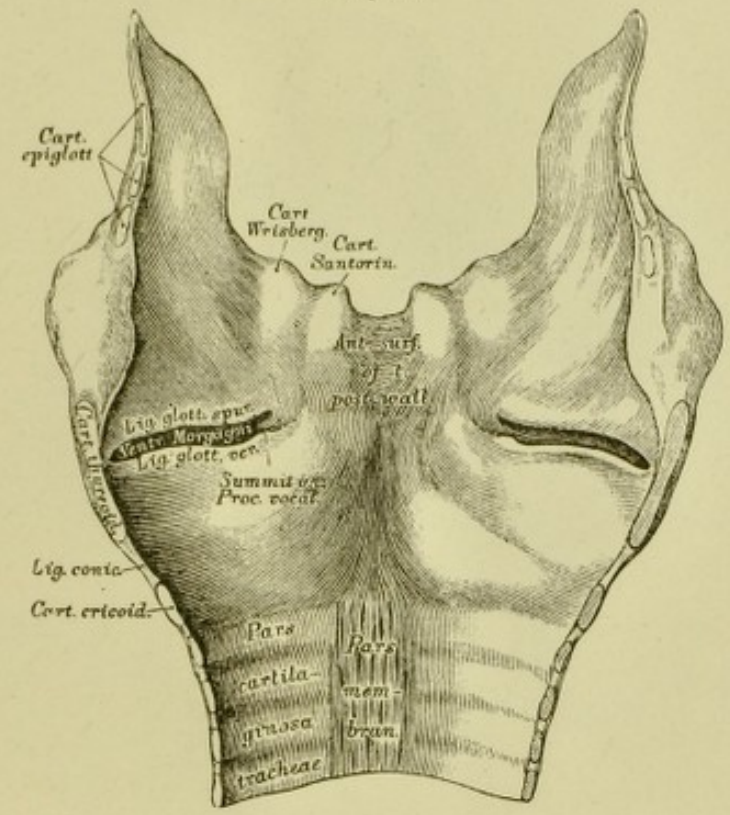
b) *M. thyreo-epiglotticus* and *M. ary-epiglotticus* between the layers of the *Lig. ary-epiglotticum*, passing from the thyroid and arytenoid cartilages to the epiglottis.



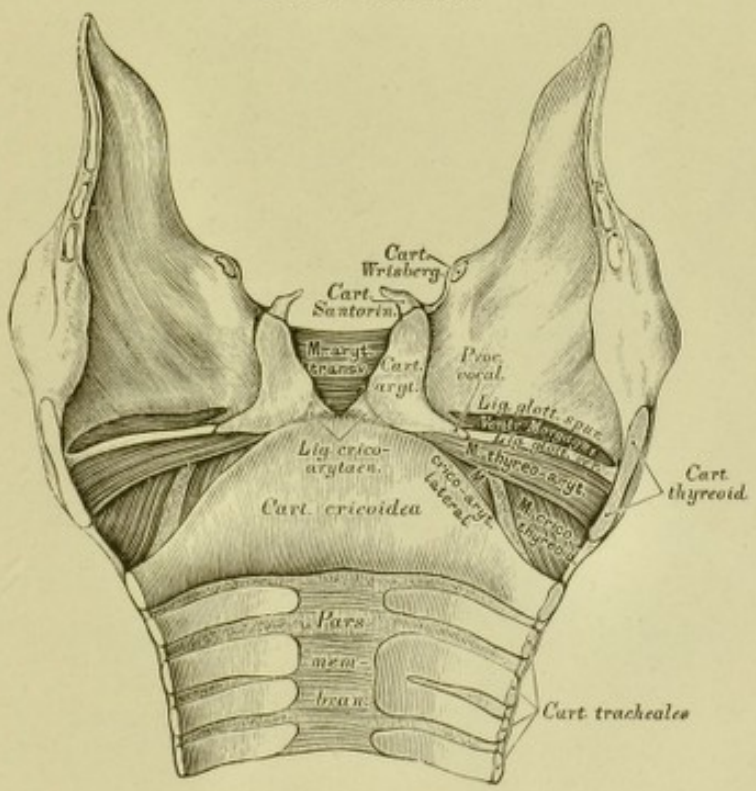
378. Larynx, seen from behind, after Removal of the Mucous Membrane, with the Muscles.



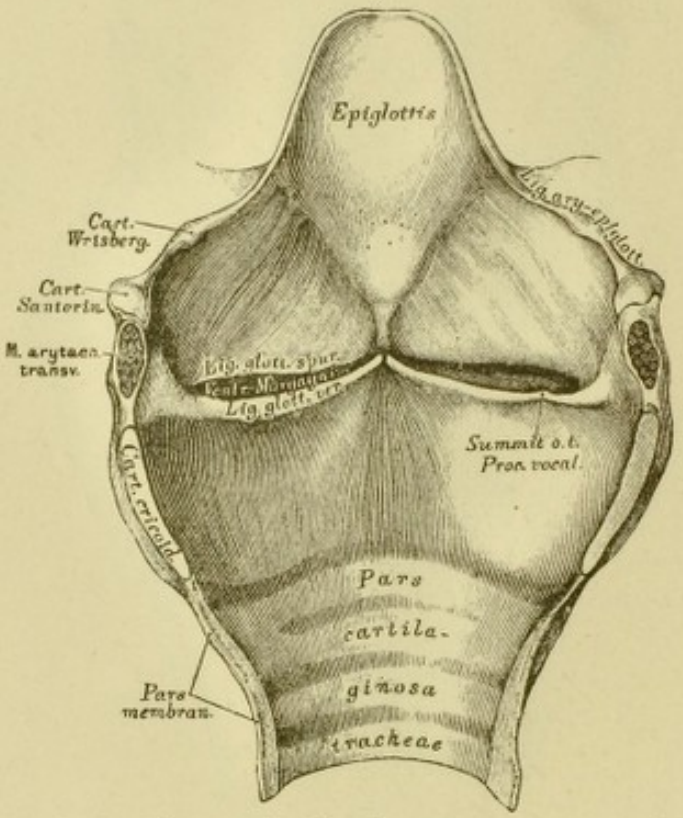
379. Larynx, seen from behind, after Removal of the Muscles, with the Cartilages and Ligaments.



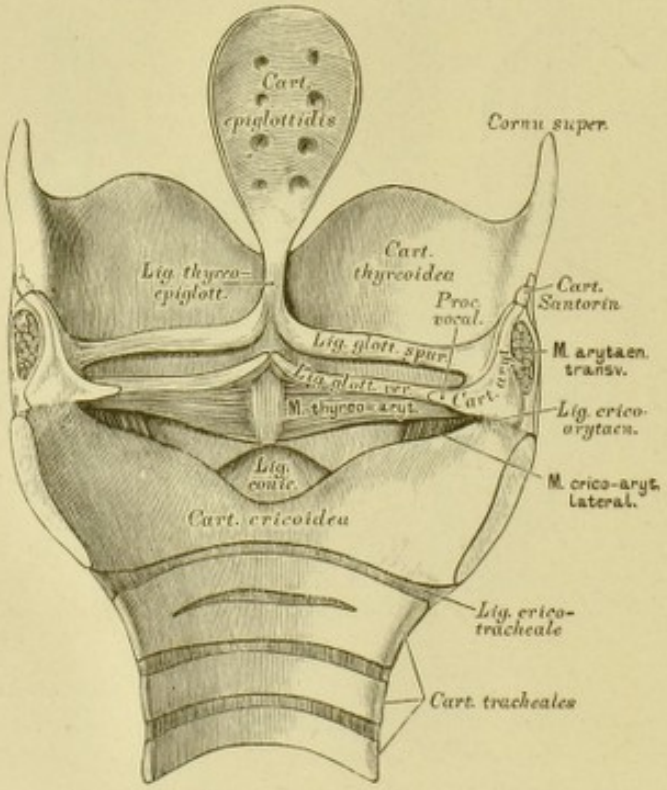
380. The Interior of the Larynx seen from before.
The anterior wall cut through in the middle line, and both lateral portions folded outwards.



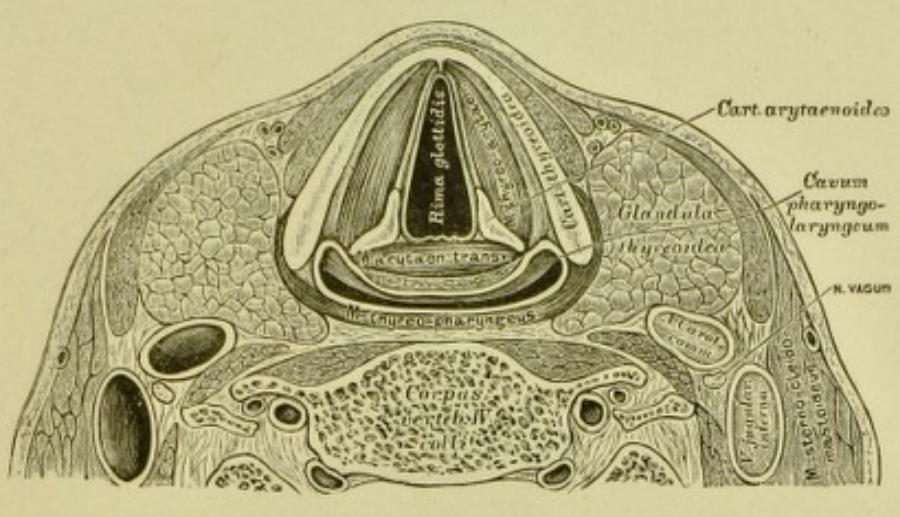
381. The Interior of the Larynx seen from before,
after removal of the mucous membrane.



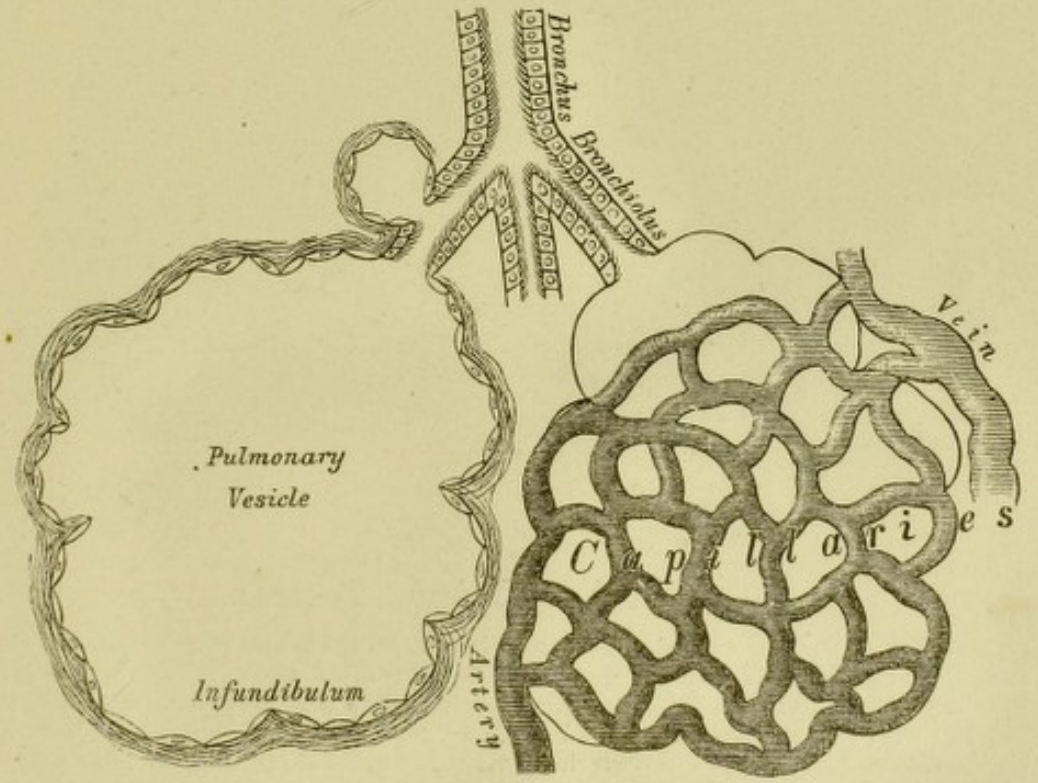
382. The Interior of the Larynx seen from behind.
The posterior wall cut through in the middle line, and both lateral portions folded outwards.



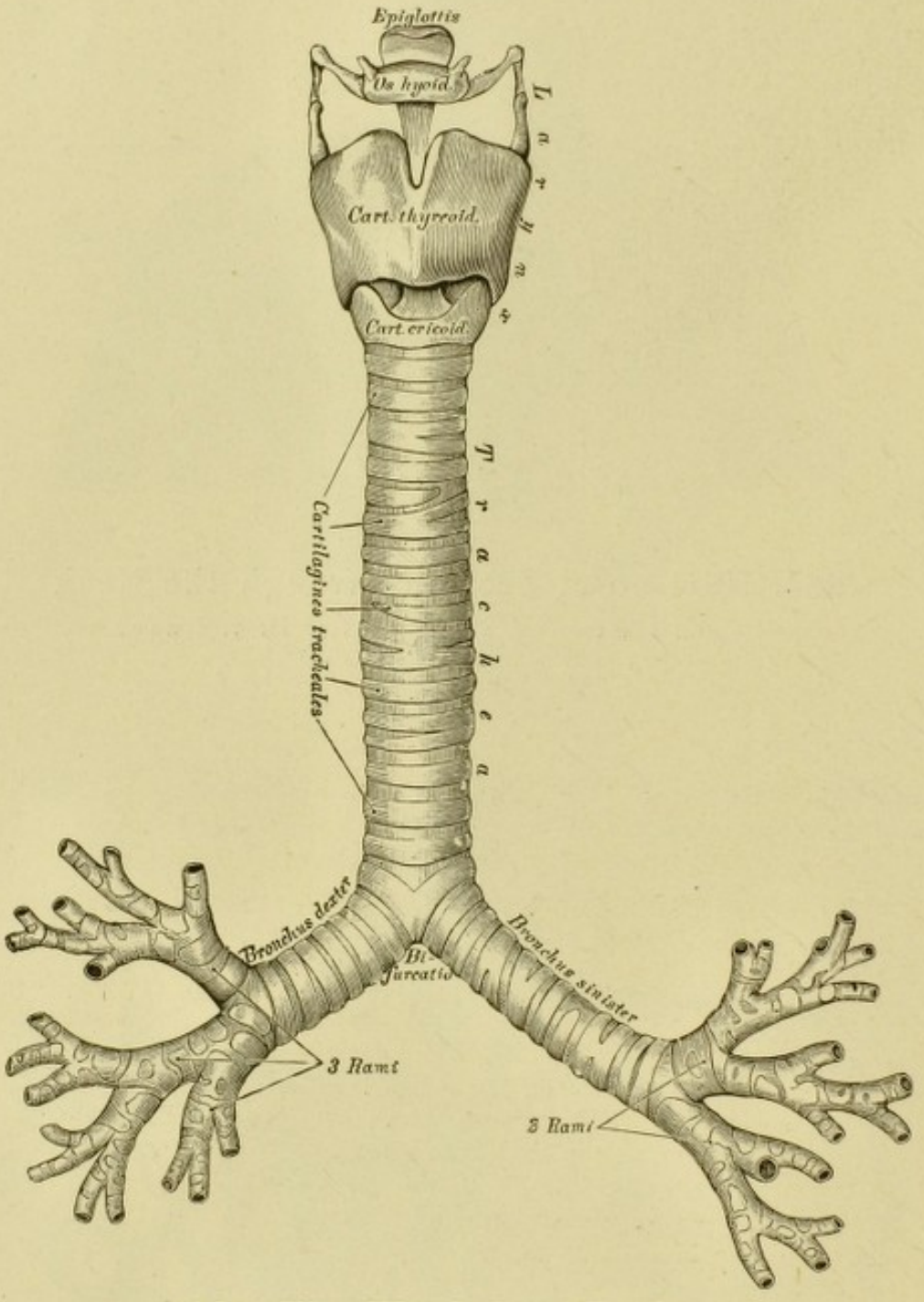
383. The Interior of the Larynx seen from behind,
after partial removal of the mucous membrane.



384. Horizontal Section through the Neck opposite the IV. cervical vertebra. After H. v. Luschka.

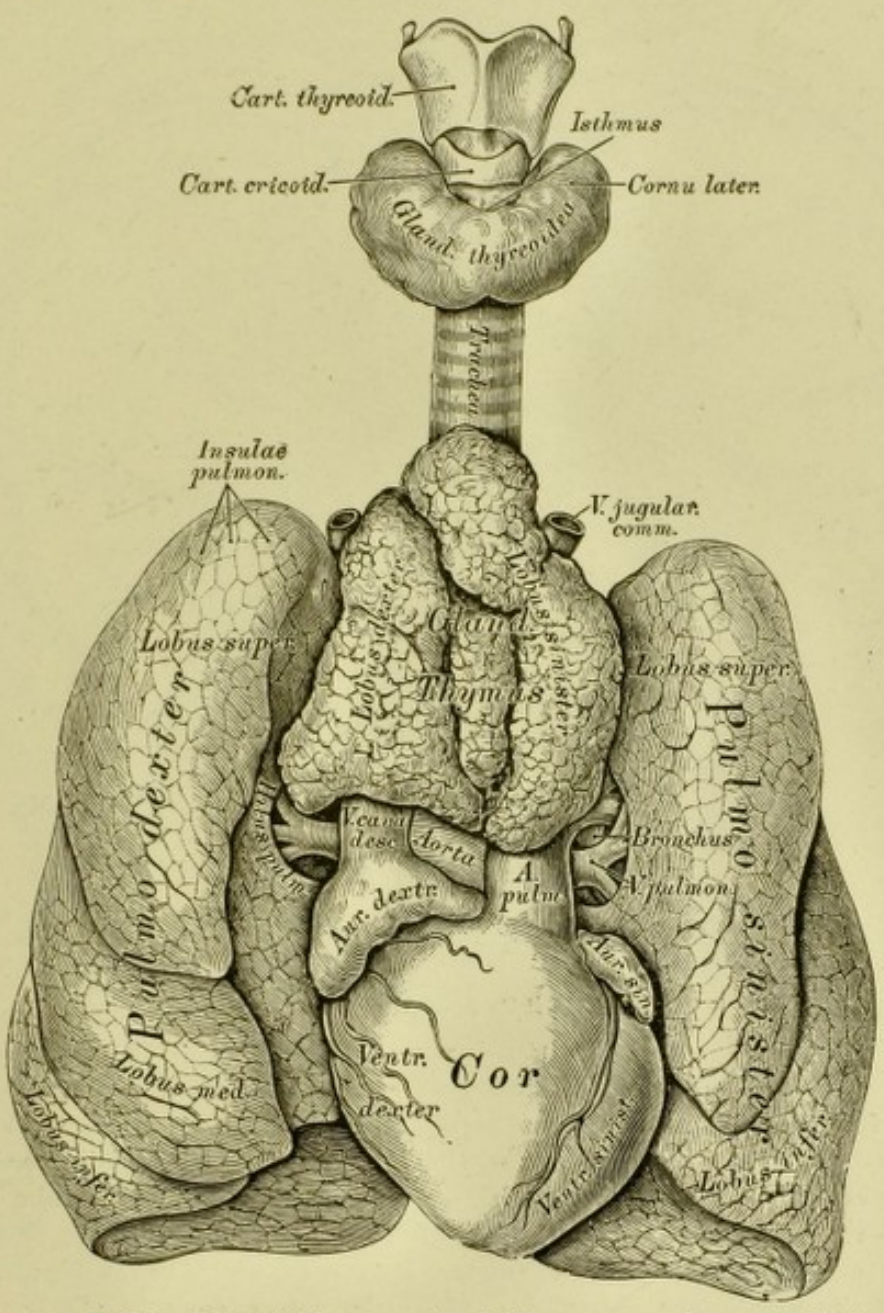


385. Structure of the Lung. (Diagrammatic.)



386. The Windpipe, *Trachea.*

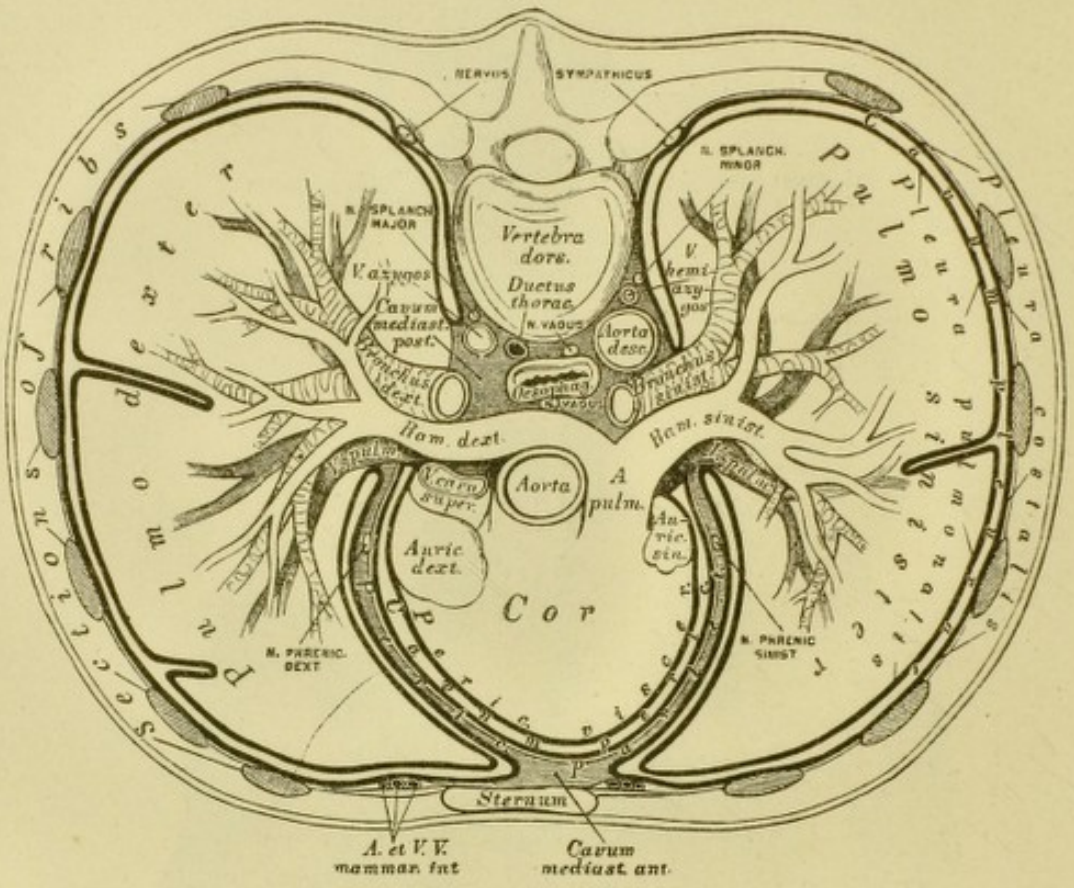
The trachea extends from the lower part of the larynx, on a level with the fifth cervical vertebra, to opposite the third dorsal, where it divides into the two bronchi; in front and at the sides are a series of imperfect cartilaginous rings, *Cartilagines tracheales,* 16—20 in number, held together by a strong fibrous membrane; the posterior portion is membranous, and presents transverse muscular fibres of the unstriped variety. The right bronchus, *Bronchus dexter,* is more horizontal, shorter and wider than the left bronchus, *Bronchus sinister;* the former has 6—8, the latter 9—12 cartilages, similar to those of the trachea. The bronchi, upon entering the substance of the lungs, divide, the right into three, the left into two branches, these again into smaller branches, and so on; each of the smaller subdivisions enters a pulmonary lobule, and, again subdividing, ultimately terminates in the intercellular passages and air cells of which the lobule is composed.



387. The Thoracic Viscera of a Child.

View from before. Natural size. (The thymus gland pushed somewhat upwards; the lungs turned aside.)

The lungs, *Pulmones,* are placed one in each of the lateral cavities of the chest; the concave base rests upon the diaphragm, the concave inner surface is in part adapted to the convex pericardium, and the external surface, which is convex, corresponds to the form of the cavity of the chest. The right lung is broader and shorter than the left, and divided into three lobes, *Lobi pulmonum;* the left is smaller, narrower and longer than the right, and has only two lobes. The base is of semilunar form, the anterior border thin and sharp, the posterior border rounded and broad. At the inner surface is a fissure, the *Hilus s. Porta pulmonis;* here the bronchus and pulmonary artery enter the lung, and the two pulmonary veins have their exit from the lung. These structures, the bronchus, pulmonary artery and pulmonary veins, form together the root of the lung, *Radix s. Pedunculus pulmonis.*



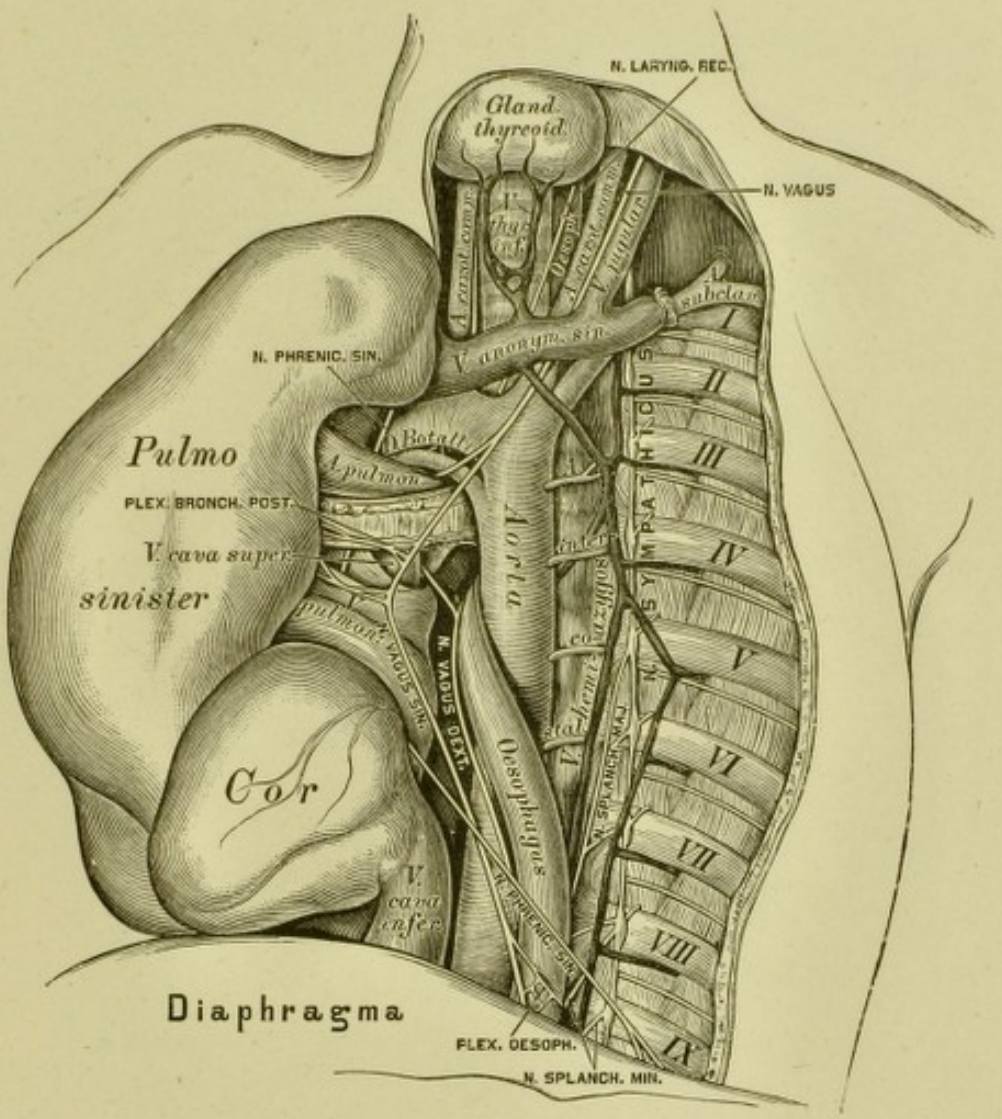
388. Horizontal Section of the Thorax, showing the relative Position of the Viscera, and the Reflections of the Pleurae.

The parenchyma of the lung is composed of lobules, *Lobuli s. Insulae pulmonales*, which are quite distinct from each other. Each lobule is composed of one of the ramifications of the bronchial tube and its terminal air-cells, and of the ramifications of the pulmonary and bronchial vessels, lymphatics and nerves. The walls of each lobular bronchial tube are closely covered by numerous saccular dilatations, the air-cells, *Cellulae pulmonales*. The air-cells are surrounded by the capillary network, placed between the pulmonary artery and vein; the artery conveys the venous blood to the lungs, the vein returns the purefied blood to the heart.

In purely anatomical relation with the thoracic viscera are:

The thyroid gland, *Glandula thyreoidea;* it is situated at the upper part of the trachea, and consists of two lateral lobes, *Cornua lateralia*, connected together by a narrow transverse portion, the isthmus; occasionally a third lobe, *Cornu medium*, arises from the isthmus. The glandular substance consists of round vesicles, which are closed cavities.

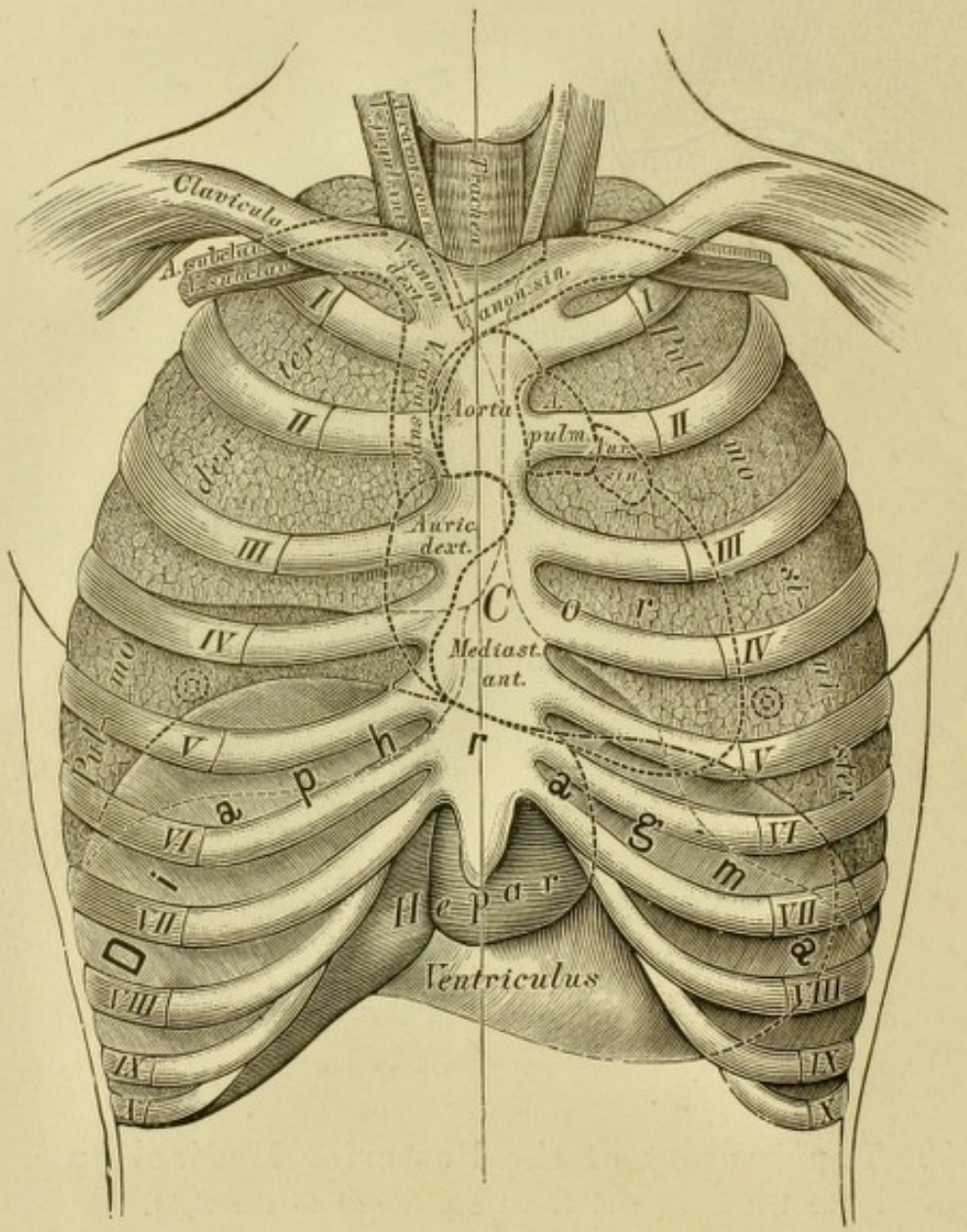
The thymus gland is developed only in the foetus and up to the second year of life, when it ceases to grow and gradually dwindles, until at puberty it has almost disappeared. It lies partly in the thorax and partly in the lower region of the neck, and is composed of two lateral lobes, which become elongated inferiorly into two lateral cornua. Its structure is analogous to the lymphatic glands.



389. Topography of the Posterior Mediastinum.

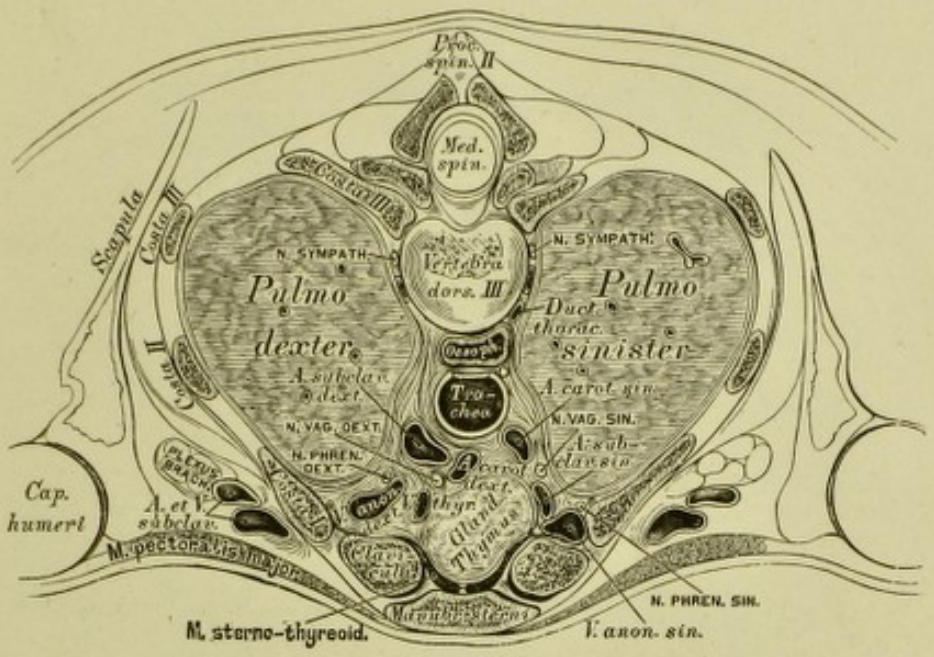
The left Lung and Heart are turned to the right.

The two lungs and the inner surface of the thorax are invested by serous membranes, the two pleurae; the portion investing the surface of the lung is called the *Pleura pulmonalis*, while that which lines the inner surface of the chest is called the *Pleura costalis* (Fig. 388); that part of the *Pleura costalis* which comes in contact with the upper surface of the diaphragm is called *Pleura phrenica*. The third serous membrane in the thorax covers the heart and commencement of the great vessels, and is called pericardium. The space left in the median line of the chest by the non-approximation of the two pleurae is called the mediastinal space, *Cavum mediastini*, or simply mediastinum. The part of this space in front of the pericardium is called the anterior mediastinum, *Cavum mediastini anterius*, and that behind the pericardium, the posterior mediastinum, *Cavum mediastini posterius*.

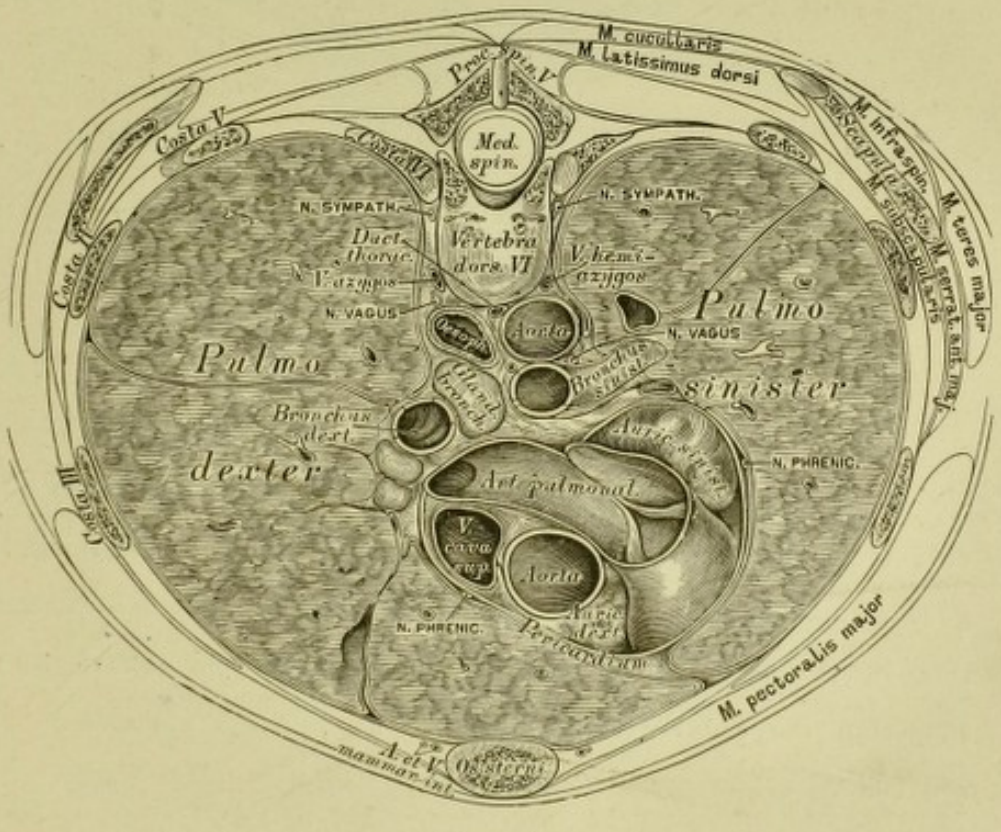


390. Topography of the Thoracic Viscera.

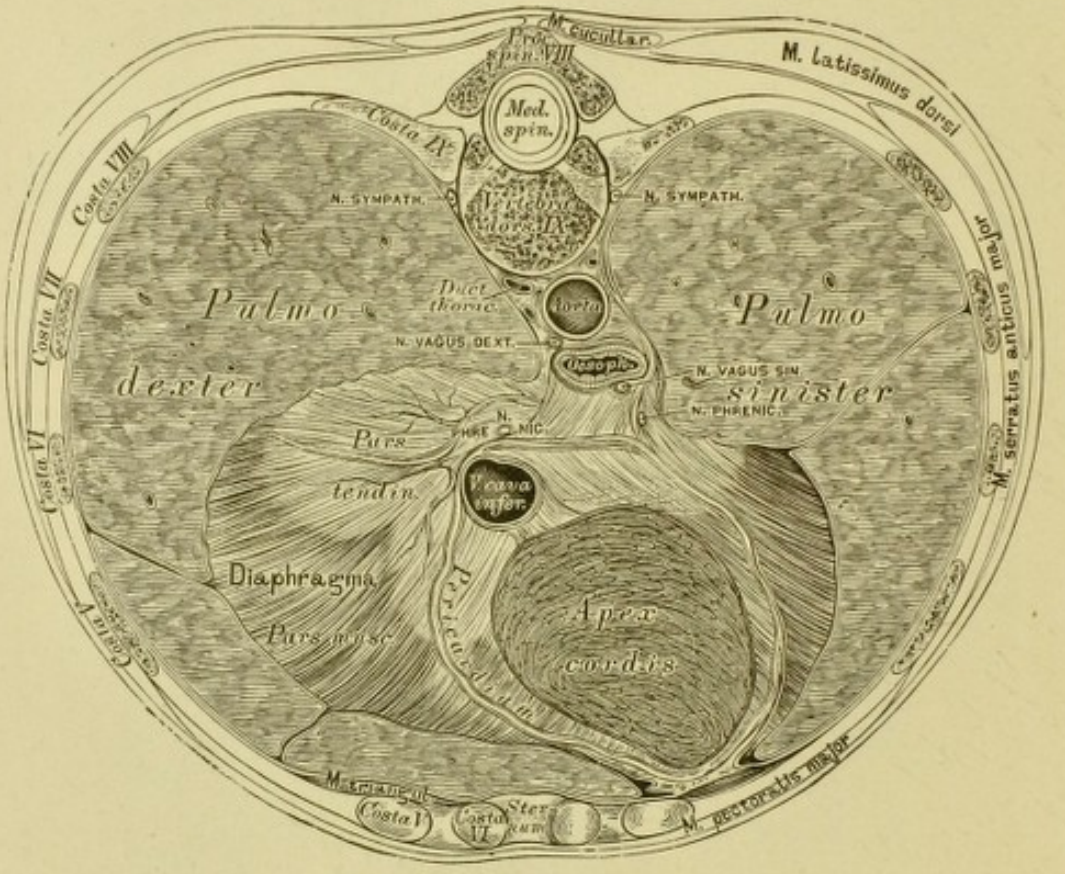
Owing to the oblique position of the heart, towards the left side, the anterior mediastinum is not parallel with the sternum, but directed obliquely from above downwards and to the left of the median line; its length corresponds to that of the sternum. The posterior mediastinum is an irregular triangular space, running parallel with the vertebral column; the organs contained in it are evident from Fig. 389, in which the left lung and the heart are lifted out of the thorax and laid to the right and the lateral wall of the posterior mediastinal space is dissected away. The arch of the aorta curves over the left bronchus; the oesophagus forms a spiral around the aorta; to the right of the descending aorta is the *Vena azygos,* to the left the *Vena hemiazygos.* Between the *Vena azygos* and aorta is the thoracic duct, *Ductus thoracicus* (see Fig. 388), which ascends behind and to the left of the oesophagus, to terminate at the angle of junction of the left subclavian and internal jugular veins.



391. Horizontal Section of the Thorax
in the region of the *Articulatio sterno-clavicularis.*



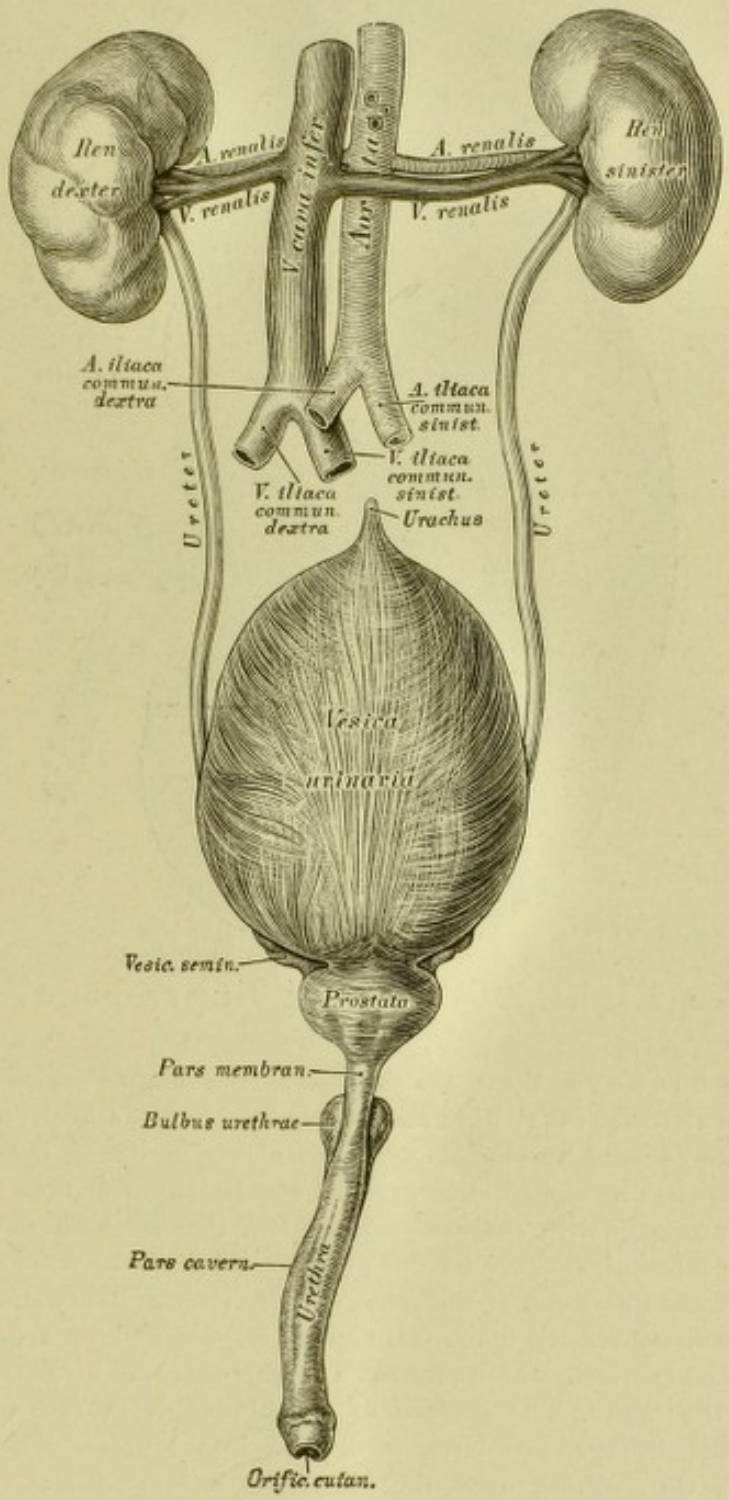
392. Horizontal Section of the Thorax
immediately below the Nipples.



393. Horizontal Section of the Thorax

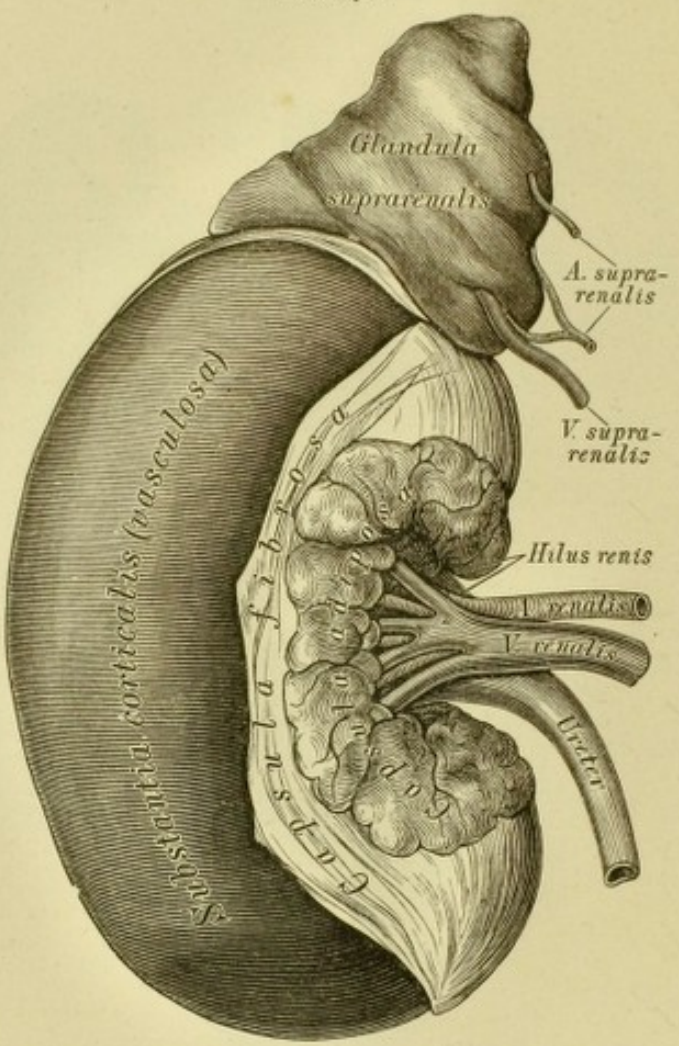
at the lower end of the Gladiolus of the Sternum, immediately above the summit of the Diaphragm.

Fig. 370, 391, 392 and 393 are drawings from sections, which were made with the saw from the frozen cadaver of a child about a year old; these drawings are made in natural size. The same thing holds good for these, which was said for the sections from frozen extremities, that is, the sections were made from the lower cut surface, so that, supposing the cadaver to stand erect, the drawings are seen in bird's eye view.



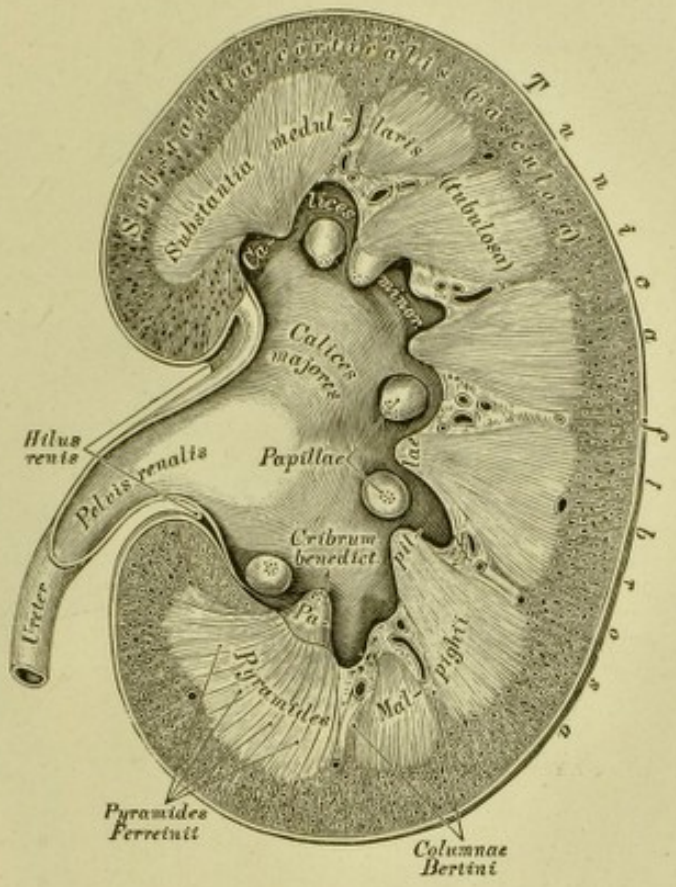
394. The Urinary Organs of a Child,

natural size.



395. The Right Kidney and Supra-renal Capsule.
$^2/_3$ natural size.

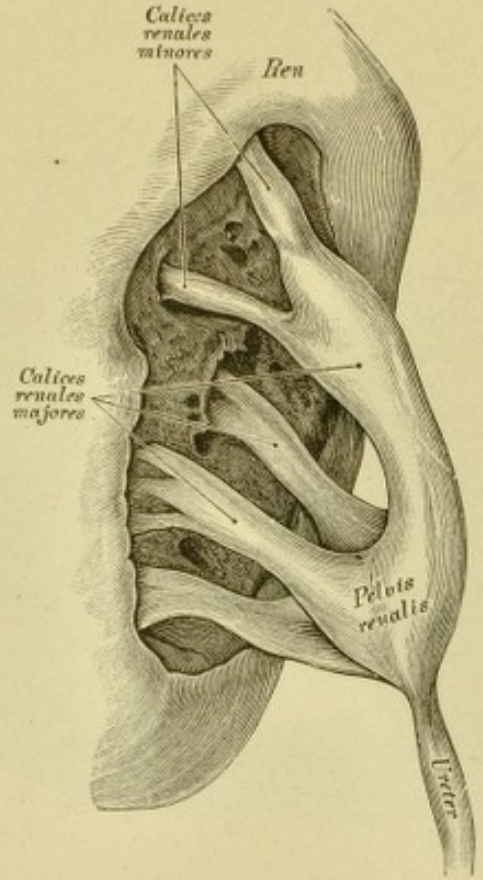
The kidneys, *Renes*, are situated in the lumbar region at the back part of the abdomen; they have somewhat the shape of a bean; their anterior surfaces are covered by peritoneum, their posterior lie on the *Musculi quadrato-lumborum*. The right kidney, placed somewhat lower than the left, is in relation anteriorly with the ascending colon, the left with the descending colon. The internal, concave border presents a fissure, the *Hilus s. Porta renis*, for the entrance and exit of the renal vessels. They are surrounded by loose areolar tissue containing much fat, *Capsula adiposa*, and by a proper fibrous coat, *Capsula fibrosa*, which forms a thin, smooth investment, closely covering the organ. The surface of the kidney is in the adult entirely smooth, but in the new-born is divided into lobules, *Renes lobati* (see Fig. 394). On splitting open the kidney by a longitudinal section, it is found to consist of a medullary substance, *Substantia medullaris s. tubulosa*, around which is the reddish-brown cortical substance, *Substantia corticalis s. vasculosa s. glomerulosa;* the former consists of palish-red masses, the pyramids of Malpighi, 10—15 in number, whose apices, directed towards the hilus, are called *Papillae renales*. The prolongations of the cortical substance between any two pyramids are called columns of Bertini.



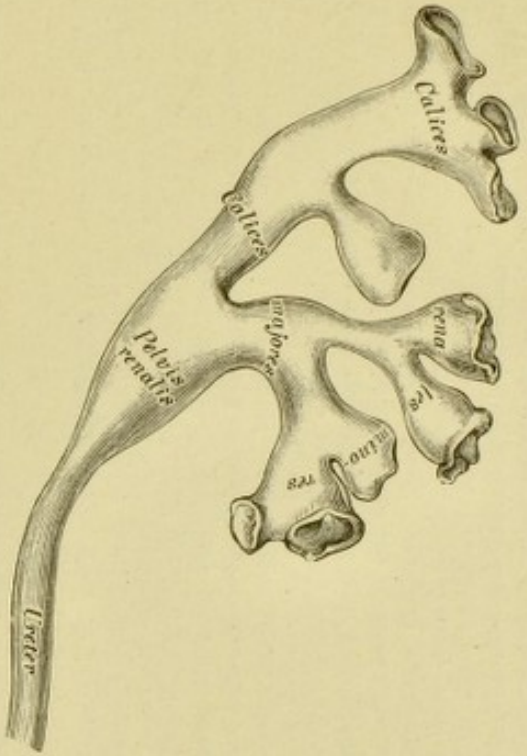
396. Longitudinal Section through the Kidney.

The renal artery enters the hilus dividing into four or five branches, which, penetrating the substance of the organ, pass into the cortical substance between the pyramids, and continue to divide and subdivide; these branches have a convoluted arrangement and finally form the *Glomeruli renales,* which are surrounded by a capsule. A vein smaller than the artery emerges from the glomerulus, and divides into branches, from which a network of capillaries arises. The *Tubuli uriniferi* commence at the capsule of the glomerulus opposite the place where the artery enters and leaves; they are at first convoluted *(Tubuli contorti I. ordinis),* but approaching the medullary portion become more or less spiral (spiral tubule of Schachowa); they then enter the pyramids and form loops (looped tubule of Henle, *Ansae Henlei),* pass back into the cortical substance to again become convoluted *(Tubuli contorti II. ordinis)* and are connected with the straight or collecting tubules. These straight tubules, *Tubuli recti s. Belliniani,* enter the pyramids and are arranged in groups; the tubes open at the papillae by fine orifices, the *Cribrum benedictum;* the separate bundles of each tube form the pyramids of Ferrein, these together form a *Pyramis Malpighii* (see Fig. 399). The vascular loops in the pyramids come from the capillaries of the cortical substance.

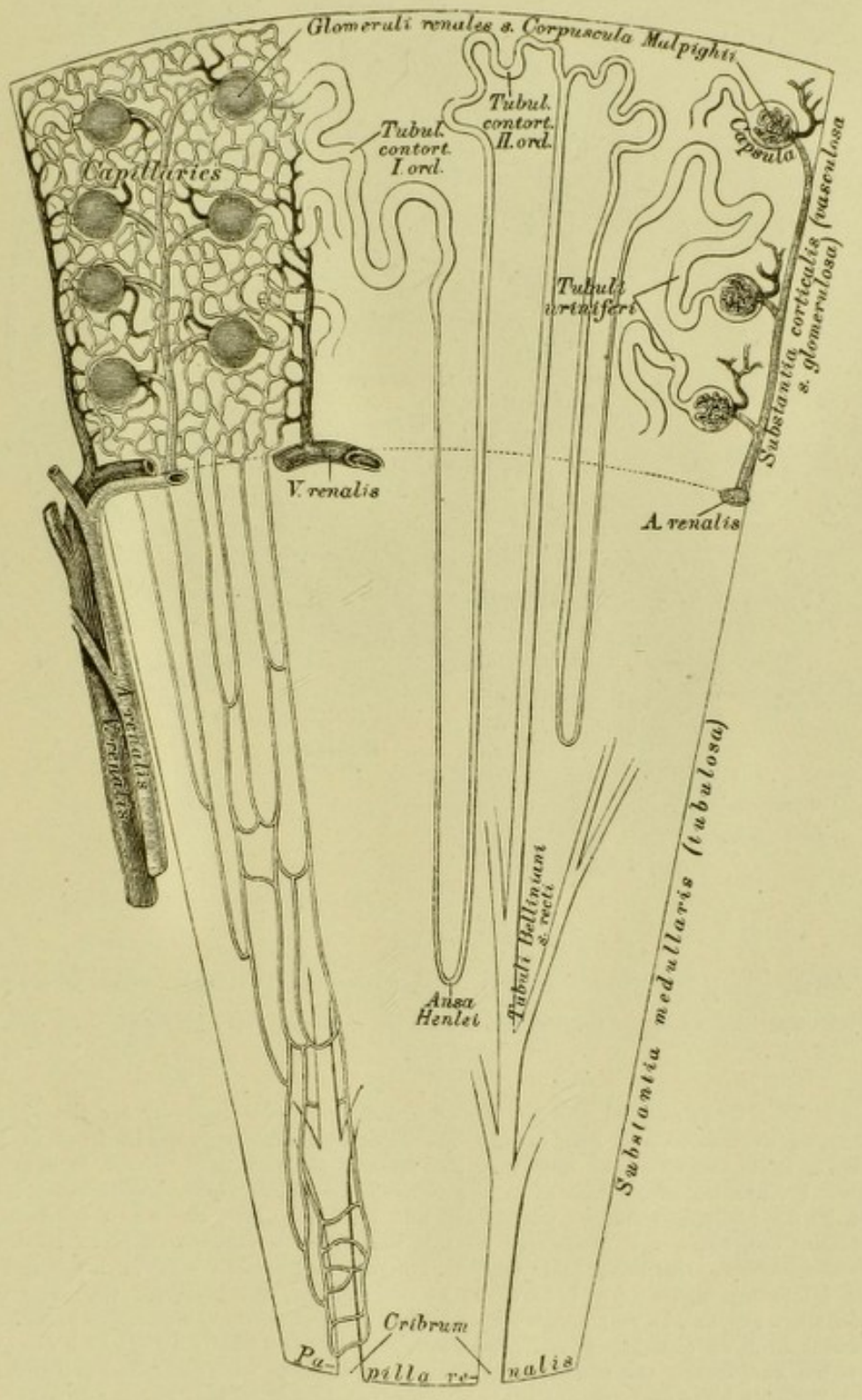
The *Calices renales minores* receive the *Papillae renales* into their wide mouths and unite (2—3) to form the *Calices renales majores (infundibula);* these again, by their junction form the *Pelvis renalis,* which lies in the hilus behind the renal artery and vein and becomes continuous with the ureter, which carries the urine into the bladder.



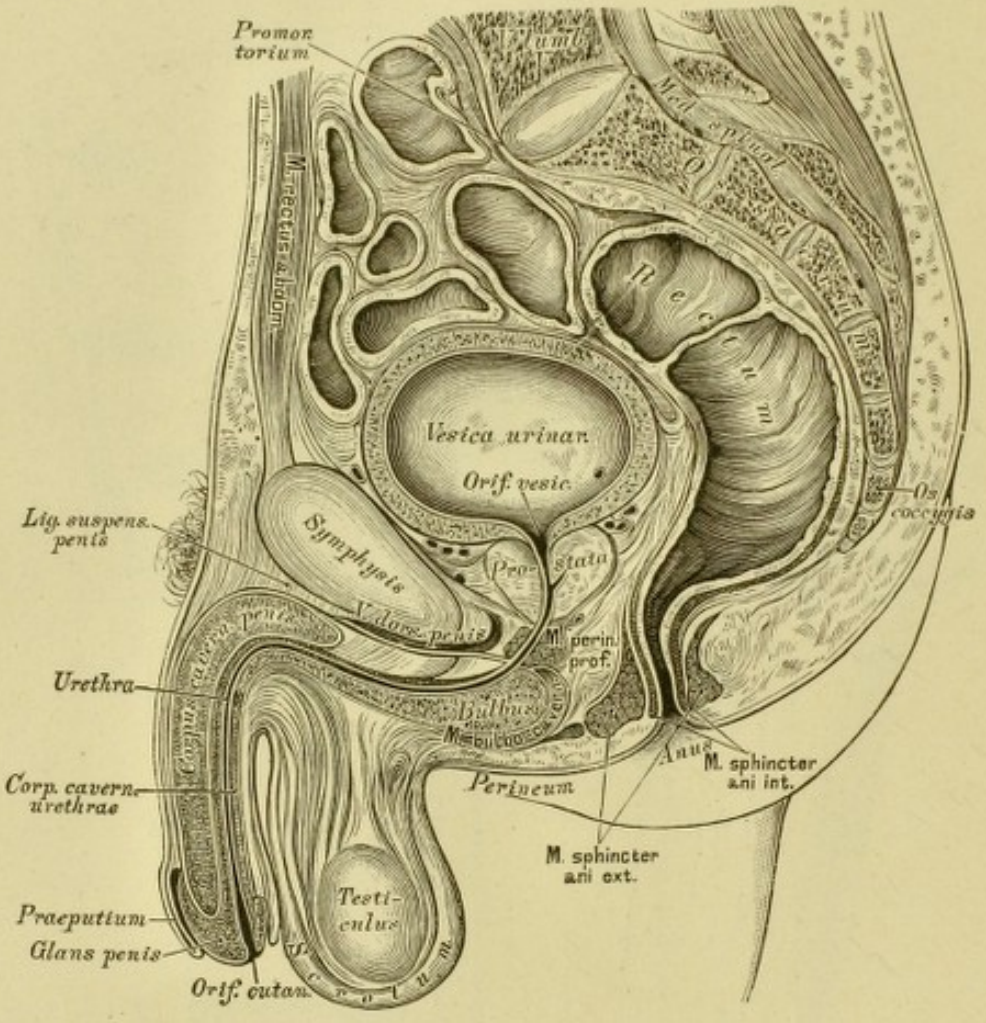
397. Pelvis and Calices of the Kidney, prepared out of the Renal Substance.



398. Wax Cast of the Ureter, the Pelvis and the Calices of the Kidney.



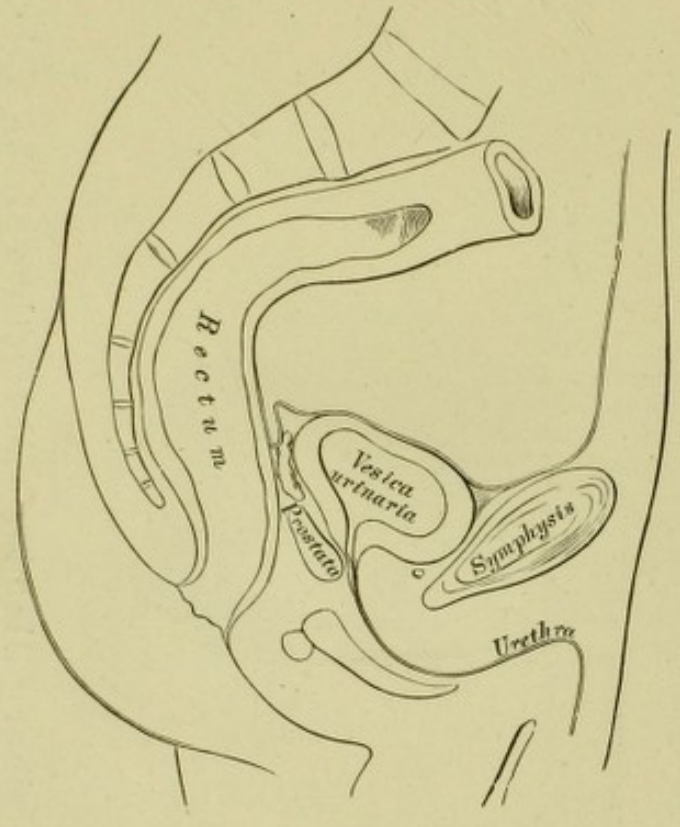
399. Diagram of the Structure of the Kidney.



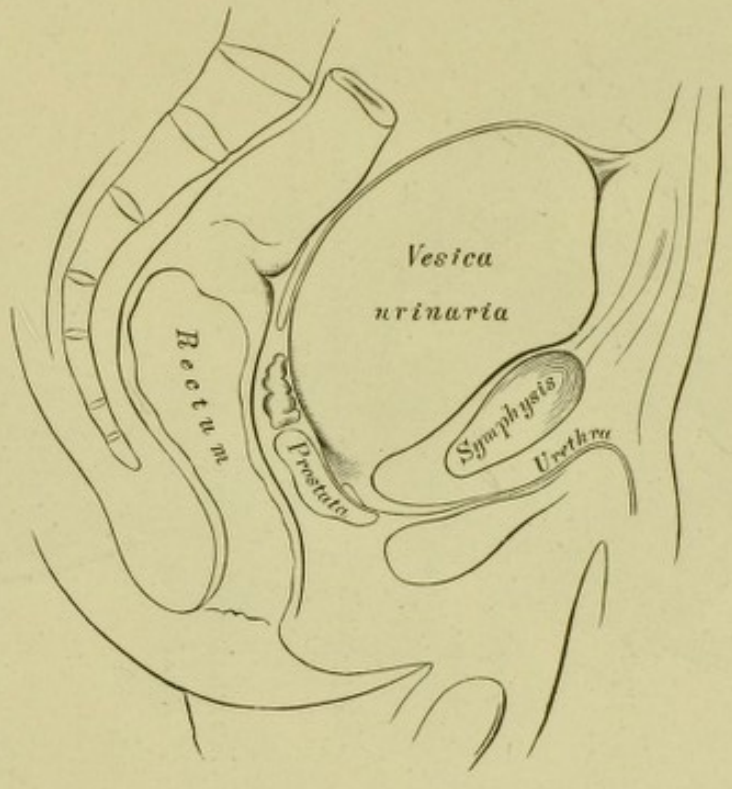
400. Sagittal Median Section through the Male Pelvis. From the frozen cadaver of a man of about twenty years.

The urinary bladder, *Vesica urinaria,* is the reservoir for the urine; it is of oval form and lies behind the *Symphisis ossium pubis,* in front of the rectum in the male, of the uterus in the female. Its summit, *Vertex,* is connected to the umbilius by means of the *Ligamentum vesico-umbilicale medium (urachus);* the body becomes enlarged posteriorly and inferiorly into the base or *Fundus vesicae;* the sides are connected to the umbilicus by means of the *Ligamenta vesico-umbilicalia lateralia* (obliterated hypogastric arteries). — The bladder has the following layers: peritoneum at the summit, the posterior wall and the sides; muscular layer composed of longitudinal and transverse fibres *(Detrusor urinae)* and of circular fibres *(Sphincter vesicae);* submucous connective tissue and finally the mucous membrane covered with stratefied epithelium.

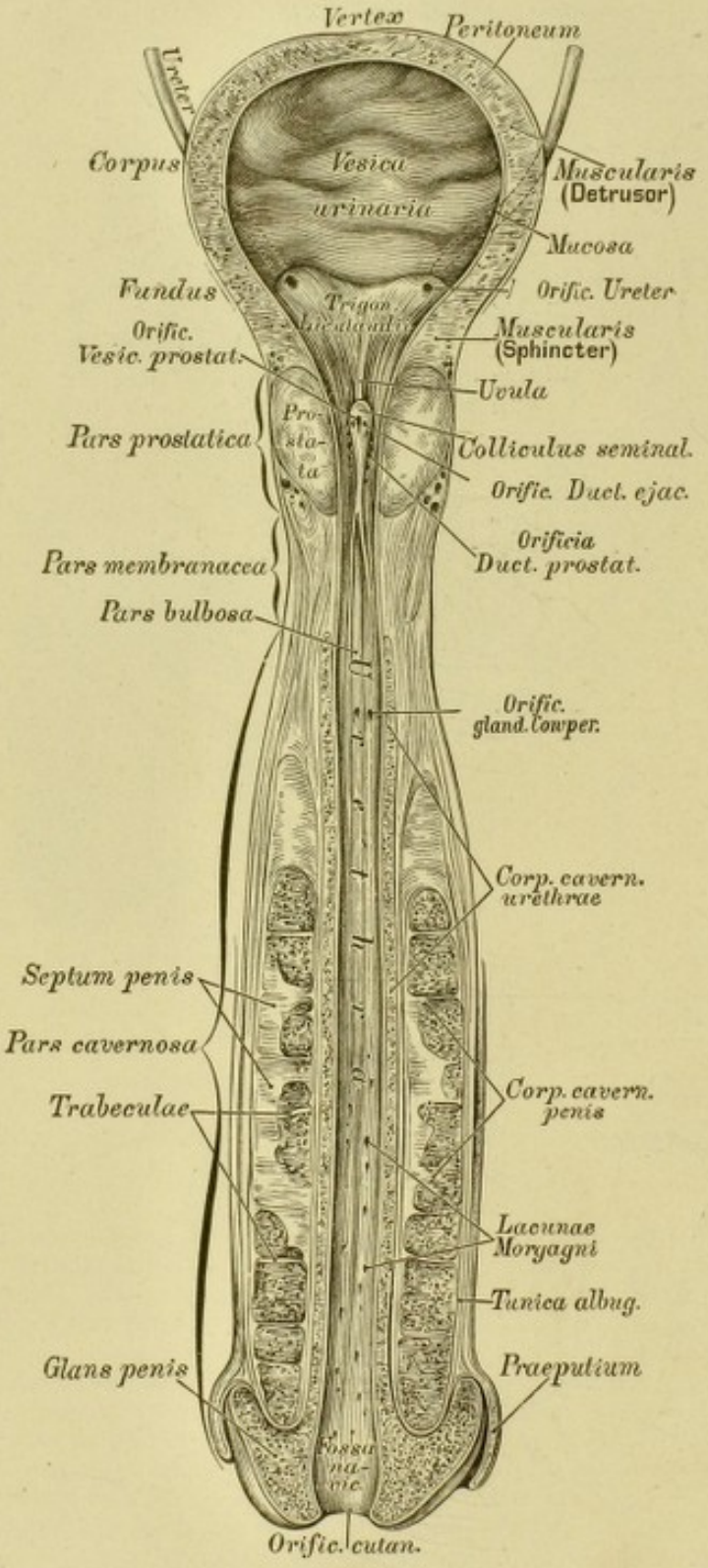
The ureters pass obliquely downwards and inwards, enter the coats of the bladder, and open into the fundus of the bladder by two narrow and oblique slit-like openings; at the line of union of these with the urethra is the trigone, *Trigonum Lieutaudii;* the summit of this triangle is called *Uvula vesicae* (see Fig. 403); here the muscular layer of the bladder is more strongly developed.



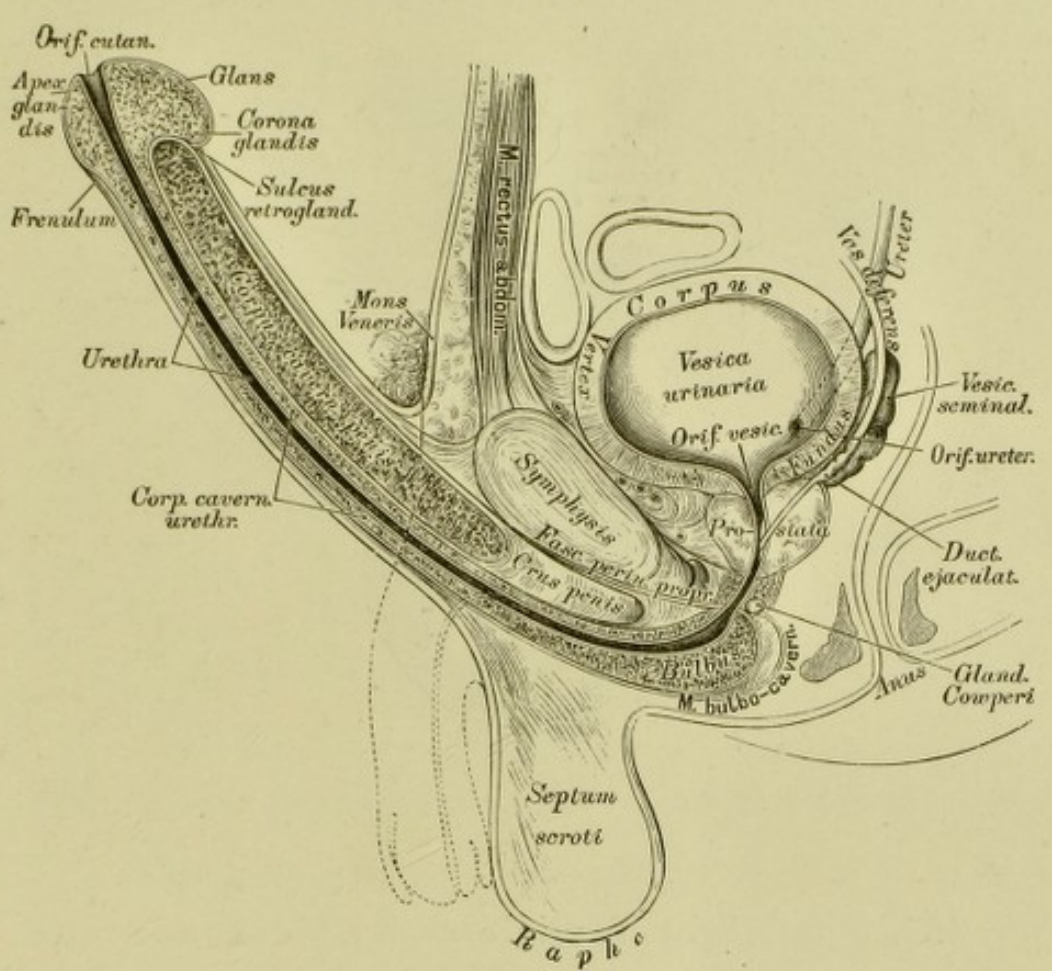
401. Sagittal Median Section through the Pelvis of a Young Man, the Bladder being contracted.
After C. Langer.



402. Sagittal Median Section through the Pelvis of a Young Man, the Bladder being distended.
After C. Langer.



403. The Urinary Bladder and Urethra of the Male, opened from before. $^1/_2$ natural size.



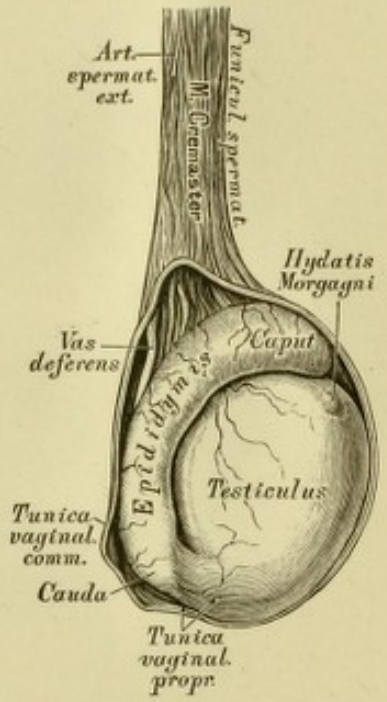
404. Sagittal Median Section through the Male Pelvis, the Penis being erect. (Construed out of Fig. 400.)

The male urethra, 6—7 inches long, extends from the neck of the bladder (*Orificium vesicale*), to the *Meatus urinarius* (*Orificium cutaneum*); in the erect state of the penis it forms only a single curve, but in the flaccid state a double curve. It is divided into the prostatic portion, *Pars prostatica,* membranous portion, *Pars membranacea* (*Isthmus*) and the spongy portion, *Pars cavernosa.* Along the floor of the prostatic portion is a narrow, longitudinal ridge, the *Caput gallinaginis s. Colliculus seminalis,* formed by an elevation of the mucous membrane; at the fore part of the *Caput gallinaginis* is the *Vesicula prostatica* (*Sinus pocularis*), and upon or within its margins are the slit-like openings of the ejaculatory ducts; on each side of the caput are the orifices of the prostatic ducts.

The membranous portion is the narrowest part of the urethra, surrounded neither by the prostate nor by the *Corpus cavernosum.*

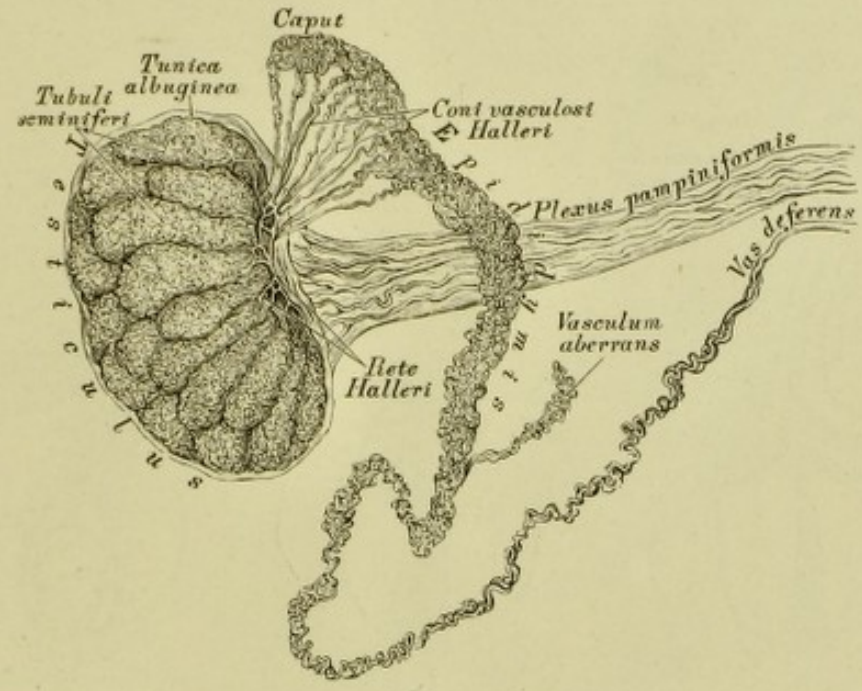
The spongy portion is surrounded by the *Corpus spongiosum* (*Corpus cavernosum urethrae*), which is situated in the groove on the under surface of the *Corpora cavernosa penis;* at its commencement, the *Corpus spongiosum* forms a rounded enlargement, the bulb, *Bulbus urethrae,* therefore the part of the urethra contained within the bulb, which is somewhat dilated, is called

Bulbous portion, *Pars bulbosa;* here the excretory ducts of Cowper's glands open. The lining membrane of the urethra is beset with small glands and follicles, and larger recesses or *Lacunae Morgagni,* especially abundant in the bulbous portion. At the glans penis the urethra is again dilated, forming the *Fossa navicularis.*



405. The Right Testicle and Epididymis,
natural size.

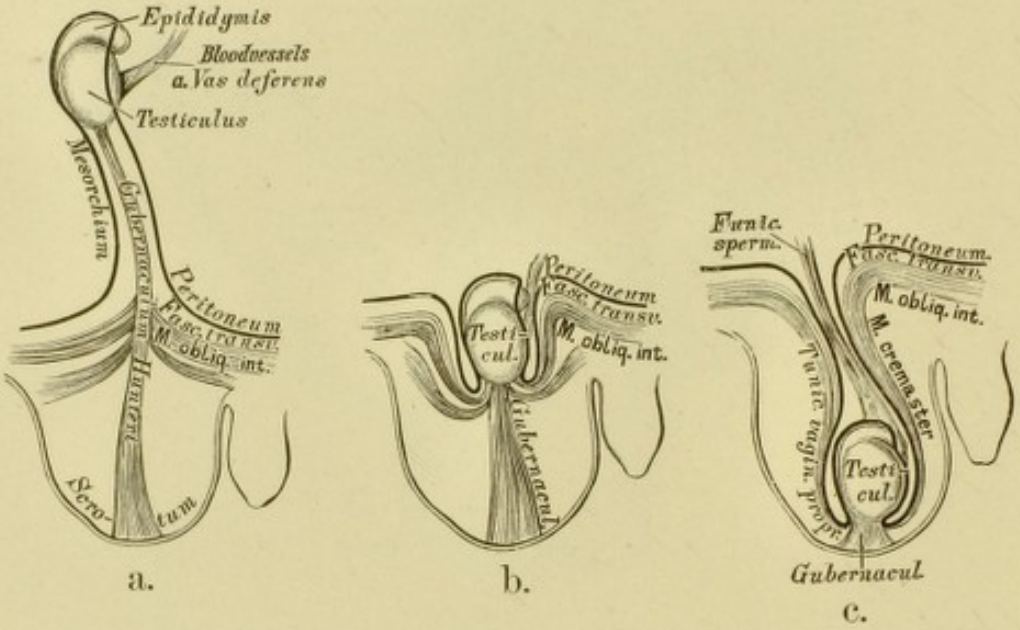
The two testicles, *Testiculi*, the glands producing the semen, are suspended in the scrotum by the spermatic cords. Each testis has an ovoid form; its upper end is directed forwards and outwards, its lower end backwards and inwards. The *Tunica albuginea s. propria* surrounds the glandular structure of the testicle, and, at its posterior and upper border is reflected into the interior of the gland, forming an incomplete vertical septum called the *Mediastinum testis s. Corpus Highmori.* From this septum numerous slender fibrous cords are given off, which pass to be attached to the inner surface of the *Tunica albuginea;* they join with similar cords given off from the *Tunica albuginea* to form spaces which enclose the separate lobules of the testis. Each lobule consists of from 2—5 convoluted tubes, the *Tubuli seminiferi;* as these approach the *Corpus Highmori* they unite with one another and finally form the *Rete Halleri;* from this rete, 12—19 stronger tubules, the *Vasa efferentia,* arise, which perforate the *Tunica albuginea* beneath the *Globus major* of the epididymis, in the convoluted canal of which they ultimately terminate.



406. Testis and Epididymis, Injected with Mercury.

The epididymis lies at the posterior border of the testis; it has an upper enlarged extremity, the head, or *Globus major*, and a lower pointed extremity, the tail, or *Globus minor*, which is continued into the *Vas deferens*. The lobules, which are formed by the convolutions of the seminiferous tubules coming from the testis, are of pyramidal form and are called *Coni vasculosi Halleri*. By the union of these coni a single canal or duct is formed, the intervening and subsequent convolutions of which constitute the epididymis itself. This single canal gradually becomes thicker at the *Globus minor* of the epididymis, its windings become less and less tortuous, and now the *Vas deferens* is formed, which ascends from the lower end of the epididymis along the back of the testicle; it then passes in the spermatic cord to the inguinal canal, through this to the abdominal cavity and the posterior wall of the bladder, and finally opens at the base of the bladder, after union with the corresponding seminal vesicle, in the *Caput gallinaginis*.

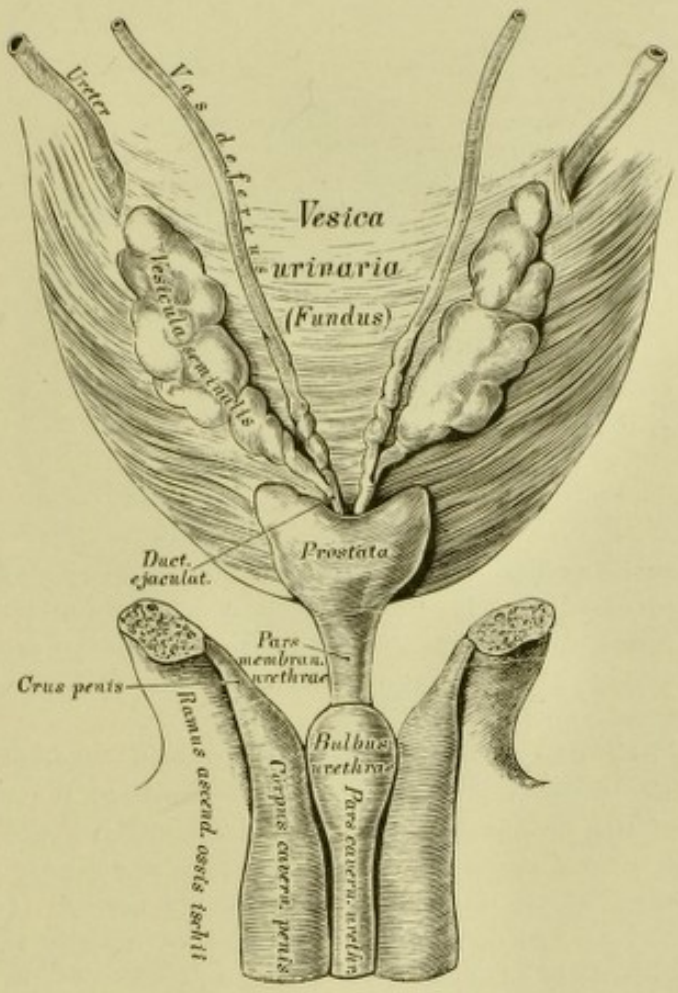
Attached to the upper end of the testis or to the epididymis are one or more small pedunculated bodies; these are termed *Hydatis Morgagni* (see Fig. 405). With the duct of the epididymis is often connected a small convoluted duct, the *Vasculum aberrans Halleri*.



407. a. b. c. Diagrammatic View of the *Descensus testiculi.*

The testis is developed in the embryo in the abdominal cavity, and is covered by peritoneum, with the exception of the posterior wall where the *Vas deferens* and the bloodvessels enter and leave; it is supported in its passage from the abdomen into the scrotum by a duplicature of the peritoneum, called the *Mesorchium.* In the mesorchium a conical-shaped cord, the *Gubernaculum testis s. Hunteri*, is attached to the testicle and the bottom of the scrotum; it is surrounded by striped muscular fibres and is divided below into three processes. By a shortening of this cord the testicle gradually passes through the inguinal canal into the scrotum, a small pouch of peritoneum preceding the testis in its course through the canal; this pouch is called *Processus vaginalis peritonei;* the bloodvessels and *Vas deferens* are not contained in it. The cavity of the *Processus vaginalis* closes after birth from the inguinal canal towards the testicle, and only a thin connective tissue cord, called the *Ligula*, remains; at the testicle and a part of the epididymis the cavity remains pervious, and the serous covering, which entirely surrounds the testicle constitutes the *Tunica vaginalis propria testis.*

The spermatic cord, *Funiculus spermaticus*, is the bundle of vessels and nerves, which supports the testicle, and is invested, as is also the testis, by the *Tunica vaginalis communis;* this is a continuation of the *Fascia transversa abdominis* and is also called infundibuliform fascia; on its outer surface the bundles of the cremaster muscle lie.

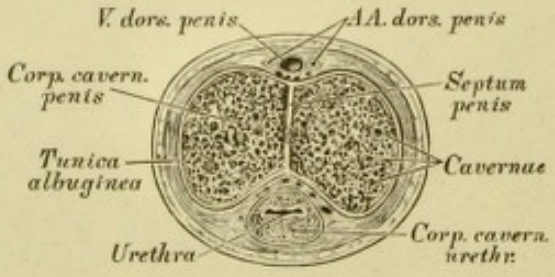


408. The Base of the Bladder and Upper Portion of the Urethra, view from behind. After a dried specimen, natural size.

The cutaneous pouch, which contains the testes and spermatic cords, is called scrotum; it is divided by a median external raphe into two lateral halves; the cavity of the scrotum is divided into two, by the *Septum scroti*. Beneath the integument is the *Tunica dartos*, formed of unstriped muscular fibres, which is continuous with the superficial fascia of the groin, perinaeum and inner side of the thighs.

The seminal vesicles, *Vesiculae seminales*, are two lobulated membranous pouches at the base of the bladder behind the prostata, each having an upper obtuse and a lower pointed extremity, which latter unites with the corresponding *Vas deferens*, to form with it the ejaculatory duct. The ejaculatory ducts, *Ductus ejaculatorii*, run between the prostate gland and posterior wall of the prostatic portion of the urethra forwards and downwards, and end in the urethra at the *Caput gallinaginis*.

The prostate gland, *Prostata*, has the form of a chestnut and encloses the first part of the urethra in such a manner, that the greater part of the gland lies behind the urethra. The posterior surface of the prostate is divided by two slight ridges into three lobes.



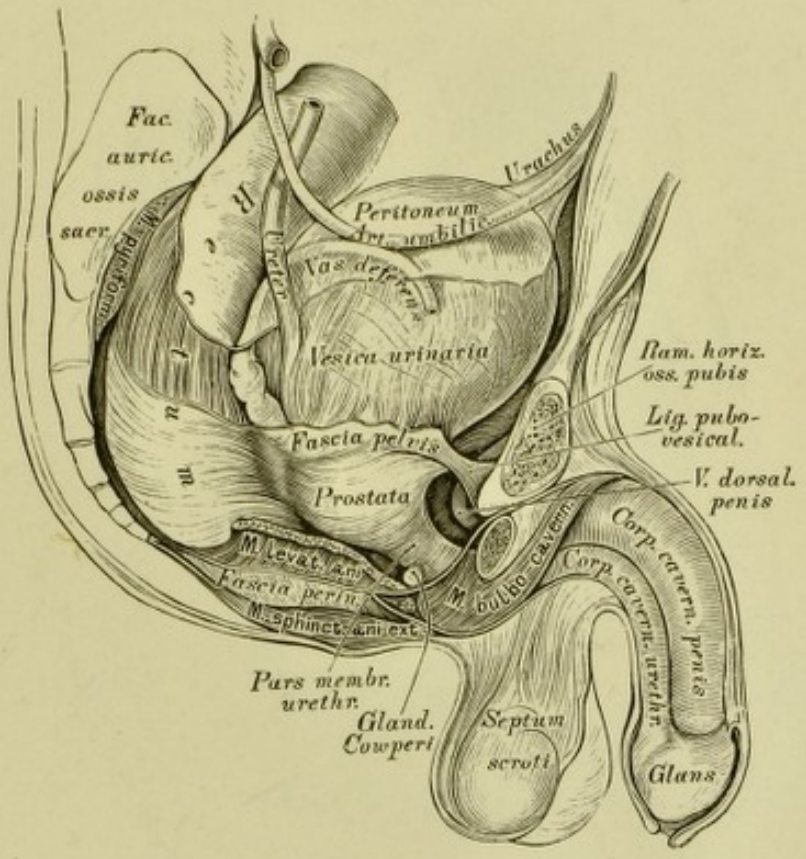
409. Transverse Section of the Penis in the Distended State.

The muscular tissue constitutes the proper stroma of the prostate; it is arranged in several layers, between which, strong muscular bands, decussating freely, form meshes in which the glandular substance of the organ is imbedded; the excretory ducts of the glands open on both sides of the *Caput gallinaginis.*

Cowper's glands (see Fig. 410) are compound racemose glands, about the size of peas; they lie behind the bulb of the urethra at the lower wall of the membranous portion, surrounded by the fibres of the *M. transversus perinei profundus.* Their excretory ducts pass obliquely forwards and open at the bulbous portion of the urethra (see Fig. 403).

The male organ, *Penis,* is composed of erectile tissue, enclosed in three cylindrical fibrous compartments; of these, two, the *Corpora cavernosa penis,* form the principal part of the organ, while the third, *Corpus cavernosum urethrae* or *Corpus spongiosum* encloses the urethra.

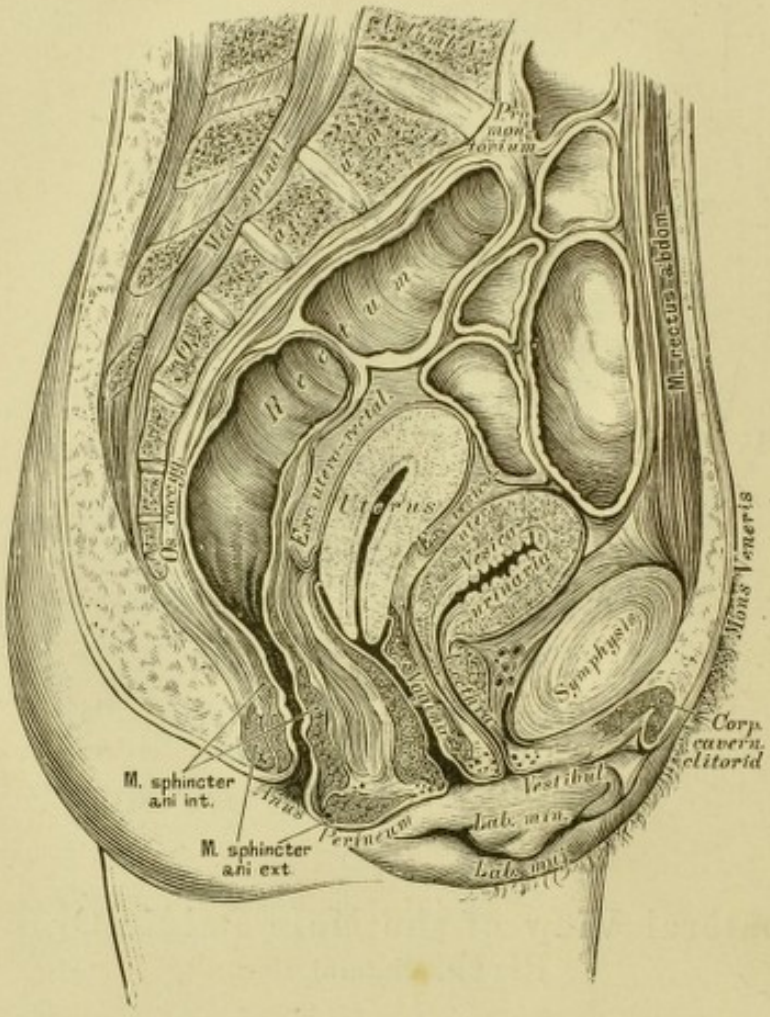
The *Corpora cavernosa penis* are cylindrical, erectile bodies, intimately connected along the median line for their anterior three-fourths, their posterior fourth being separated to form the two *Crura penis,* by which the penis is connected to the rami of the pubes; each crus presents a slight enlargement, the bulb of the *Corpus cavernosum.* The upper surface of the united cavernous bodies is marked by a slight groove containing the single *Vena dorsalis* and the two *Arteriae dorsales penis;* the under surface presents a longitudinal groove, in which is lodged the *Corpus spongiosum.* Each *Corpus cavernosum* is enclosed in the fibrous *Tunica albuginea,* which sends off numerous fibrous bands, *Trabeculae;* these cross the cavity in all directions, subdividing it into a multitude of interstices. The fibrous septum between the *Corpora cavernosa* is incomplete in front, exhibiting numerous clefts. The erectile tissue consists of a venous plexus lodged in the interspaces between the trabeculae. The arteries of the *Corpora cavernosa* are the cavernous branches of the internal pudic (*Art. profundae penis*), and branches from the dorsal artery of the penis. Within the cavernous tissue, the numerous arterial branches are supported by the trabeculae, and terminate in branches of capillary minuteness which open into the intertrabecular spaces.



410. Lateral View of the Male Pelvic Organs at Birth. Natural size.

The *Corpus cavernosum urethrae (Corpus spongiosum)* encloses the urethra; at its posterior extremity it forms a rounded enlargement, the *Bulbus urethrae* (see Fig. 408), and at its anterior extremity the *Glans penis*, which overlaps the anterior rounded extremity of the *Corpora cavernosa penis*. The fibrous tunic of the *Corpus spongiosum* is much thinner and the meshes between the trabeculae much smaller than those of the *Corpora cavernosa penis*.

The *Glans penis* has at its summit, *Apex glandis*, a vertical fissure forming the external orifice of the urethra; its base is formed by the *Corona glandis*, behind which lies a depression, the *Cervix* or *Sulcus retro-glandularis*. The *Glans penis* is surrounded by a duplicature of the skin, the prepuce, *Praeputium;* the covering of the glans is very thin and at the *Meatus urinarius* is continuous with the mucous membrane of the urethra. The prepuce is connected with the *Glans penis* by means of a fold, the *Fraenulum praeputii*. The *Fascia penis*, a continuation of the superficial fascia of the abdomen surrounds the body of the penis up to the *Corona glandis;* near the root of the organ there is in front a dense band of fibro-elastic tissue, named the suspensory ligament, *Ligamentum suspensorium penis*.

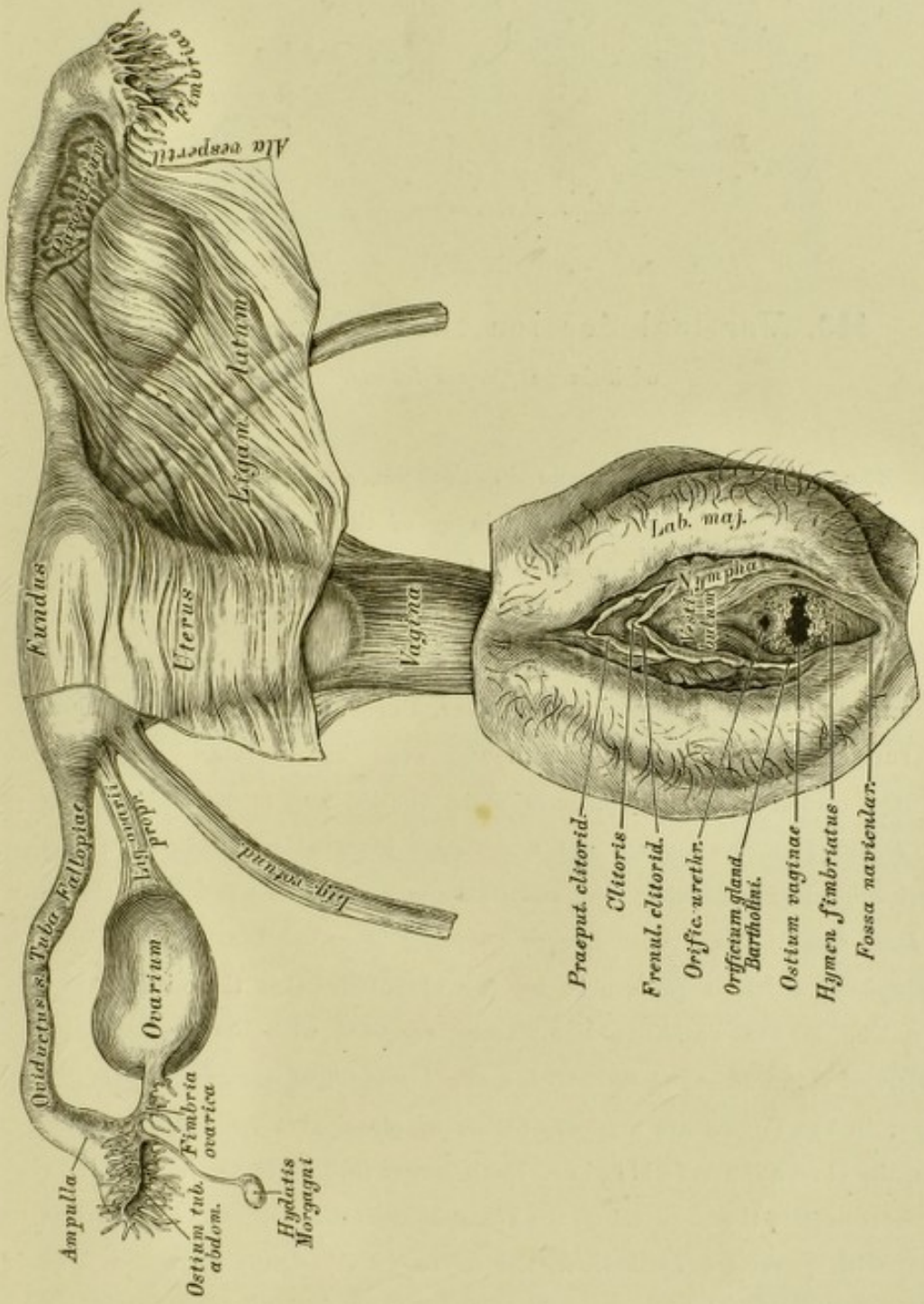


411. Sagittal Median Section through the Female Pelvis.

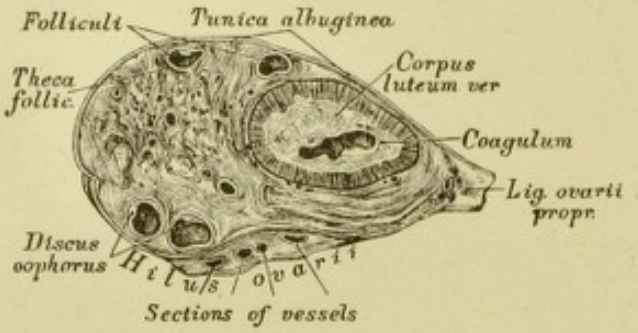
From the frozen cadaver of a person of about 25 years. $^1/_2$ natural size.

The urinary bladder in the female rests posteriorly against the uterus; it is larger in the transverse than in the vertical diameter, and its capacity is greater than in the male. Between the bladder (which in the above figure is shown in an empty state) and uterus is the vesico-uterine fold, *Excavatio vesico-uterina*, formed by the peritoneum, and between the uterus and rectum the recto-uterine, *Excavatio utero-rectalis;* in both these spaces serum was contained in the above case.

The female urethra is $1^1/_2$ inches long and much more dilatable than the male. It is directed obliquely downwards and forwards, is imbedded in the anterior wall of the vagina, and opens in the vulva above the entrance to the vagina, surrounded by a pouch of mucous membrane.



412. Organs of Generation of a 14 Year Old Virgin.
View from before, natural size.



413. Vertical Section through an Ovary

with large *Corpus luteum.*

The ovaries, *Ovaria,* lie in the plane of the superior pelvic aperture, enveloped in the posterior layer of the broad ligament of the uterus; they are of an oval form; each has an outer obtuse extremity, and an inner end, connected to the uterus by the proper ligament of the ovary, *Ligamentum ovarii proprium,* an upper and a lower surface, and an anterior and posterior border. Before menstruation has begun the surface of the ovary is smooth and even, but in later years, after repeated menstruations, it becomes more uneven and is marked by pits and scars. The ovaries are not completely invested by peritoneum, the anterior borders remaining free, and here the bloodvessels enter and leave — *Hilus ovarii.* The proper fibrous covering is called the *Tunica propria s. albuginea,* which is perforated by the bloodvessels at the hilus.

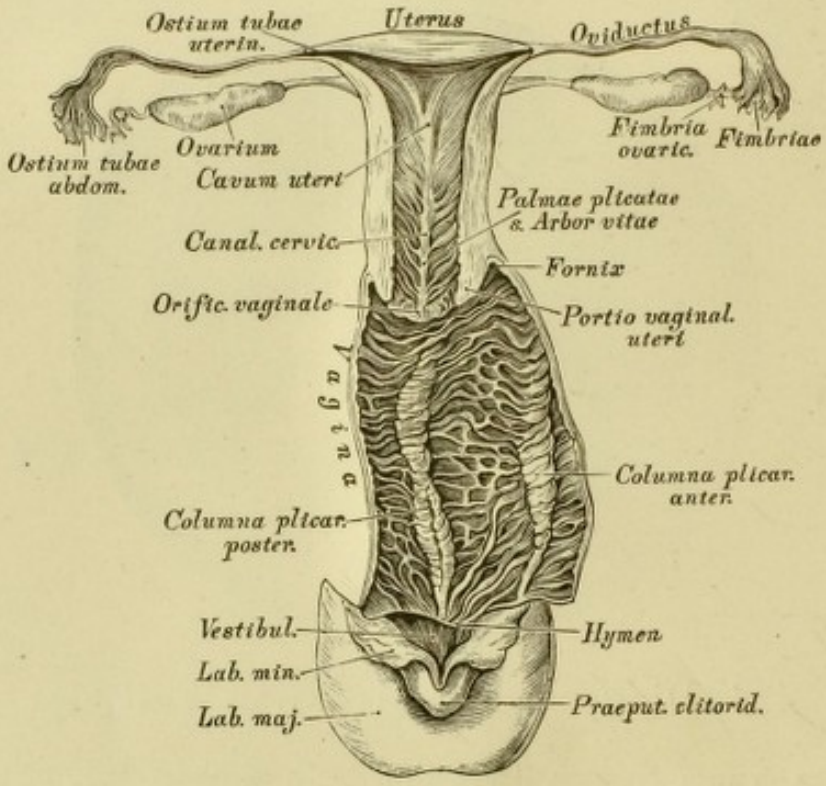
The *Stroma ovarii* is abundantly supplied with bloodvessels and consists of spindle-shaped cells with a small amount of ordinary connective tissue; in the stroma are a great number of closely set vesicles of various sizes, the Graafian follicles. Each larger follicle is surrounded by a dense connective tissue covering, the *Theca folliculi;* then follows a structurless layer with pavement epithelium, the so called *Membrana granulosa.* The cavity contains a light yellow fluid, the *Liquor folliculi.* In one part of the Graafian follicle the epithelial cells are collected into a mass, the *Discus oophorus s. proligerus,* in the center of which the ovum is imbedded.

414. Diagram of a Graafian Follicle.

The ovum is a small spherical body of about $^1/_{125}$ of an inch in diameter, barely visible to the naked eye; it consists of the vitelline membrane or *Zona pellucida*, the yolk, *Vitellus*, and the germinal vesicle, *Vesicula germinativa*. The *Zona pellucida* forms a transparent layer around the opaque yolk substance, which is composed of granules consisting of protagon and fat; the germinal vesicle forms the nucleus of the ovum and consists of a transparent, structureless membrane, containing a watery fluid, and an opaque spot, the germinal spot, *Macula germinativa*.

The largest Graafian follicles usually lie near the surface of the ovary, where they may be seen projecting somewhat. At the time of menstruation the mature follicles burst, and the *Liquor folliculi* and ovum are liberated and pass into the Fallopian tube; after the discharge of its contents, the empty and collapsed Graafian follicle is filled with blood-tinged fluid, and in a short time its circumference is occupied by a firm reddish-yellow substance, the *Corpus luteum;* the former, cicatrized opening in the follicle is called *Cicatrix*. With the number of the menses the number of the cicatrices is also increased. Those *Corpora lutea* which remain after a menstruation, are called false, *spuria;* those remaining after the liberation of an impregnated ovum and after pregnancy: true, *Corpora lutea vera*.

The *Parovarium* or organ of Rosenmüller consists of from 15—20 closed tubes, and is situated in the broad ligament, *Ala vespertilionis*, between the ovary and Fallopian tube.



415. Generative Organs of a New-Born Girl.

The uterus laid open in the posterior median line, the vagina in the left lateral line. Natural size.

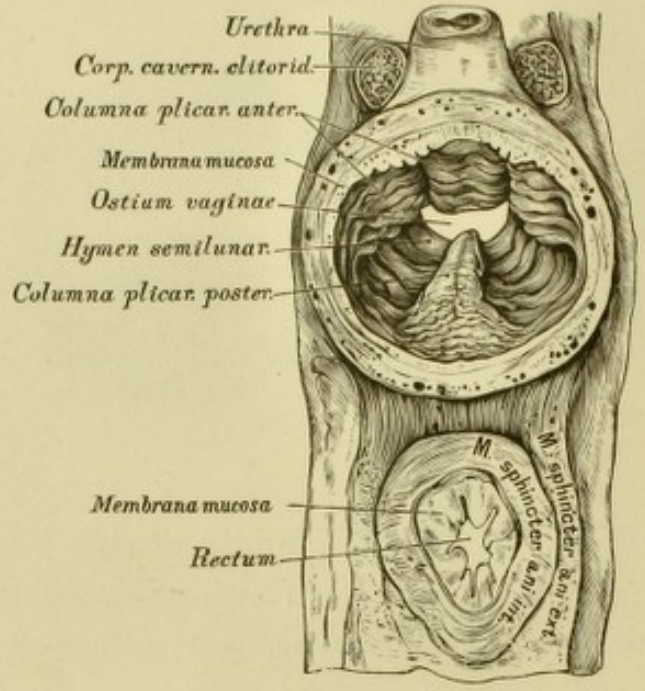
The womb, *Uterus,* is a hollow, muscular organ, situated between the rectum and urinary bladder; it is pear-shaped, flattened from before backwards. The fundus is the upper broad extremity of the organ; the body, *Corpus,* gradually narrows as it extends from the fundus to the neck, *Cervix s. Collum;* the junction of the body and neck is, especially in younger persons, marked by a constriction. The cervix projects into the upper end of the vagina, and this projecting portion is called the vaginal part, *Portio vaginalis uteri.* The broad ligaments, *Ligamenta lata,* pass from the sides of the uterus to the lateral walls of the pelvis; the round ligaments, *Ligamenta rotunda,* continuations of the uterus substance, are enclosed in the anterior layer of the broad ligaments (see Fig. 412). The round ligaments pass through the inguinal canal to the fore part of the pubic symphisis, and become lost in the *Labia majora.* Besides the broad ligaments, the peritoneum forms ligaments between the bladder and uterus, the two anterior, *Ligamenta vesico-uterina,* and between the rectum and uterus, the two posterior, *Ligamenta recto-uterina.*

416. The Specular View of the *Portio vaginalis uteri* in the virginal state.

417. The Specular View of the *Portio vaginalis uteri* after repeated confinements.

The cavity of the uterus, *Cavum uteri,* is triangular; its base is directed upwards towards the *Fundus uteri;* in the two angles of the triangle are the openings of the two tubes; the inferior portion is prolonged into the cavity of the cervix, *Canalis cervicis uteri.* This canal is somewhat dilated in the middle, its upper extremity opening into the cavity of the uterus is called the internal orifice, *Orificium uterinum,* its lower end opening into the vagina is called the external orifice, *Orificium vaginale.* The external orifice presents, before a labor has taken place, a smooth, transverse aperture, with an anterior longer lip, *Labium anterius,* and a posterior shorter lip, *Labium posterius;* after parturition, the external orifice becomes irregular, and sometimes fissured or cleft.

The uterus is composed of three coats: a) an external, derived from the peritoneum, only present at the anterior and posterior surfaces and fundus of the uterus; b) an internal mucous membrane, which, on the anterior and posterior walls of the cavity of the cervix, forms rugae, the *Palmae plicatae s. Arbor vitae* (see Fig. 415). Between the rugae are closed follicles, the *Ovula Nabothi;* in the cavity of the uterus, the mucous membrane has numerous tubular glands, the *Glandulae utriculares.* c) The middle, very dense coat of the uterus consists of smooth muscular fibres, which are disposed in bundles and cross each other in different directions; between the bundles are blood-vessels and areolar tissue. In the pregnant uterus the muscle fibres are increased by new formations both in thickness and length.

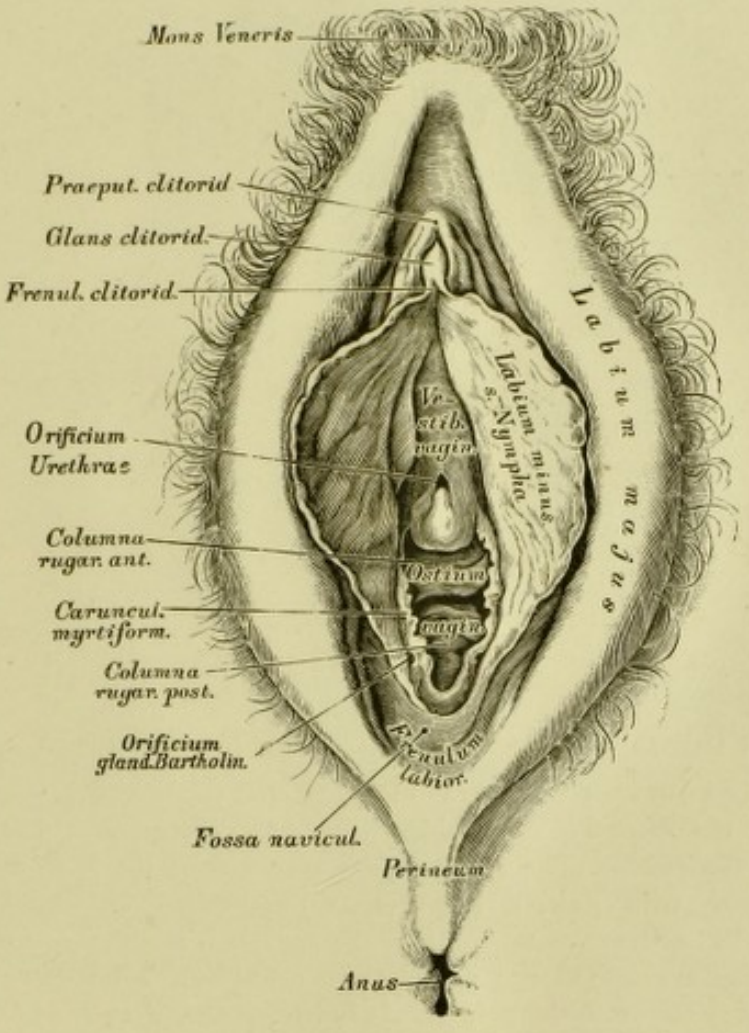


418. Section through a Virginal Vagina.

View from behind; the Vagina dilated, to show the *Columnae* and *Rugae* on its inner surface.

The Fallopian tubes or oviducts, *Tubae Fallopianae s. Oviductus* (see Fig. 412 and 415), commence at the superior angles of the uterus and pursue an undulatory course; they are inclosed in the free margin of the broad ligaments. The inner half is narrow and cord like, *Isthmus*, the outer half is enlarged and called *Ampulla*. The opening of the Fallopian tube into the uterus is called *Ostium tubae uterinum*. The external orifice, *Ostium tubae abdominale*, which lies in front of and below the ovary, and communicates with the peritoneal cavity, is wide and trumpet-shaped, and its margins are surrounded by a series of fringelike processes, termed *Fimbriae;* to this part of the tube the term fimbriated extremity or *Morsus diaboli* is applied. One of these processes, *Fimbria ovarica*, is connected with the outer end of the ovary, and probably effects (by means of ciliated epithelium) the passage of the ovum from the ovary into the tube. The Fallopian tubes have three coats similar to the uterus.

The vagina is a membranous canal, about 3 inches in length, which commences at the vulva with the *Ostium vaginae*, and ends above at the *Fornix*. The vaginal portion of the uterus extends into the fornix, thereby dividing it into an anterior, shallow, and a posterior, deeper part.

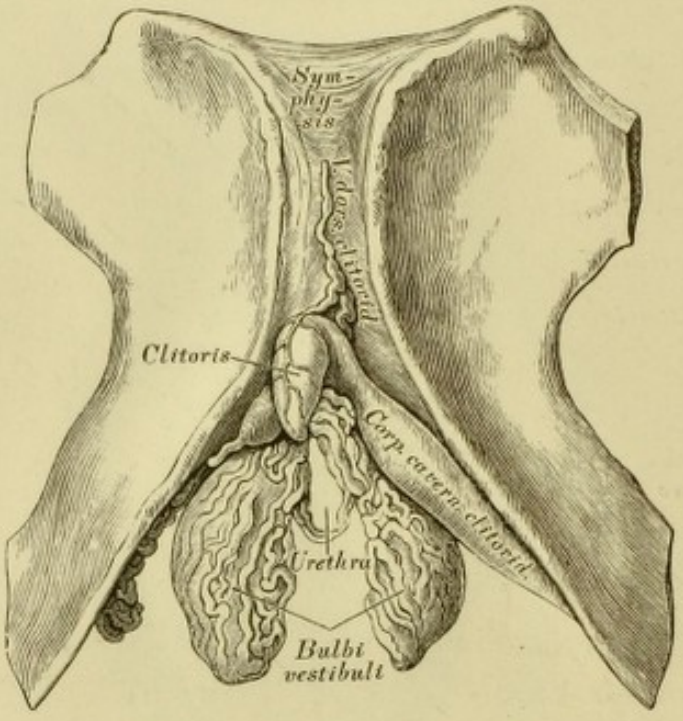


419. The External Female Organs of Generation.

The *Labia majora* and *minora* pressed apart.

The anterior and posterior walls of the vagina are in contact with each other; the uppermost part of the posterior wall is invested by peritoneum. The walls of the vagina are composed of connective tissue, which contains a dense layer of smooth muscle fibres and a venous network. The mucous membrane of the vagina is provided with numerous papillae; its inner surface presents anteriorly and posteriorly a slightly elevated ridge, forming the columns of the vagina, *Columna plicarum anterior et posterior*, which gradually become less marked at its upper end (see Fig. 418).

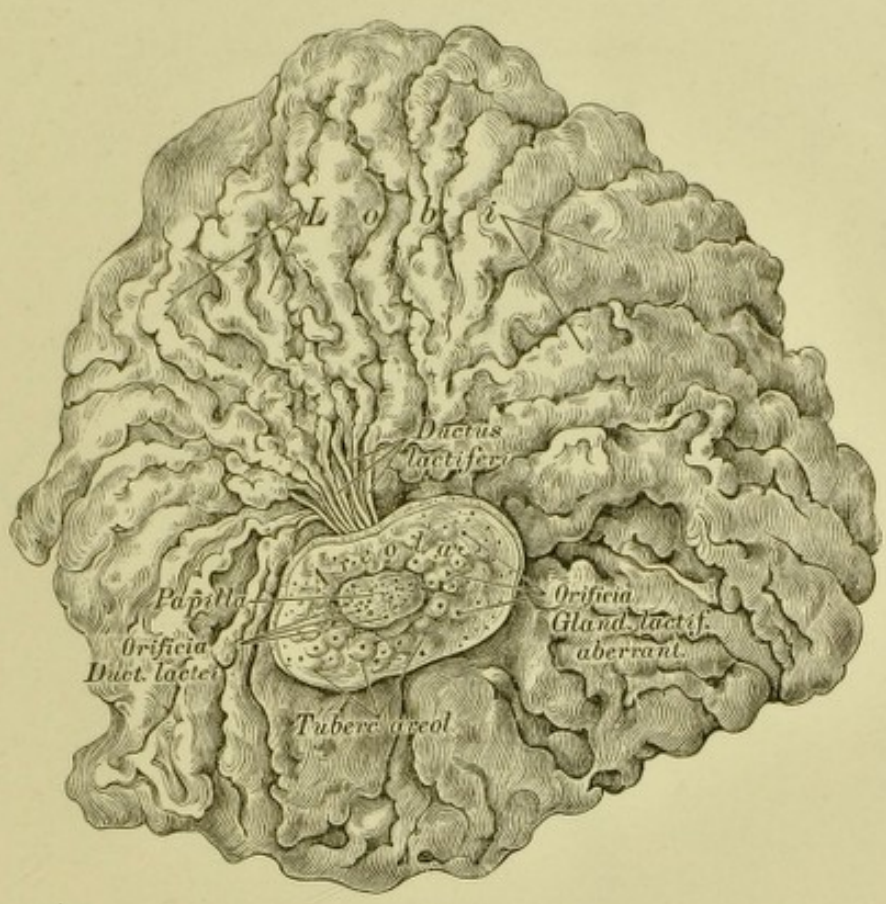
At the orifice of the vagina the mucous membrane forms, in the virginal state, a duplicature, the hymen, which usually appears semilunar, with an upper opening, but sometimes circular, perforated at the upper margin *(Hymen annularis)* or pierced with several small apertures *(Hymen cribriformis)*, or (rarely) may be fimbriated *(Hymen fimbriatus)*, (see Fig. 412). After rupture of the hymen, *Defloratio*, small rounded elevations, the *Carunculae myrtiformes*, remain.



420. The Erectile Organs of the Female.

The vulva or pudendum includes all the parts perceptible externally, viz: the *Mons Veneris, Labia majora, Labia minora s. Nymphae,* the *Hymen* and the *Clitoris.* The *Labia majora* extend from the *Mons Veneris,* which is covered with hair, downwards to the perinaeum, where they are connected by a transverse fold, the *Fraenulum labiorum;* the two points where they are united are called the anterior and posterior commissures; the elliptical interval between the *Labia majora* is called *Rima pudendi.* The space between the fraenulum and posterior commissure is named the *Fossa navicularis.* The *Labia minora* are situated within the *Labia majora* and extend from the clitoris downwards to become lost one on each side of the orifice of the vagina; at the sides of the clitoris each labium divides into two folds, which surround the *Glans clitoridis,* the inferior folds forming the *Fraenulum clitoridis,* the superior uniting to form the *Praeputium clitoridis.* The space between the *Labia minora* from the clitoris to the entrance of the vagina, is called the vestibule, *Vestibulum vaginae;* along either side of the vestibule are two large oblong masses, consisting of a plexus of veins, the *Bulbi vestibuli.*

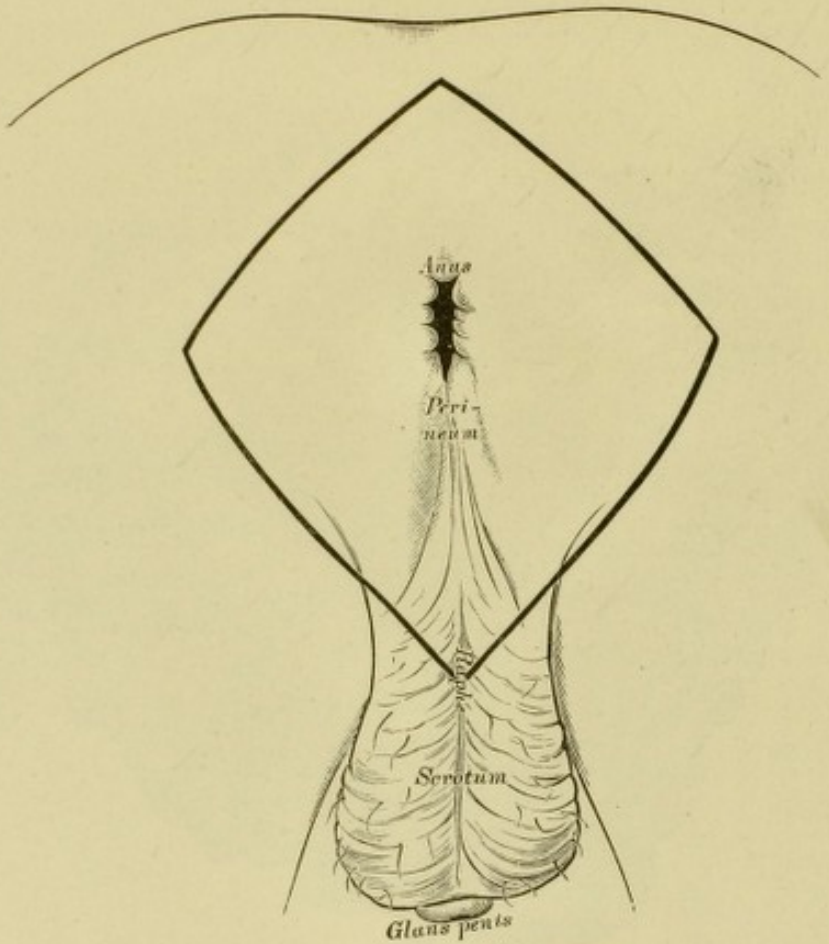
The clitoris is a small elongated body corresponding to a diminutive penis, but differing in having no corpus spongiosum nor urethra connected with it below; it has two *Corpora cavernosa,* a *Glans* which is imperforate, a double *Fraenulum,* a *Praeputium* and two *MM. ischiocavernosis,* called *MM. erectores clitoridis.* The female urethra does not perforate the clitoris, but opens in the vestibule, above the entrance of the vagina, with a rounded orifice, surrounded by a fold of mucous membrane. On each side of the commencement of the vagina the glands of Bartholine open; these are analogous to Cowper's glands in the male.



421. The Right Mammary Gland during Lactation.

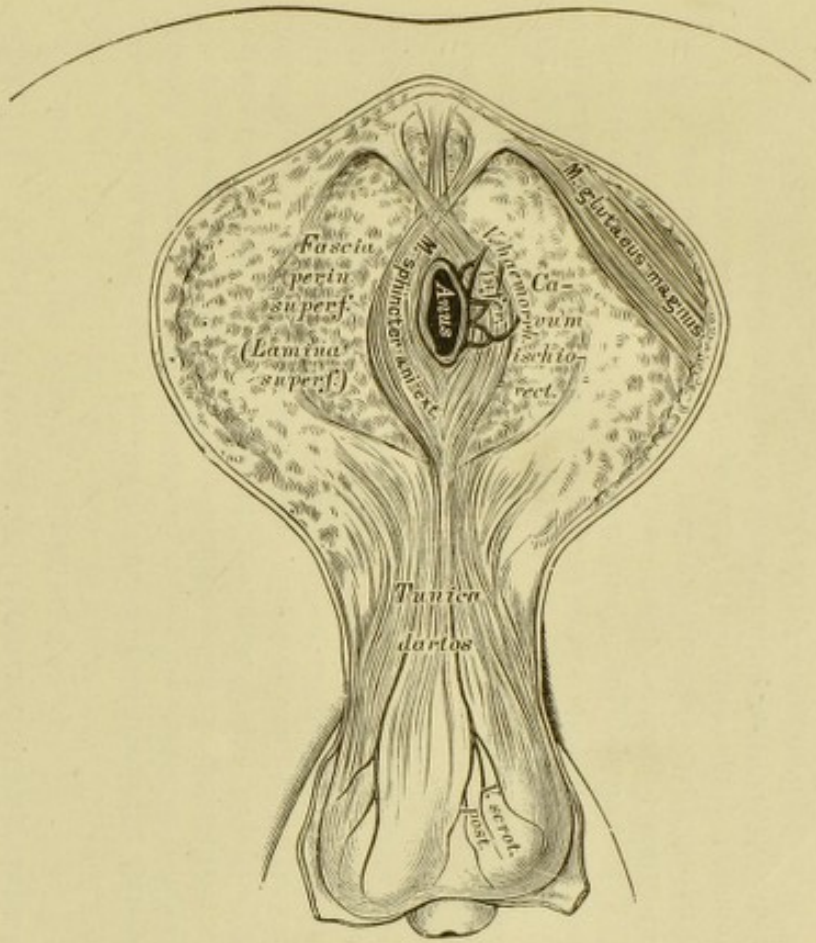
$^2/_3$ natural size.

The mammary glands or *Mammae* lie upon the *Pectoralis major* muscle, between the third and sixth ribs; they are separated from each other by the bosom, *Sinus*. They are hemispherical eminences, presenting just below the center a small conical prominence, the nipple, *Papilla s. Mamilla*. The nipple is surrounded by the areola, which has a colored tint and is covered with numerous tubercles; at the tip of the nipple the excretory ducts of the mammae open, at the surface of the areola, the *Glandulae lactiferae aberrantes*. — The mamma is formed of from 16—24 lobes held together by fibrous or areolar tissue, and having adipose tissue penetrating between them; each lobe is composed of a number of smaller lobes, and these again of smaller and smaller lobules; the smallest lobules consist of a cluster of rounded vesicles, which open into the smallest branches of the lactiferous ducts. The excretory ducts of the lobules unite to form a larger *Ductus lactiferus s. galactophorus*, of which each corresponds to one of the lobes. These ducts converge towards the areola, beneath which they become considerably dilated, especially during lactation, so as to form sinuses, *Sinus lactei;* then they again become reduced in size, and proceed without communicating with each other, to the summit of the nipple, where they open by separate orifices.



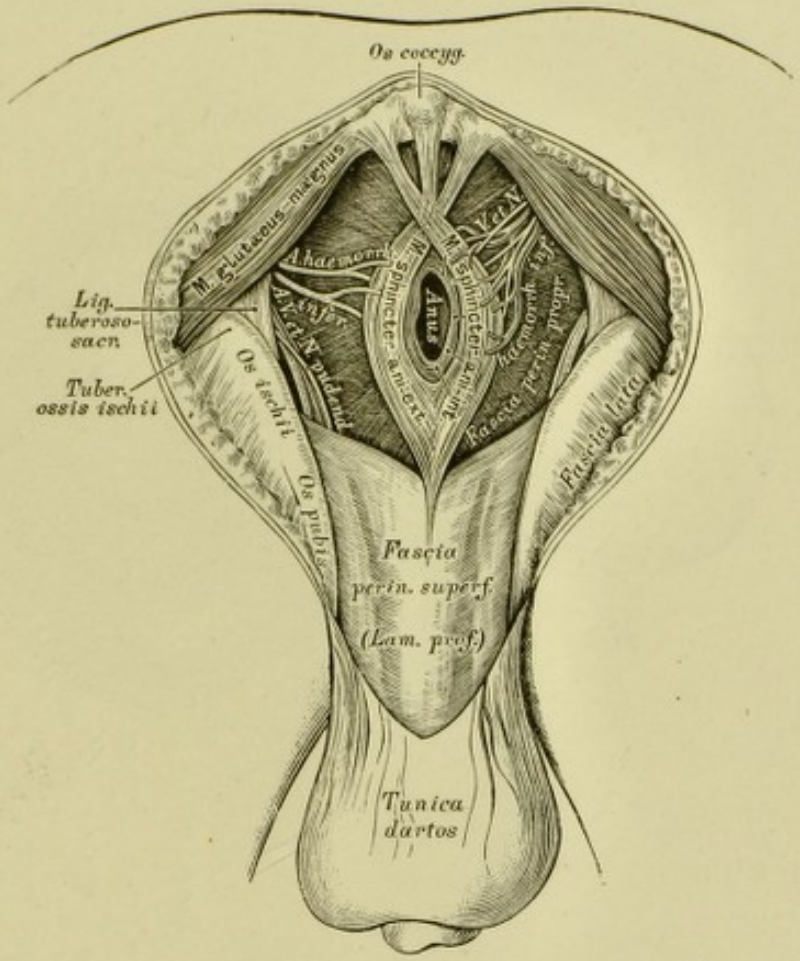
422. Topography of the Male Perinaeum. I.

Showing the cuts to be made in its dissection.



423. Topography of the Male Perinaeum. II.

View after removal of the skin.



424. Topography of the Male Perinaeum. III.

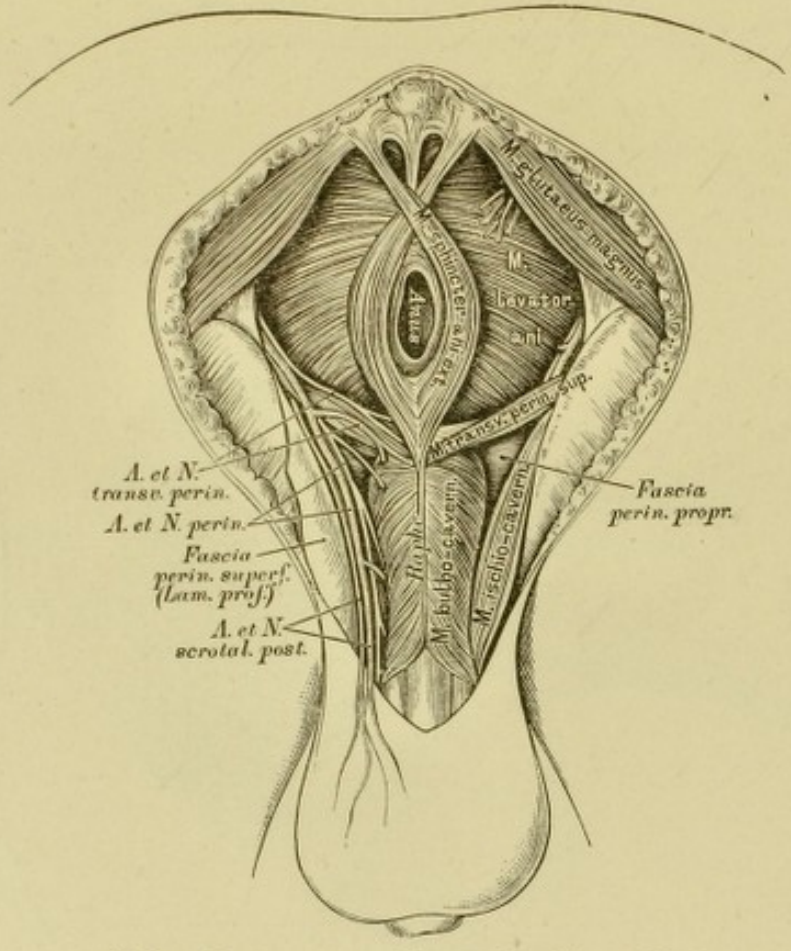
View after removal of the contents of the *Cavum ischio-rectale.*

The perinaeum is the space between the anus and scrotum in the male and between the anus and posterior commissure in the female. The male perinaeum is longer than the female.

The muscles of the perinaeum are:

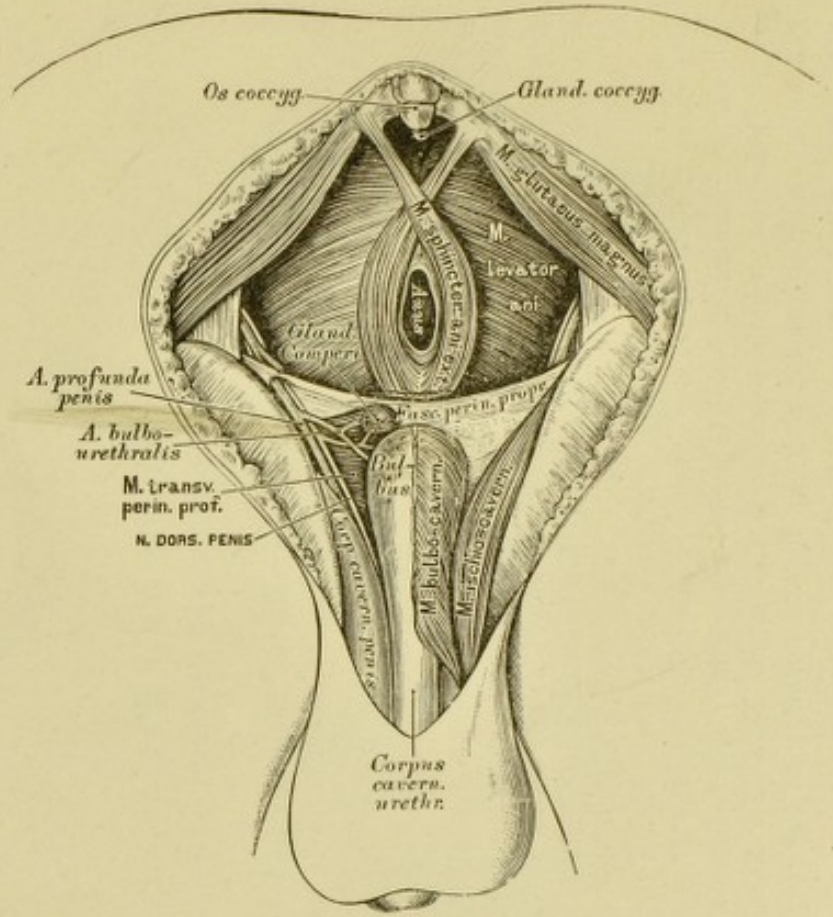
a) *M. ischio-cavernosus s. erector penis* (see Fig. 425 and 426) covers the unattached part of the crus penis; it arises from the tuberosity of the ischium, behind the crus penis, whence its fibres are directed forwards to an aponeurosis which is inserted into the sides and under surface of the crus penis; sometimes it joins its fellow on the other side in a median aponeurosis.

b) *M. bulbo-cavernosus s. accelerator urinae* (see Fig. 425 and 426) lies upon the *Bulbus urethrae*, and is connected with the *M. sphincter ani externus* and the *M. transversus perinei superficialis;* it consists of two symmetrical halves, which arise from the *Raphe bulbi.* Its fibres encircle the bulb, and are inserted into the fibrous covering of the *Corpora cavernosa penis.*



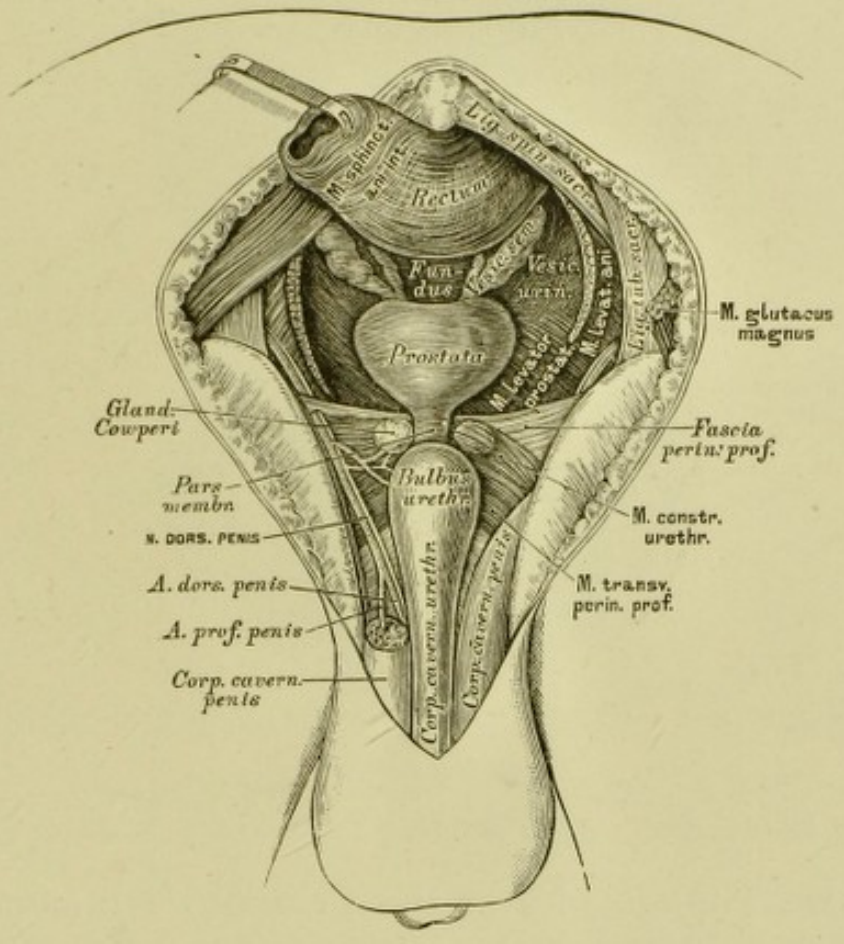
425. Topography of the Male Perinaeum. IV.

View after removal of the *Fascia superficialis.*



426. Topography of the Male Perinaeum. V.

View of the deep perinaeal fascia, *Fascia perinei propria.*

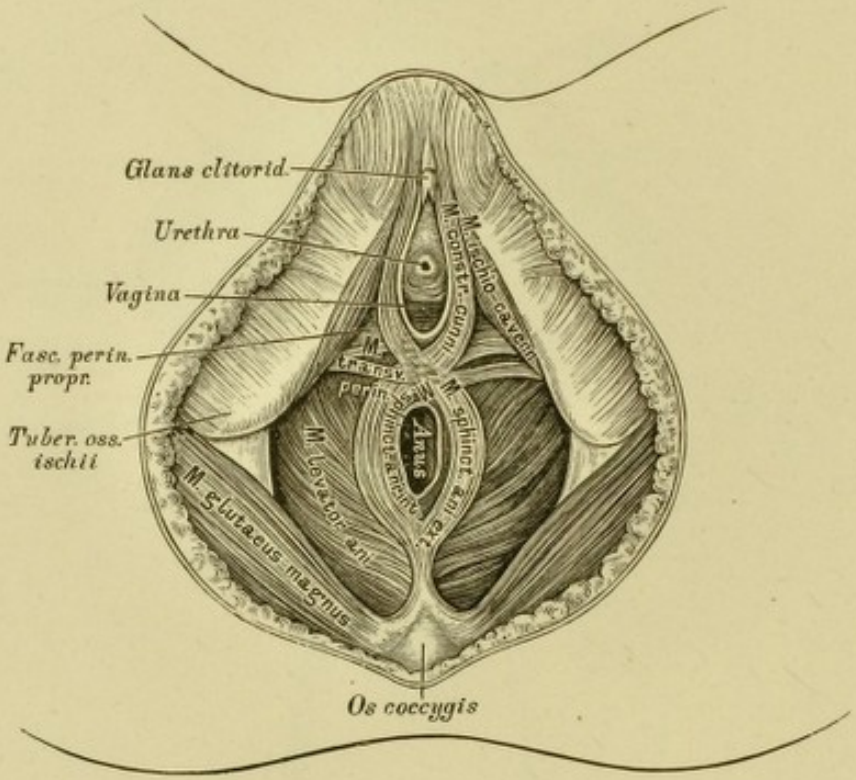


427. Topography of the Male Perinaeum. VI.

View after removal of the *M. levator ani.*

c) The *MM. transversi perinei* (see Fig. 425 and 426). The *M. transversus perinei superficialis* arises from the ascending ramus of the ischium, runs forwards and inwards, and unites with the corresponding muscle of the other side, as well as with the *Sphincter ani externus,* the *Accelerator urinae* and the *Levator ani.* — The *M. transversus perinei profundus* (usually described as the hindmost fibres of the *Compressor urethrae)* lies above the superficial, arises from the ascending ramus of the ischium and the descending ramus of the pubes, and is united with the muscle of the other side and the following. In it Cowper's glands are imbedded.

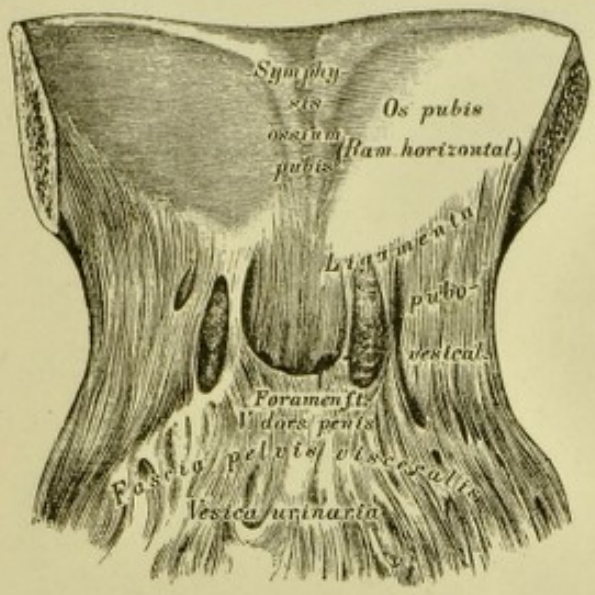
d) The *M. constrictor s. compressor urethrae* is a single muscle, which arises from the descending ramus of the pubes together with the *M. transversus perinei profundus;* it surrounds the membranous portion of the urethra, some of the fibres being in front of and others behind that portion. The *M. transversus perinei profundus* and the *M. constrictor urethrae* form together a broad, muscular plate, whose fibres cross each other in the median line, the *Centrum carneo-tendineum perinei s. Diaphragma urogenitale.*



428. Topography of the Female Perinaeum.

In the female the *M. ischio-cavernosus s. erector clitoridis* lies upon the clitoris, on the back of which the muscles of the two sides unite in a common tendon. The *M. bulbo-cavernosus* is wanting; it is replaced by the *M. constrictor cunni s. sphincter vaginae.* This muscle is to be looked at as a continuation of the *M. sphincter ani externus,* whose right half passes to the left wall of the orifice of the vagina, whose left half to the right wall of the orifice, and it is inserted partly into the back of the clitoris, partly runs to the *Fascia superficialis. Sphincter ani externus* and *Sphincter vaginae* therefore form one common muscle, which has the figure of an 8; both are voluntary muscles. The lower bundles of the *M. transversus perinei* run to the median line, the upper bundles to the vagina.

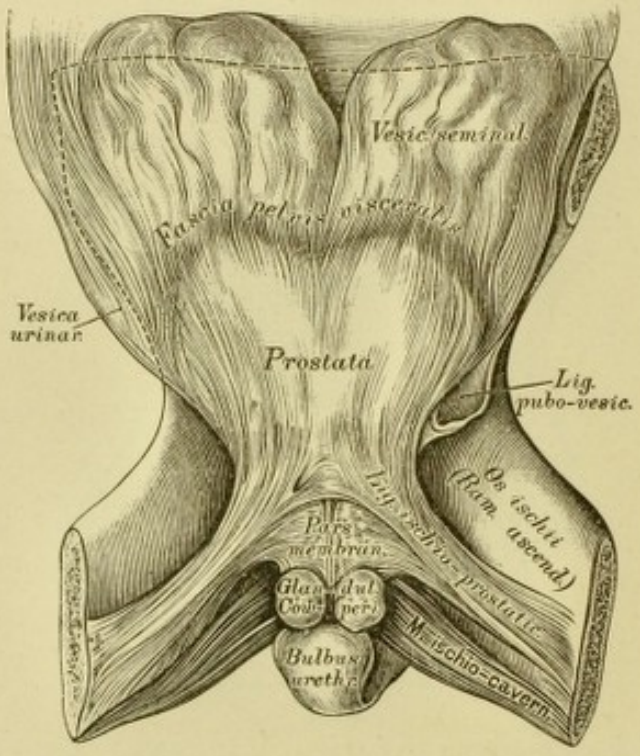
If the coccygeal origin of the *M. sphincter ani externus* is removed, a fibrous layer is reached, which unites the *MM. levatores ani;* between this layer and the apex of the coccyx the coccygeal gland of Luschka, *Glandula coccygea,* lies; it is about the size of a hemp seed, sometimes single, sometimes formed of several lobes, and consists in great measure of dilated arterial vessels (see Fig. 426).



429. The Ligaments of the Visceral Layer of the *Fascia pelvis.*

View of the Symphisis from behind, the Bladder being turned back.

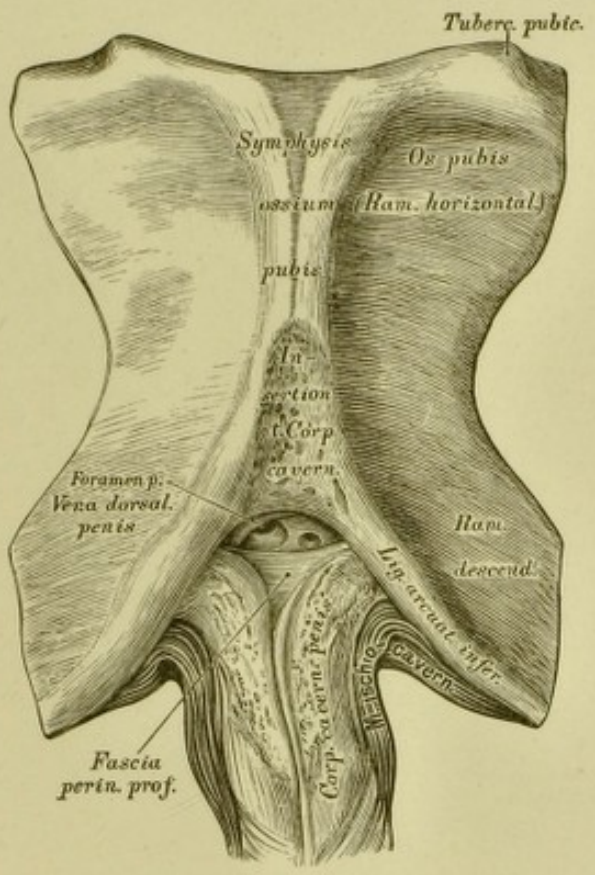
The fasciae of the perinaeum are: a) *Fascia perinei superficialis;* b) *Fascia perinei profunda;* c) *Fascia pelvis.* — The pelvic fascia consists of two parts, which are known as the obturator fascia and the recto-vesical fascia; the latter forms the visceral layer of the pelvic fascia. The obturator fascia covers the inner surface of the *M. obturator internus;* it is attached above to the iliac portion of the ilio-pectineal line; in front, to the body of the pubis along an oblique line extending from the obturator foramen to below the symphisis; behind, to the great sciatic notch, and below it joins the falciform process of the great sacro-sciatic ligament, by means of which it is connected to the rami of the ischium and pubes. At the upper end of the obturator foramen the fascia joins the upper edge of the obturator membrane, forming an arch over the border of the muscle, and bounding below the short canal by which the obturator vessels and nerves issue.



430. The Ligaments of the Visceral Layer of the *Fascia pelvis.*

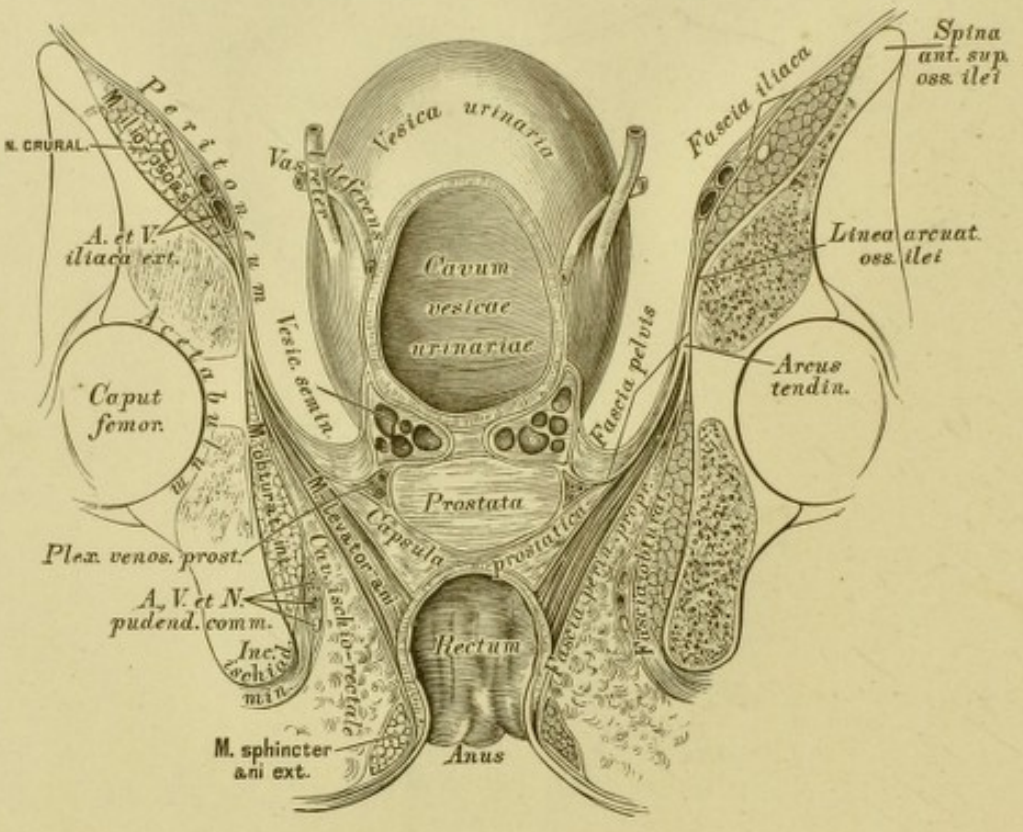
View of the Rami of the Ischium and the Bladder from behind.

The visceral layer of the pelvic fascia (recto-vesical fascia), is attached anteriorly to the back of the pubis, from which it is separated by the origin of the *M. levator ani;* laterally it springs from the obturator fascia along a curved line passing from the upper part of the obturator foramen to the ischial spine. Lying upon the upper surface of the *Levator ani,* the visceral layer, which forms a fibrous partition completely separating the pelvic cavity above from the perineal space below, passes in front to the prostata and anterior surface of the bladder, as *Ligamenta pubo-prostatica* (better *pubo-vesicalia*) *lateralia;* in the middle portion it passes to the prostate, as *Ligamenta ischio-prostatica,* then it enters between the base of the bladder and rectum as *Fascia recto-vesicalis;* finally in the posterior portion it reaches the outer surface of the rectum as a thin layer.



431. Anterior Surface of the Symphisis, after removal of the *Corpora cavernosa penis.*

The deep perineal fascia, *Fascia perinei profunda*, is stretched across the subpubic arch on the deep surface of the crura of the penis and bulb of the urethra. It consists of two layers, an anterior and a posterior; the anterior is attached on each side to the rami of the pubis and ischium, while posteriorly it becomes connected with the posterior layer. This layer is perforated by the urethra about an inch below the symphisis. The posterior layer consists of right and left lateral halves, which are separated in the middle line by the urethra close to the neck of the prostate. The layer is superficial to the anterior fibres of the *Levator ani* muscle, which lie between it and the recto-vesical fascia, and is connected with a thin web of areolar tissue, which extends backwards on the surface of the *M. Levator ani*, and is distinguished as the anal fascia.



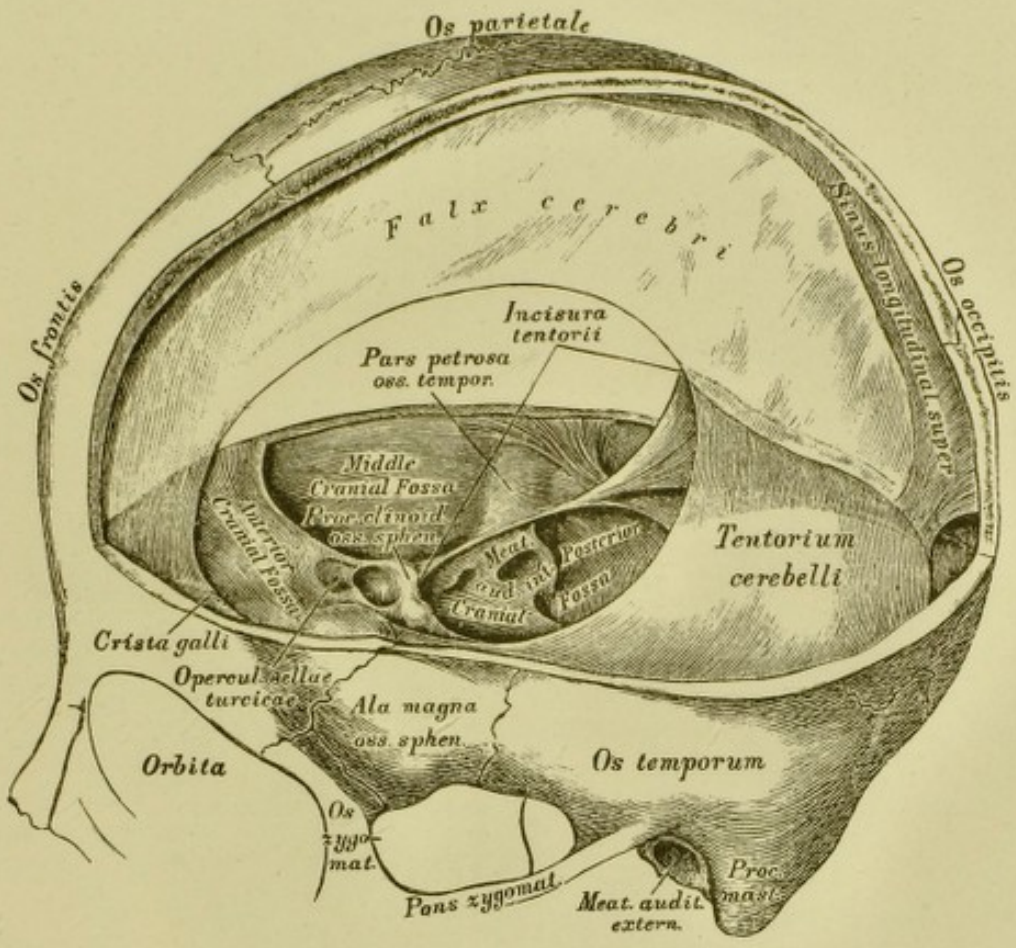
432. Frontal Section through the Pelvis of a Child.

Semi-diagrammatic, for demonstration of the Pelvic Fasciae. Nat. size.

The superficial perinaeal fascia can also be divided into two layers. The superficial layer is thick, loose, areolar in texture, and contains much adipose tissue in its meshes; it is continuous with the *Tunica dartos* of the scrotum; the deep layer is a thin layer, free from fat, which covers the *M. ischio-* and *bulbo-cavernosus* and the *M. transversus perinei superficialis;* it is attached to the crus penis and becomes the *Fascia penis* (see Fig. 424). The covering of the two *MM. levatores ani* by the *Fascia pelvis* and *Fascia perinei profunda*, their direction, as well as their relation to the *Cavum ischio-rectale*, which is rich in fat, is demonstrated in the above figure.

V.

NERVOUS SYSTEM.

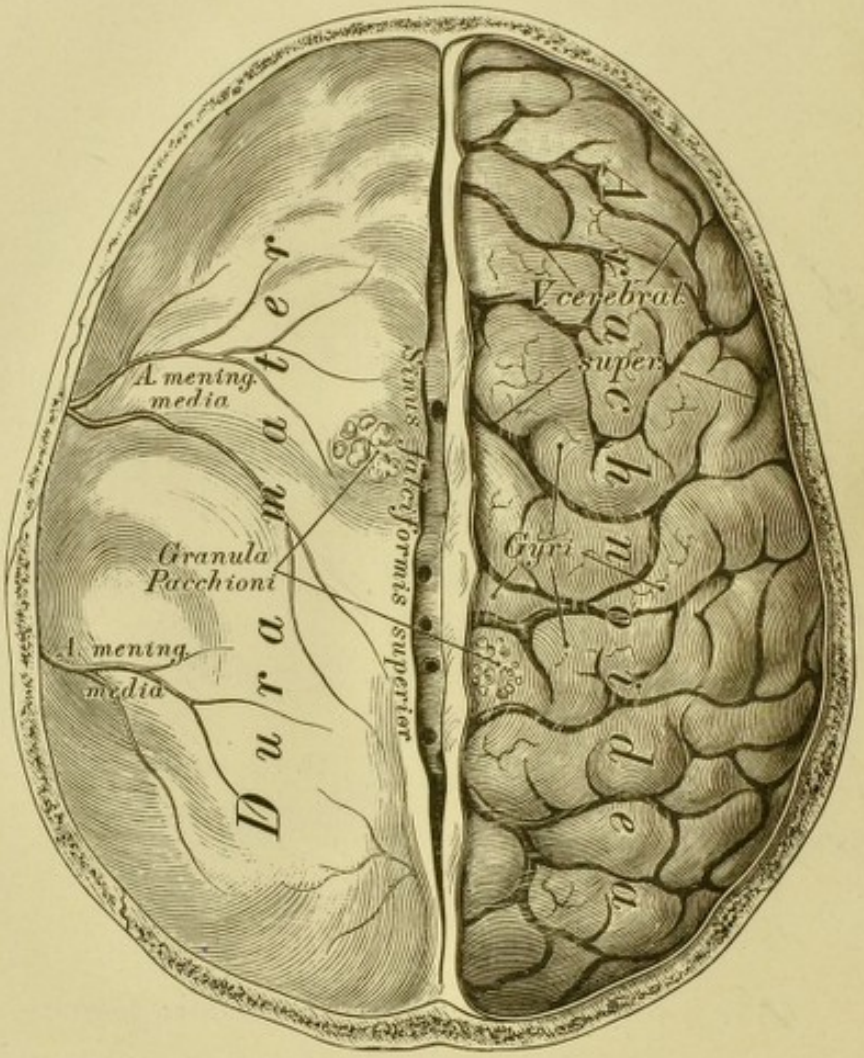


433. The Processes of the *Dura mater.*

The brain and spinal cord are covered by three membranes: the *Dura mater (Meninx fibrosa)*, the *Arachnoidea (Meninx serosa)* and the *Pia mater (Meninx vasculosa)*.

The *Dura mater* forms the external covering; it is a thick and dense inelastic fibrous membrane, whose outer surface adheres closely to the inner surface of the bones, forming their internal periosteum. It sends numerous processes inwards, into the cavity of the skull, and is prolonged to the outer surface of the skull through the various foramina which exist at the base; its fibrous layer forms sheaths for the nerves which pass through these apertures. In certain situations in the skull, the fibrous layers of this membrane separate, to form sinuses for the passages of venous blood, *Sinus durae matris.*

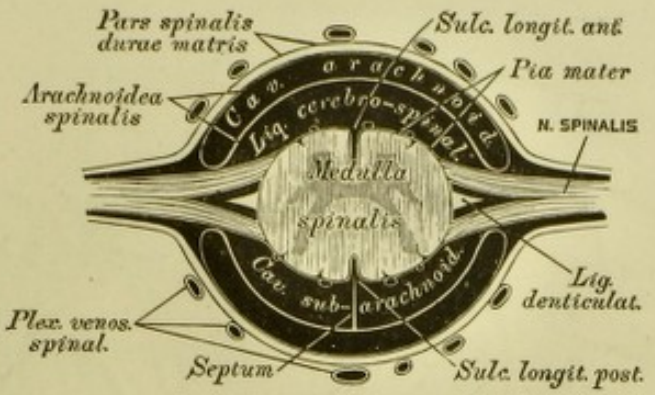
The *Dura mater* also sends inwards into the cavity of the skull three strong membranous processes, the *Falx cerebri s. Processus falciformis major*, the *Falx cerebelli s. Processus falciformis minor*, and the *Tentorium cerebelli.*



434. The Brain and its Membranes.

View from above.

The *Falx cerebri* descends vertically in the longitudinal fissure between the two hemispheres of the brain; it is narrow in front, where it is attached to the *Crista galli*, broader behind, where it is connected with the tentorium. Along its upper convex border, which is attached to the inner surface of the skull as far back as the internal occipital protuberance, runs the superior longitudinal sinus, *Sinus falciformis superior;* its free concave margin is turned towards the *Corpus callosum*, but does not touch it. The *Falx cerebelli* descends from the back part of the tentorium, with which it is connected, along the internal occipital crest, towards the *Foramen magnum*, bifurcating there into two smaller folds; its sinus is not constant. The *Tentorium cerebelli* is placed between the posterior lobes of the cerebrum and the hemispheres of the cerebellum; its anterior free border presents a large oval opening for the transmission of the *Crura cerebri*. The pituitary fossa of the body of the sphenoid bone is partially closed by a fourth process, the *Operculum sellae turcicae*.



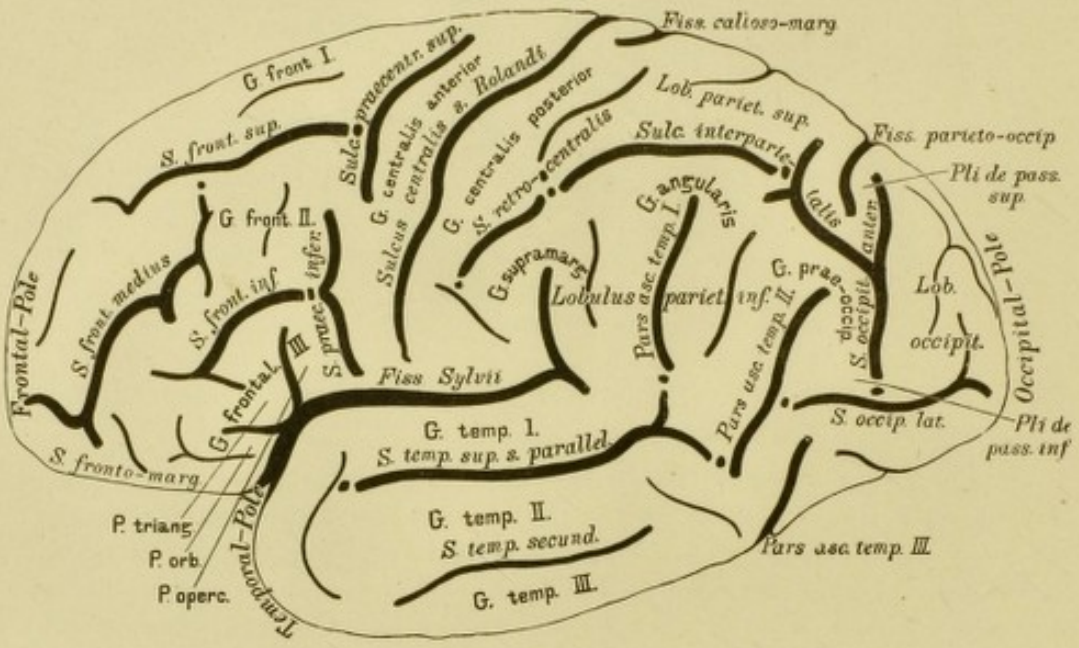
435. Diagram of the Membranes of the Spinal Cord.

Transverse Section. Magn. = 2.

The *Dura mater* of the cord, *Pars spinalis durae matris*, continuous with that which invests the brain, extends, below, as far as the top of the sacrum; beyond this point it is impervious, being continued, in the form of a slender cord, to the back of the coccyx, where it blends with the periosteum. It is not adherent to the bones of the spinal canal, which have an independent periosteum, and the intervening space is occupied by a plexus of veins, *Plexus venosi spinales*. The *Dura mater* of the cord accompanies each of the spinal nerves into its vertebral foramen, and sends off from its inner surface to each side of the cord, from 20—23 slender processes in the form of denticuli, which serve to support the cord, and are collectively called the *Ligamentum denticulatum*.

The *Arachnoidea* is a delicate membrane, situated between the dura mater externally and pia mater internally. The space between the dura mater and arachnoid is called subdural space or *Cavum arachnoideale;* that between the arachnoid and pia mater, sub-arachnoid space, *Cavum subarachnoideale;* the latter contains a considerable quantity of fluid, the cerebro-spinal fluid, but the former also contains some fluid. The arachnoid passes over the various eminences and depressions on the cerebrum and cerebellum, without dipping down into the sulci and smaller grooves. It invests the brain *(Arachnoidea cerebralis)* and spinal cord *(Arachnoidea spinalis)* much less closely than the pia mater. From the posterior median fissure, *Sulcus longitudinalis posterior*, of the cord, a septum passes to the inner surface of the *Arachnoidea*, which is only complete in the cervical region. Upon the external surface of the dura mater, in the vicinity of the longitudinal sinus, the *Granula* (wrongly *Glandulae) Pacchioni* lie; they are also found in other situations.

The *Pia mater*, the innermost membrane, dips down into all the sulci of the brain and into the fissures of the cord, and is intimately adherent to their surfaces. It is a highly vascular membrane; at the transverse fissure of the cerebrum it is invaginated into the lateral ventricles and over the third ventricle, and there forms the *Velum interpositum* or *Tela choroidea superior;* it is also prolonged over the posterior wall of the fourth ventricle, where it forms the *Tela choroidea inferior* and choroid plexuses of that ventricle. At the point where the cord terminates, the *Pia mater* is continued down as a long, slender filament, *Filum terminale*.



436. Left Hemisphere, from the outside. After Eberstaller.

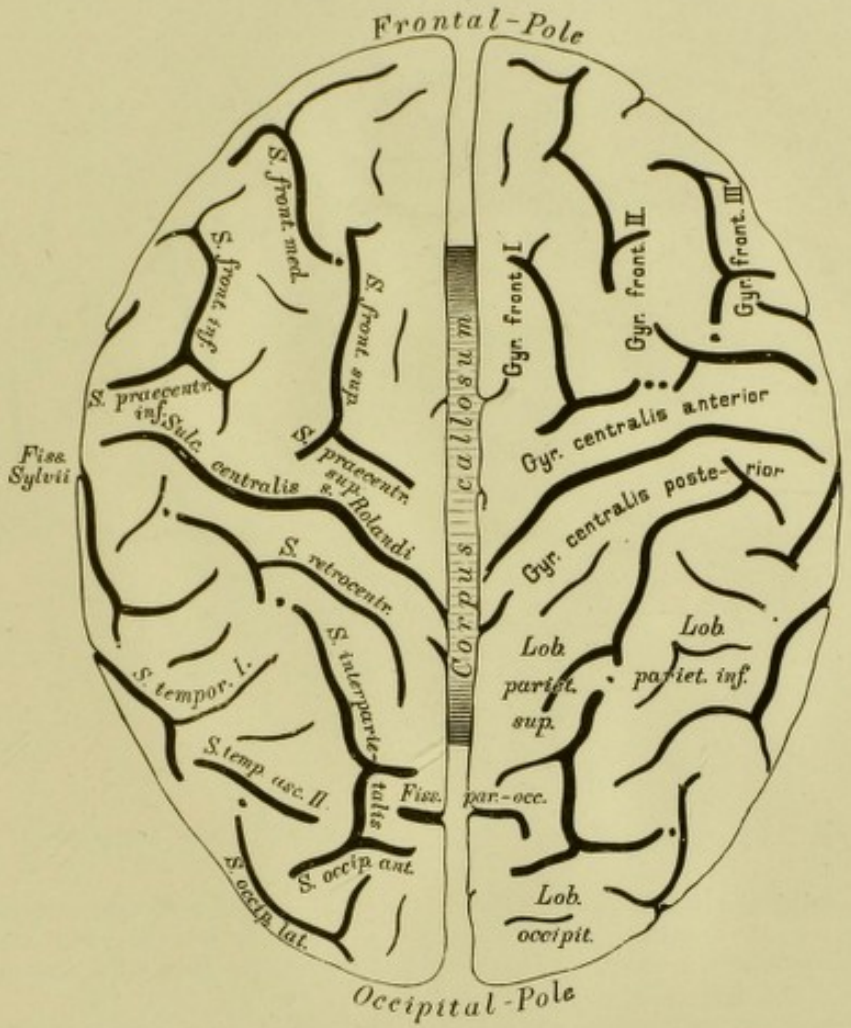
The brain, *Encephalon,* is divided into four principal parts, the cerebrum, cerebellum, *Pons Varolii* and *Medulla oblongata.*

The cerebrum is divided into two hemispheres, right and left. Each hemisphere has a dorsal or outer, convex surface, in contact with the vault of the cranium, an inner, flat surface, which forms one side of the longitudinal fissure, and an irregular under surface, in which is a deep cleft, the fissure of Sylvius. The anterior extremity is called frontal pole, the posterior, occipital pole.

The entire surface of the hemispheres presents a number of convoluted eminences, the convolutions or *Gyri,* separated from each other by fissures or *Sulci.* At certain places, several, otherwise separate sulci may blend together, and this is the chief cause for the great variety in the convolutions found in different brains; if this is the case, a concealed convolution will always be found beneath the union of the fissures; the places where these deep gyri are most frequent, are marked by points in the diagram.

The deepest of all the fissures is the Fissure of Sylvius, *Fissura Sylvii;* it commences as *Fossa Sylvii,* at the under surface of the brain, turns outwards and backwards *(Ramus posterior fissurae Sylvii)* and ends by dividing into a *Ramus ascendens* and a short *Ramus descendens.* At the place where it curves around, the *Ramus anterior ascendens* branches off, often also a *Ramus anterior horizontalis.* The fissure of Sylvius divides the frontal lobe and partly also the parietal lobe from the temporal lobe; the central lobe or island of Reil, *Insula Reilii,* lies deeply within its commencement, being rarely visible except when the lips of the fissure are separated; the parts of the hemisphere covering it, are called *Operculum.*

The central fissure or fissure of Rolando, *Sulcus centralis s. Rolandi,* is situated about the middle of the outer surface of the hemisphere; it commences near the longitudinal fissure and runs downwards and forwards to terminate a little above the horizontal limb of the fissure of Sylvius; the parallel convolutions which bound it, are named the ascending frontal, or *Gyrus centralis anterior* and the ascending parietal, or *Gyrus centralis posterior.* That portion of the brain, situated in front of the fissure of Rolando, and above and in front of the fissure of Sylvius is called the **frontal lobe,** *Lobus frontalis.*

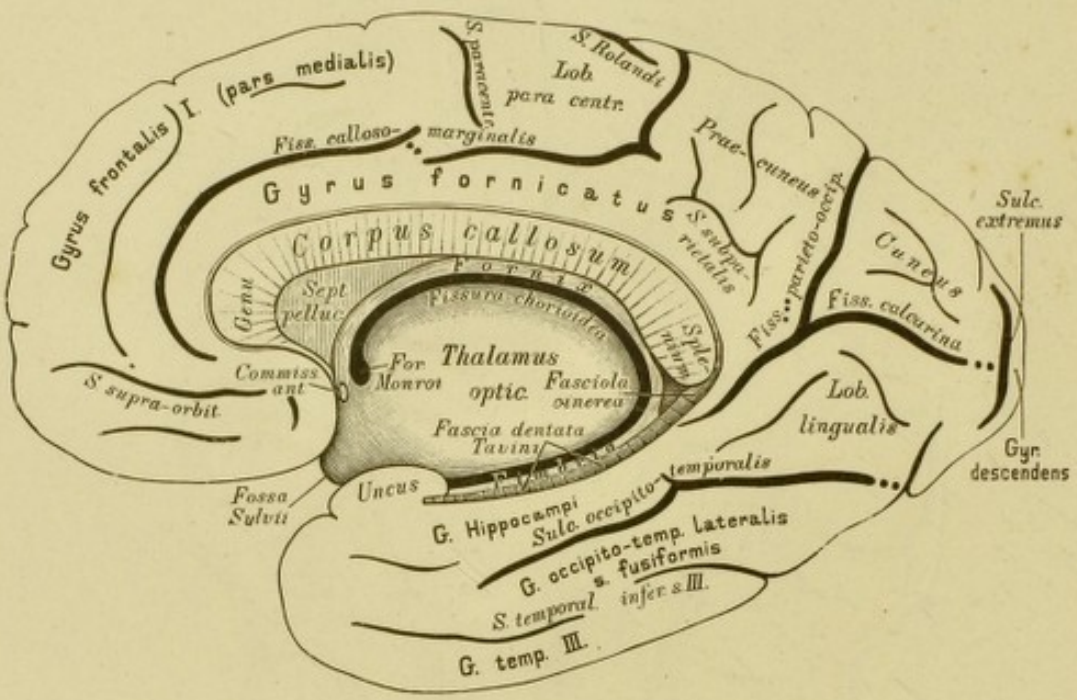


437. Cerebrum, from above. After Eberstaller.

The anterior central or ascending frontal convolution is limited in front by the transverse frontal fissure or *Sulcus praecentralis,* which is usually divided into two parts, the *S. praecentralis superior* and *inferior.* The portion of the frontal surface anterior to this convolution is occupied by three gyri, the superior, middle and inferior frontal convolutions, or *Gyri frontalis I, II* and *III;* the fissures separating them are the superior and inferior frontal, *S. frontalis superior* and *inferior.* The middle frontal convolution is the broadest; it is divided anteriorly by the *S. frontalis medius* into two portions. At the *Gyrus frontalis inferior* a *Pars ascendens s. opercularis,* a *Pars triangularis* and a *Pars orbitalis* are distinguished.

The posterior central or ascending parietal convolution is limited posteriorly by the intra-parietal fissure or *S. retrocentralis;* from it, two convolutions, the superior and inferior parietal lobules, *Lobulus parietalis superior* and *inferior,* run backwards; the sulcus separating them is the *S. interparietalis.* The fissures of the temporal lobe divide the inferior parietal lobule into three portions: *G. supramarginalis, G. angularis* and *G. parietalis posterior.*

About midway between the posterior extremity of the brain and the fissure of Rolando is the deep parieto-occipital fissure, *Fissura parieto-occipitalis;* it is only seen to a slight extent on the outer surface, the greater part of it being on the internal surface of the hemisphere; a little behind it, the *S. interparietalis* ends with a transverse portion: *S. occipitalis anterior s. perpendicularis externus.* That portion of the external surface, which is bounded in front by the sulcus of Rolando and behind by the parieto-occipital fissure and the *S. occipitalis anterior,* is called **parietal lobe,** *Lobus parietalis;* it comprises the ascending parietal convolution, the superior and the inferior parietal lobules.



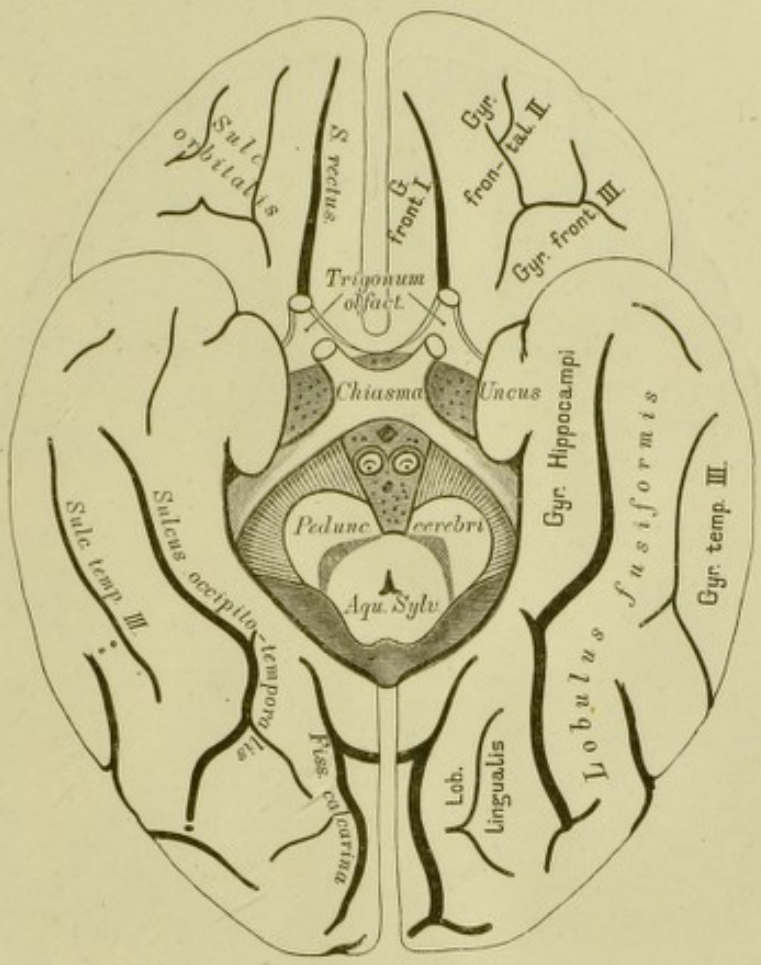
438. Right Hemisphere, from the inside. After Eberstaller.

The **occipital lobe,** *Lobus occipitalis,* is situated at the posterior extremity of the brain; it is bounded in front by the *S. occipitalis anterior,* and below by the *S. occipitalis lateralis;* the convolutions separating this lobe from the parietal lobe, have been named *Plis de passage sup.* and *inf.* (Fig. 436).

The **temporal** or **temporo-sphenoidal lobe,** *Lobus temporalis,* is bounded in front and above by the fissure of Sylvius. Three transverse sulci, whose posterior ends are turned upwards (*Pars ascendens*), divide it into three convolutions. The uppermost of these sulci is always the best developed; it is called the first or superior temporal (temporo-sphenoidal) or parallel sulcus, *Sulcus temporalis primus s. parallelus;* the second or middle temporal sulcus, *S. temporalis secundus,* is generally interrupted by a vertical gyrus; the third or inferior, *S. temporalis tertius,* lies on the under surface of the lobe. Between them, the first, second and third temporal convolutions, *Gyrus temporalis I. s. superior, G. temporalis II. s. medius, G. temporalis III. s. inferior,* lie. Posteriorly, the I. and II. are continuous with the inferior parietal lobule, the III. with the inferior occipital convolution (Fig. 436 and 437).

On the internal surface of the hemisphere the *Gyrus fornicatus* or convolution of the *Corpus callosum* is seen; it turns around the anterior extremity of the *Corpus callosum,* and is interrupted anteriorly by the *Fossa Sylvii;* its lower half is the *Gyrus hippocampi* or uncinate convolution, also called *Subiculum cornu Ammonis,* which ends with the uncus. Above the *G. hippocampi* is the *Fissura hippocampi;* concealed in it are the gray *Fascia dentata Tarini* and the white *Fimbria.* Superiorly, the *Gyrus fornicatus* is bounded by the calloso-marginal sulcus, which commences somewhat below the *Genu corporis callosi* and ends a short distance behind the upper extremity of the sulcus of Rolando.

Somewhat behind and below the *Splenium corporis callosi* a deep fissure, which posteriorly divides into two rami, commences in the *G. fornicatus;* one ramus extends upwards and is called parieto-occipital fissure, *Fissura parieto-occipitalis s. perpendicularis interna;* the other extending pretty horizontally backwards, is called calcarine fissure, *Fissura calcarina,* and ends at the pole in the *S. extremus.*

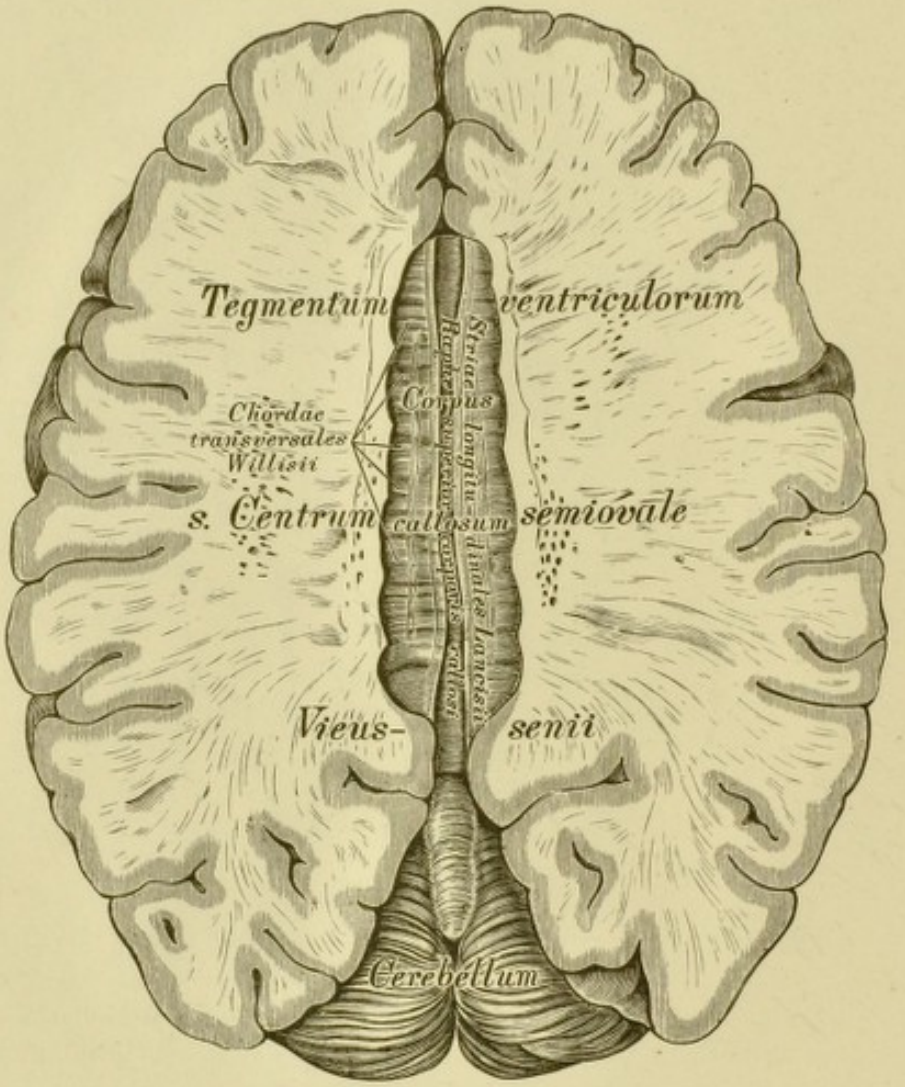


439. Cerebrum, from below. After Eberstaller.

The cuneate lobule, *Cuneus*, is a wedge-shaped area lying between the calcarine and parieto-occipital fissures; the quadrate lobule, *Praecuneus*, is a four-sided area lying between the parieto-occipital and calloso-marginal fissures; the latter is imperfectly separated from the *Gyrus fornicatus* by the *Sulcus subparietalis*. The prolongation of the anterior central convolution on the median surface of the hemisphere, forms part of the paracentral lobule, *Lobulus paracentralis*. From the summit of the cuneus a deep convolution runs through the lower end of the parieto-occipital fissure to the *Gyr. fornicatus* (Fig. 438).

On the under surface of the frontal lobe are only two fissures: 1. the olfactory fissure, *Sulcus olfactorius*, in which the olfactory tract and bulb lie, 2. to the side of this is the orbital fissure, *Sulcus orbitalis*, which varies a great deal. The orbital portion of the superior frontal convolution, *Gyr. frontalis superior*, is called the *Gyr. rectus;* the part between the orbital sulcus and *Fossa Sylvii* is the orbital portion of the inferior frontal convolution (Fig. 436).

On the under surface of the united temporal and occipital lobes a deep antero-posterior sulcus, the occipito-temporal sulcus, separates a lateral from a median portion; the former lies between this sulcus and the third or inferior temporal sulcus and is called *Gyr. occipito-temporalis lateralis s. fusiformis;* the latter, *Gyr. occipito-temporalis medialis*, whose anterior portion is called *Gyr. hippocampi*, the posterior, *Lobulus lingualis*.

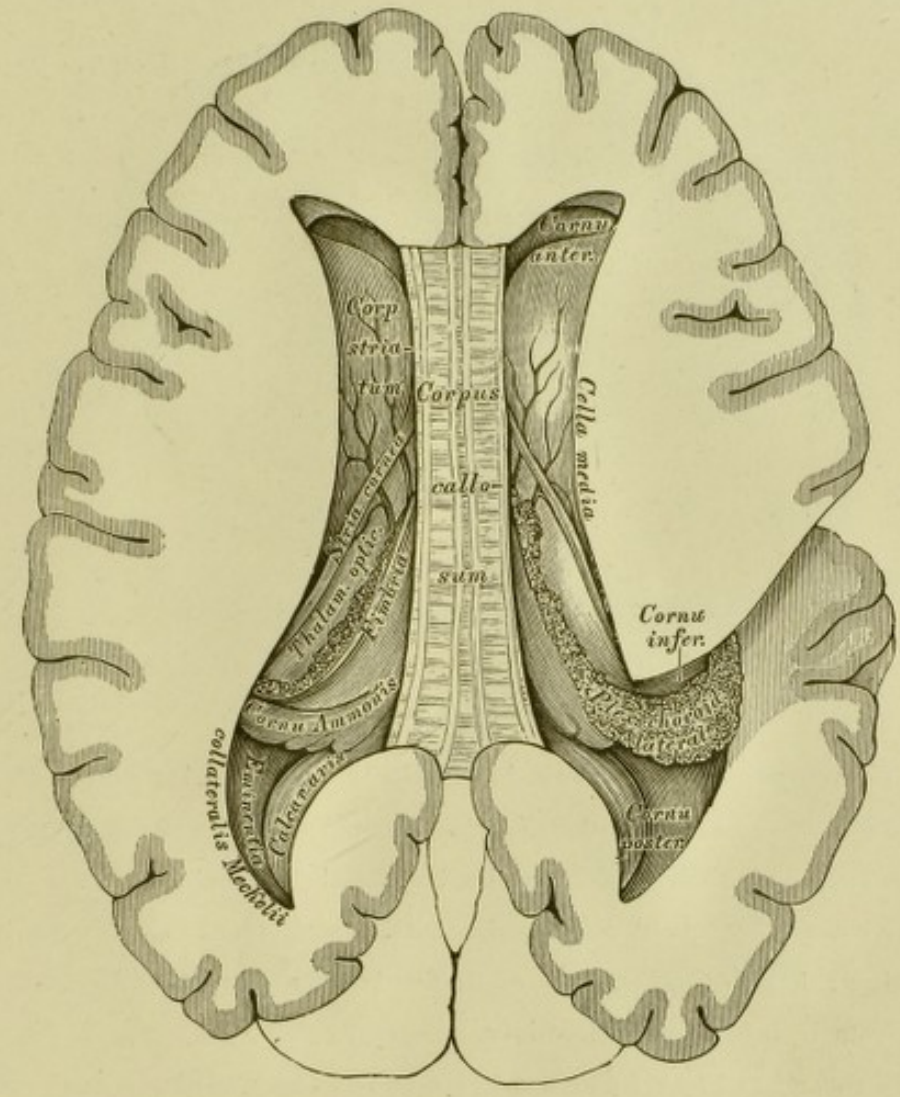


440. Horizontal Section of the Cerebrum,

on a level with the *Corpus callosum*. $^{2}/_{3}$ natural size.

The examination of the cerebrum is made in the following manner:

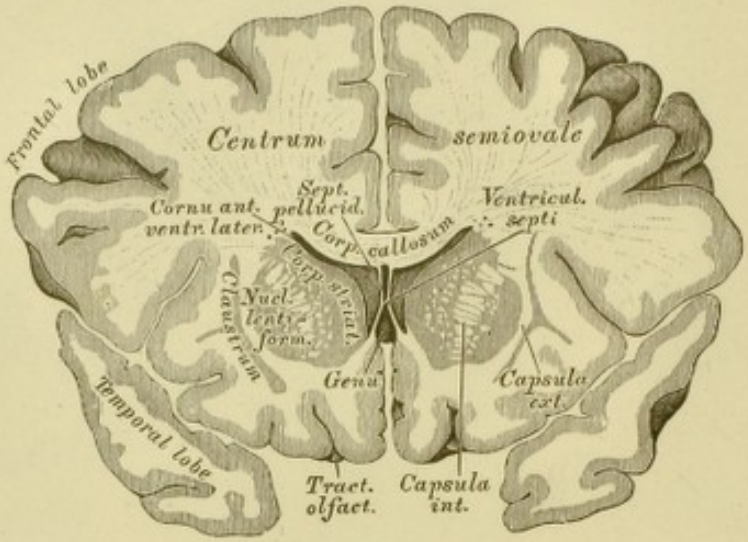
The skull-cap is removed after a circular incision has been made with the saw, between the superciliary ridges and frontal eminences and above the external occipital protuberance. The *Dura mater* is cut open lengthwise on both sides of the longitudinal sinuses, and from the middle of these sections, a transverse cut is made; it is then folded back. The *Falx cerebri* is to be separated at the *Crista galli* and laid back, and the veins opening into the longitudinal sinus must be divided. In this manner both hemispheres of the cerebrum and the great longitudinal fissure are brought into view. — The two hemispheres can be removed by horizontal sections down to the upper surface of the *Corpus callosum*.



441. Horizontal Section of the Cerebrum,

with partly opened Lateral Ventricles. $^2/_3$ natural size.

The *Corpus callosum s. Commissura maxima,* connects the two hemispheres of the cerebrum, its white substance being continuous with the internal medullary matter of both hemispheres; this large white medullary mass, surrounded by the margin of grey matter, is known as the *Tegmentum ventriculorum s. Centrum semiovale Vieussenii.* Along the middle of the upper surface of the *Corpus callosum* is a longitudinal furrow, *Raphe superior corporis callosi,* which is bounded by two, slightly elevated bands, the *Striae longitudinales Lancisii,* and crossed by transverse furrows, *Chordae transversales Willisii.* Its anterior border curves downwards and backwards to the *Tuber cinereum* and *Corpora mamillaria* at the base of the brain; in its course, it forms a distinct bend, the *Genu corporis callosi;* posteriorly, the *Corpus callosum* forms a thick rounded fold, the *Splenium s. Tuber corporis callosi.*



442. Frontal Section of the Cerebrum,

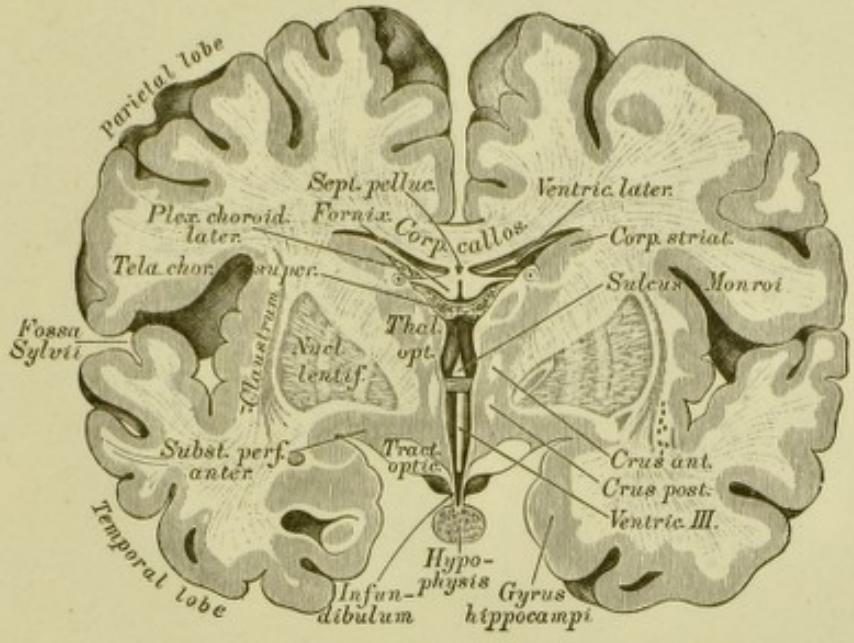
in the middle of the anterior third of the *Corpus callosum*. After C. B. Reichert. $^2/_3$ natural size.

The *Corpus callosum* roofs in the body and anterior cornu of the lateral ventricles, *Ventriculi laterales*, which are brought into view after removal of their covering. Each lateral ventricle consists of a central cavity or body, *Cella media*, and three cornua, an anterior, a posterior and an inferior or descending, which extend from it in different directions.

In the anterior cornu of the lateral ventricle are found:

a) The *Corpus striatum*, with a broad extremity directed forwards, and a narrow end directed outwards and backwards. On the outer side of the *Corpus striatum* is the lenticular or lentiform nucleus, *Nucleus lentiformis*, a biconvex grey mass, surrounded by white substance. In front and below the lenticular nucleus a rounded mass of yellowish grey matter, the *Nucleus amygdalae*, is situated, and on the outer side of the lenticular nucleus is a thin lamina of grey matter, the *Claustrum*. The white substance between the lentiform nucleus and *Corpus striatum* forms the internal capsule, *Capsula interna*, that between the lentiform nucleus and claustrum, the external capsule, *Capsula externa*.

b) The *Thalamus opticus*, situated behind the *Corpus striatum*, is composed of white substance intermixed with grey matter. Between *Corpus striatum* and optic thalamus is:



443. Frontal Section of the Cerebrum,

between anterior and middle third of the *Corpus callosum*. After C. B. Reichert. $^2/_3$ natural size.

c) The *Stria cornea*, accompanied by the *Vena terminalis*, the free margin of the *Taenia semicircularis*.

In the posterior cornu are:

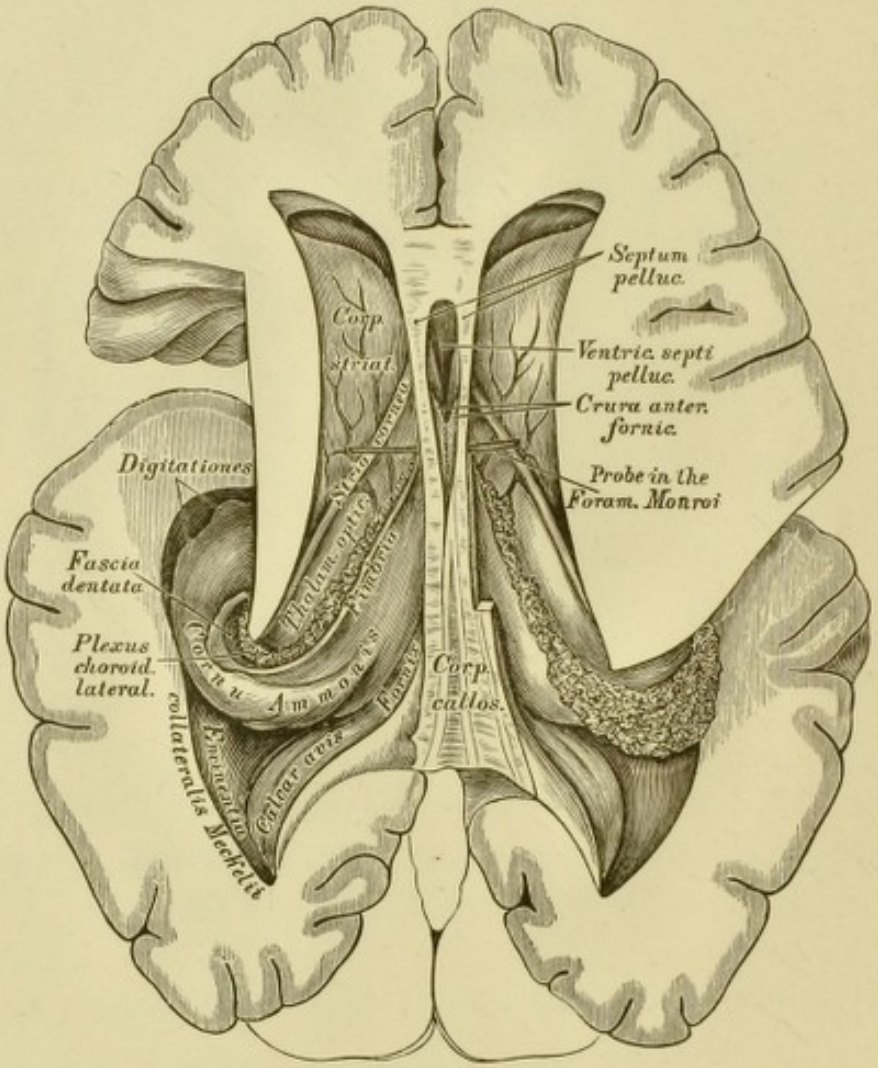
a) The *Calcar avis s. Pes hippocampi minor*, a longitudinal eminence along the inner wall of the posterior cornu. The upper wall of this cornu is called *Tapetum*.

b) The *Eminentia collateralis Meckelii s. Pes accessorius*, a smooth eminence at the junction of the posterior with the descending cornu.

In the descending cornu (see Fig. 444) are seen:

a) The *Pes hippocampi major s. Cornu Ammonis*, a curved white eminence, which surrounds the optic thalamus and cerebral peduncles, and ends at the lower extremity of the descending cornu with 3—4 digitations.

b) The *Fimbria*, a narrow white band along the concave border of the *Cornu Ammonis*, which, inferiorly is continued into a serrated band of grey substance, the *Fascia dentata*.

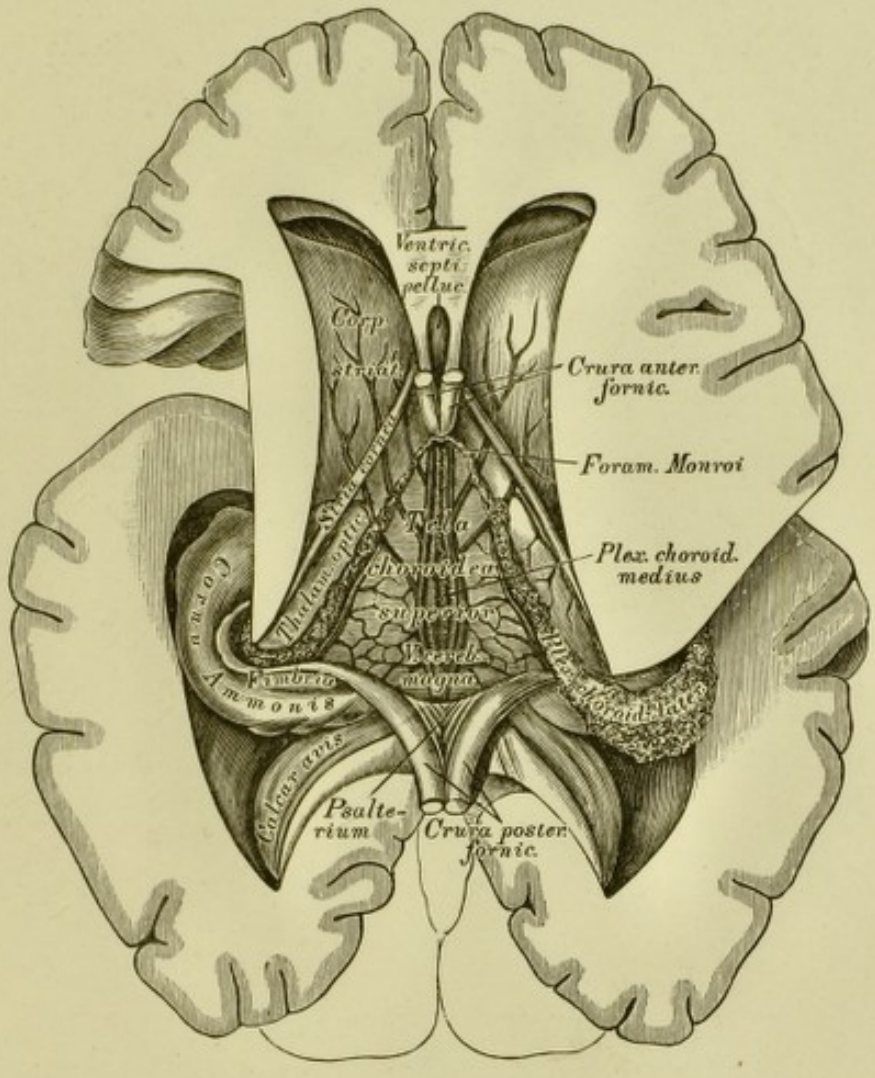


444. Horizontal Section of the Cerebrum,

the Left Lateral Ventricle being completely opened. $^2/_3$ natural size.

The *Corpus callosum* and *Fornix tricuspidalis*, which lies below it, form the roof of the third ventricle. Upon lifting up of the *Corpus callosum*, the triangular *Septum lucidum* is found between its anterior half and the fornix; it is a thin, semi-transparent septum, placed between the anterior cornua of the two lateral ventricles; it is composed of two lamina having an interval between them, the fifth ventricle or *Ventriculus septi pellucidi*. The posterior half of the *Corpus callosum* is in immediate contact with the fornix.

The *Fornix* is an arched longitudinal white commissure lying between the two optic thalami; it consists of two lateral halves, which are separated from each other in front and behind, forming the anterior and posterior pillars or crura. The anterior pillars, *Crura anteriora (Columnae) fornicis*, cylindrical in form, can be traced downwards in front of the optic thalami, curve backwards to the *Corpora albicantia s. Corpora mammillaria*, and from there they can be traced upwards again into the substance of the optic thalami. The interval between the anterior pillar of the fornix and the anterior part of the optic thalamus on each side, is called the *Foramen Monroi*.

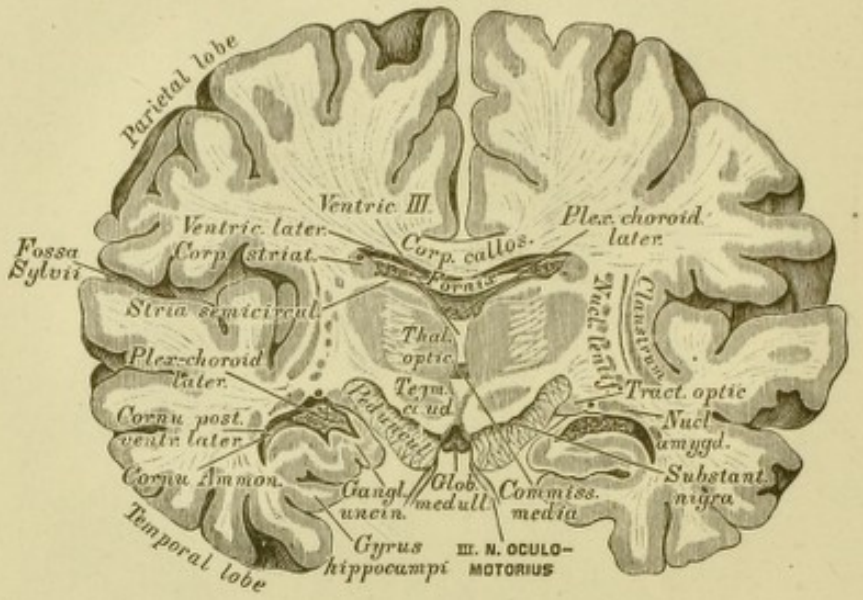


445. Horizontal Section of the Cerebrum,

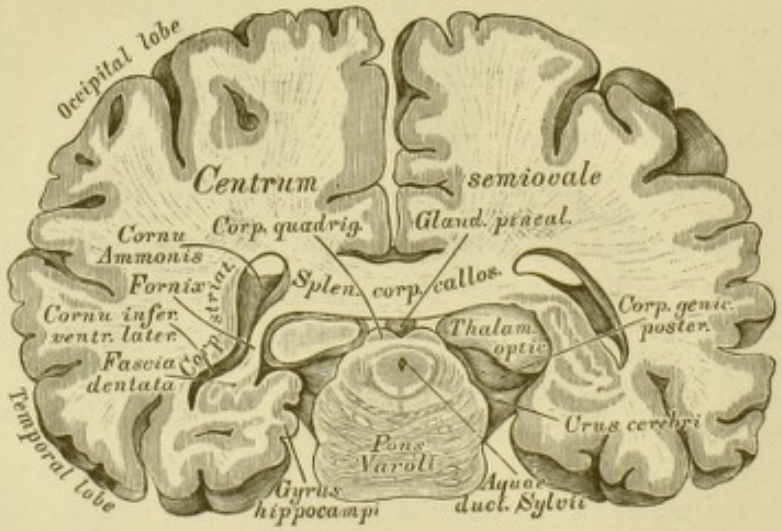
with a view of the *Tela choroidea superior*. $^2/_3$ natural size.

Between the two posterior pillars of the fornix, *Crura posteriora fornicis*, is a triangular portion, which is covered by the under surface of the *Corpus callosum;* this part of the *Corpus callosum* is marked by transverse, longitudinal and oblique lines and is called *Lyra Davidis* or *Psalterium*. The posterior pillars of the fornix are continued on into the fimbria.

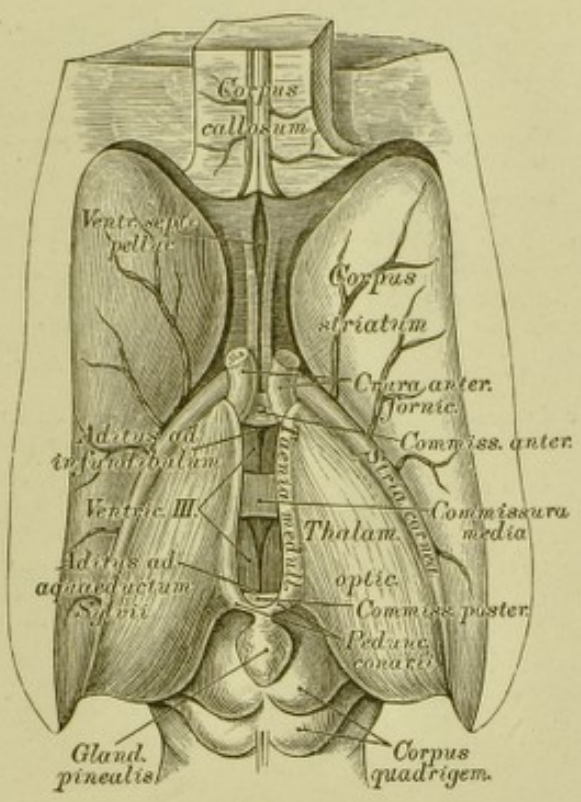
The *Tela choroidea superior* or *Velum interpositum* is a prolongation of the pia mater; it is a vascular membrane and can be exposed to view after dividing the fornix and turning aside its two halves; it has small branches of the *Art. profunda cerebri,* and in its center two venous trunks, which flow backwards to the single *Vena cerebri magna*. In it are further found two vascular fringes, the choroid plexuses, *Plexus choroidei*, which at first lie together *(Plexus choroideus medius)*, and then pass through the foramen of Monro into the lateral ventricles, *Plexus choroidei laterales*.



446. Frontal Section of the Cerebrum, in the middle of the *Corpus callosum*. After C. B. Reichert. $^2/_3$ natural size.



447. Oblique Section of the Cerebrum and *Pons Varolii*, through the Vertex towards the posterior end of the body of the Sphenoid Bone. After C. B. Reichert. $^2/_3$ natural size.

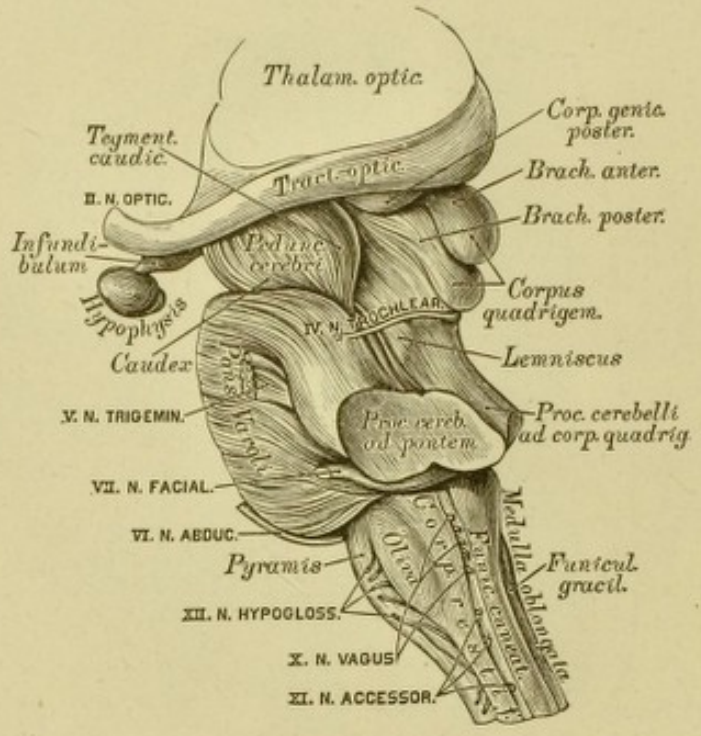


448. The Third Ventricle, laid open.

View from above, natural size.

After removing the *Tela choroidea superior (s. Velum interpositum)*, and pushing apart the inner surfaces of both optic thalami, the third ventricle, *Ventriculus medius s. tertius* is laid open to view. It is bounded by six walls: an upper, the *Tela choroidea superior;* two lateral, the inner surfaces of both optic thalami; a lower, corresponding to the middle of the base of the brain; an anterior, formed by the anterior pillars of the fornix, and a posterior, formed by the *Corpus quadrigeminum*. The lateral walls are connected by three commissures; the anterior commissure, *Commissura anterior*, in front of the anterior crura of the fornix, the posterior commissure, *Commissura posterior*, in front of the *Corpus quadrigeminum*, and the middle commissure, *Commissura media s. mollis*, which connects the grey portions of the inner surfaces of both optic thalami (sometimes wanting).

Beneath the anterior commissure is the *Iter s. Aditus ad infundibulum*, and beneath the posterior commissure, the *Aditus ad aquaeductum Sylvii*, which latter, situated below the *Corpus quadrigeminum*, connects the third and fourth ventricles.



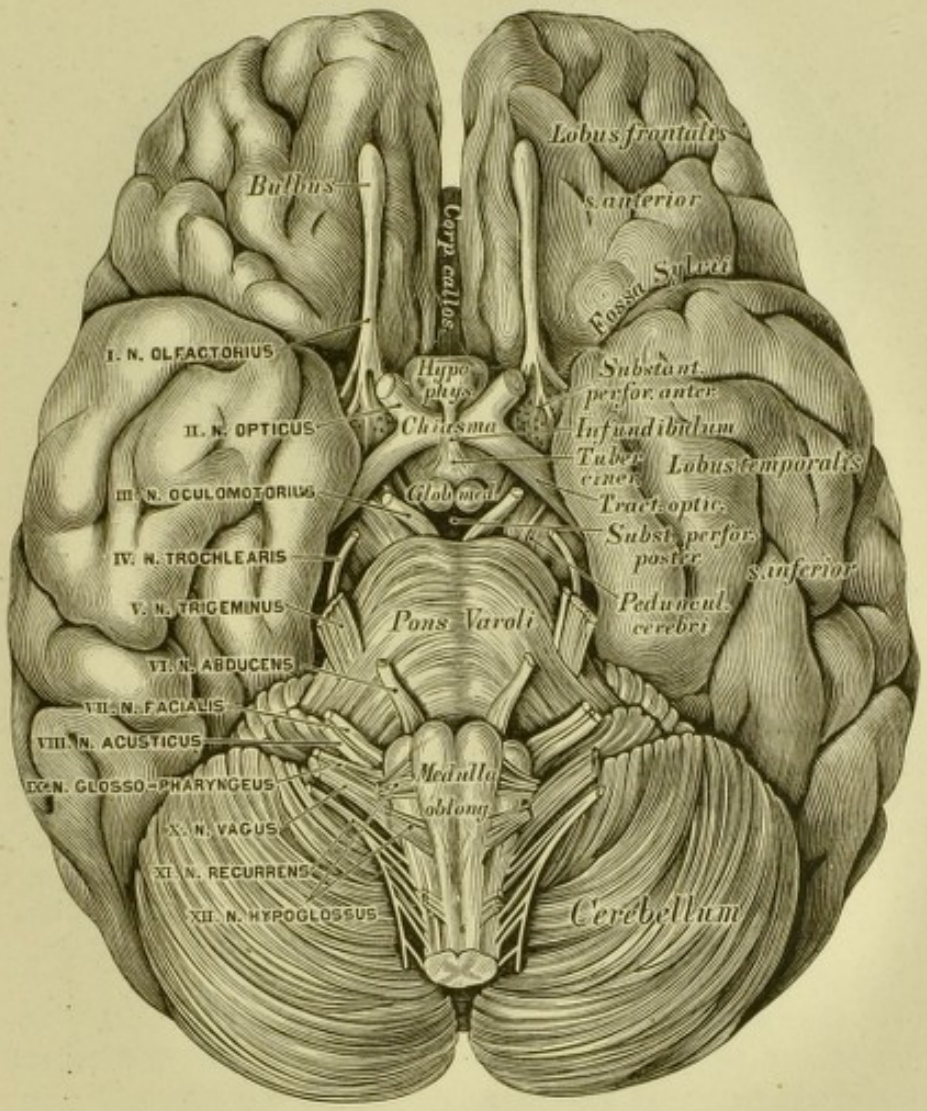
449. Lateral View of the *Pons Varolii* and the *Medulla Oblongata.* Natural size.

The *Corpora quadrigemina* are situated immediately behind the third ventricle and posterior commissure; they are two pairs of rounded eminences, the anterior, larger, being called the nates, the posterior, smaller, the testes.

Laterally the eminences are prolonged into prominent white tracts, the *Brachia corporis quadrigemini,* of which the *Brachia anteriora* on both sides are connected with the *Corpus geniculatum anticum,* and enter the optic thalami, and the *Brachia posteriora* with the *Corpus geniculatum posticum,* and partly reach the optic thalami, partly the tegmentum.

The pineal gland, *Glandula pinealis s. Penis cerebri s. Conarium,* consisting mostly of grey matter, lies upon the anterior eminences of the *Corpus quadrigeminum,* the nates; it sometimes contains the *Ventriculus conarii.* The peduncles, *Pedunculi conarii,* arise from the anterior extremity of the pineal gland; they pass forwards and downwards upon the inner margin of the optic thalami, to the anterior pillars of the fornix, as *Taeniae medullares* (see Fig. 448).

Above the *Corpora quadrigemina* is the *Splenium corporis callosi* (see Fig. 447), and between the two, the transverse fissure of the cerebrum; through this fissure the pia mater passes inwards into the third ventricle, as *Tela choroidea media;* the fissure is prolonged along the *Pes hippocampi major (Cornu ammonis)* to the base of the lower cornu and contains a continuation of the pia mater to the *Plexus choroideus lateralis.*



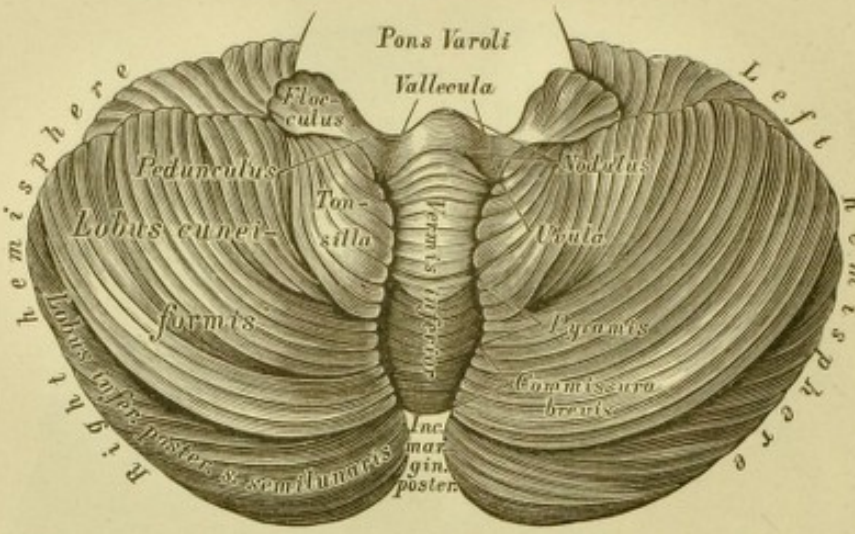
450. Base of the Brain, view from below.

$^2/_3$ natural size.

After separation of the tentorium from the pyramids of the petrous bones, and cutting through the origins of the cranial nerves, the *Medulla oblongata* and the vertebral arteries, the whole brain is taken out of the cranial cavity and turned about, and thereby the base of the brain is brought to view. Here are seen:

a) The anterior perforated space, *Substantia perforata anterior*, which consists chiefly of grey matter; it is divided into a middle and two lateral spaces, which serve for the transmission of bloodvessels. In front of the lateral portions a pyramidal grey eminence, the *Trigonium olfactorium* lies; it is prolonged into the *Nervus olfactorius*.

b) The optic commissure or *Chiasma nervorum opticorum*, is formed by the two optic tracts, *Tractus optici*, which wind across the under surface of the *Pedunculi s. Crura cerebri;* from the chiasma, the round optic nerves, *Nervi optici*, arise.



451. The Cerebellum, view from below. Natural size.

At the base of the brain (Fig. 450) there are further seen:

c) The *Tuber cinereum* and the *Infundibulum*. The *Tuber cinereum* is situated behind the chiasma and forms part of the floor of the third ventricle. From the middle of its under surface a hollow conical process, the *Infundibulum*, is continued downwards and forwards.

d) The pituitary body or *Hypophysis cerebri*, situated in the *Sella turcica*. It is a small vascular mass, consisting of an anterior and a posterior lobe, which are separated from one another by a fibrous lamina.

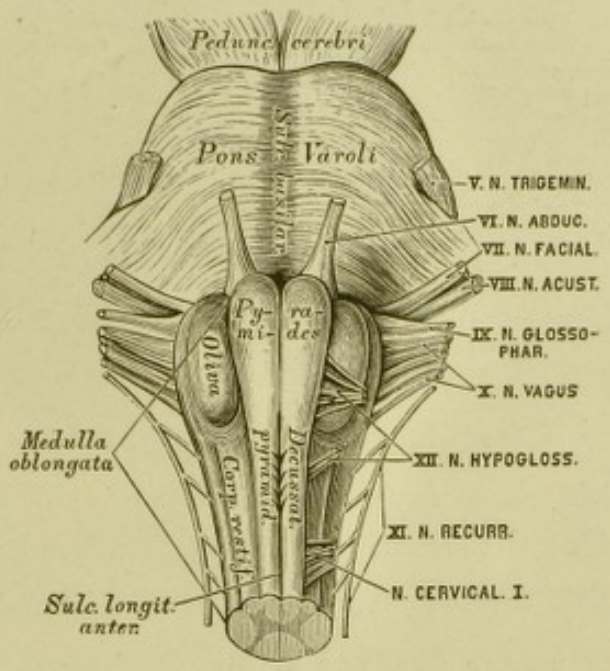
e) The *Corpora albicantia* or *mammillaria s. Globuli medullares*, two small, round, white masses, each about the size of a pea.

f) The posterior perforated space, *Substantia perforata posterior*, placed in the angle between both *Crura cerebri*, composed of grey matter, is continued anteriorly into the *Tuber cinereum*.

g) The *Crura cerebri s. Pedunculi cerebri*, two thick, cylindrical bundles of white matter, which emerge from the anterior border of the pons, and diverge as they pass forwards and outwards to enter the under part of either hemisphere. In a transverse section, each *Crus cerebri* is seen to consist of a lower, flat bundle of fibres, the proper *Pedunculus s. Caudex*, which is hollowed out for the upper, larger bundle, the *Tegmentum caudicis*; between both is a mass of dark grey matter, the *Substantia nigra pedunculi*.

The two hemispheres of the cerebellum are connected with each other by the *Pons Varolii*, and behind the pons, between the two hemispheres of the cerebellum is the *Medulla oblongata*.

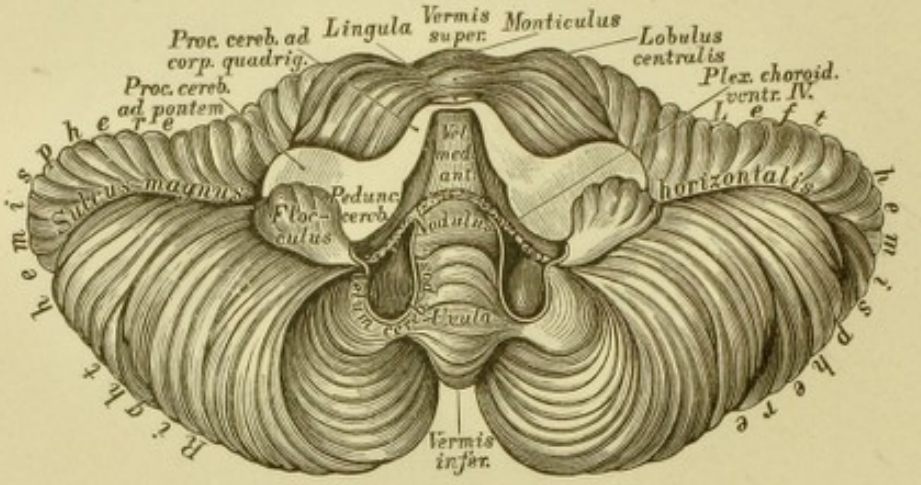
The *Pons Varolii* or *Tuber annulare* presents an under (anterior) and an upper (posterior) surface, an anterior and a posterior border. On the middle of its under surface is seen a longitudinal groove, *Sulcus basilaris*, which lodges the basilar artery. At the anterior border the *Crura cerebri* diverge; at the sides are the middle peduncles of the cerebellum or *Processus cerebelli ad pontem*, which connect the pons with the hemispheres of the cerebellum. The posterior border of the pons is in relation with the *Medulla oblongata*.



452. *Pons Varolii* and *Medulla Oblongata,* view from below. Natural size.

The *Medulla oblongata s. Bulbus medullae spinalis,* is continuous below with the spinal cord, on a level with the lower margin of the *Foramen magnum;* on each side, separated by fissures, are three columns. In the middle line, separated by the anterior longitudinal fissure, *Sulcus longitudinalis anterior,* are the two pyramids, *Pyramides;* external to these, are the olivary bodies, *Olivae,* at their sides, the restiform bodies, *Corpora restiformia,* which, because they enter the hemispheres of the cerebellum, are also called the inferior peduncles of the cerebellum. In the anterior longitudinal fissure the decussation of both pyramids, *Decussatio pyramidum,* is visible. In the substance of the olive is a white *Nucleus s. Corpus dentatum olivae,* surrounded by a grey, serrated lamina (see Fig. 462).

After removal of the *Medulla oblongata* (separation of the restiform bodies and loosening from the *Pons Varolii)* a complete view of the under surface of the cerebellum is obtained. The two hemispheres of the cerebellum are separated from each other by a deep fossa, the valley, *Vallecula Reilii.* In this fossa, the *Medulla oblongata,* just removed, was contained; the fossa ends posteriorly in the *Incisura marginalis posterior.*



453. The Cerebellum, view from before. The Tonsils completely, the Cuneiform Lobes partially removed. Natural size.

Upon the under surface of each hemisphere of the cerebellum are four lobes (see Fig. 451):

a) The inferior posterior lobe, *Lobus inferior posterior s. semilunaris;*

b) The cuneiform lobe, *Lobus cuneiformis* (this comprises the two lobes usually called digastric and slender lobes);

c) The amygdala or tonsil, *Tonsilla,* projecting into the fourth ventricle; finally

d) The *Flocculus s. Lobulus,* with the *Pedunculus flocculi,* which latter reaches down to the inferior vermiform process as posterior medullary velum, *Velum cerebelli posterius.*

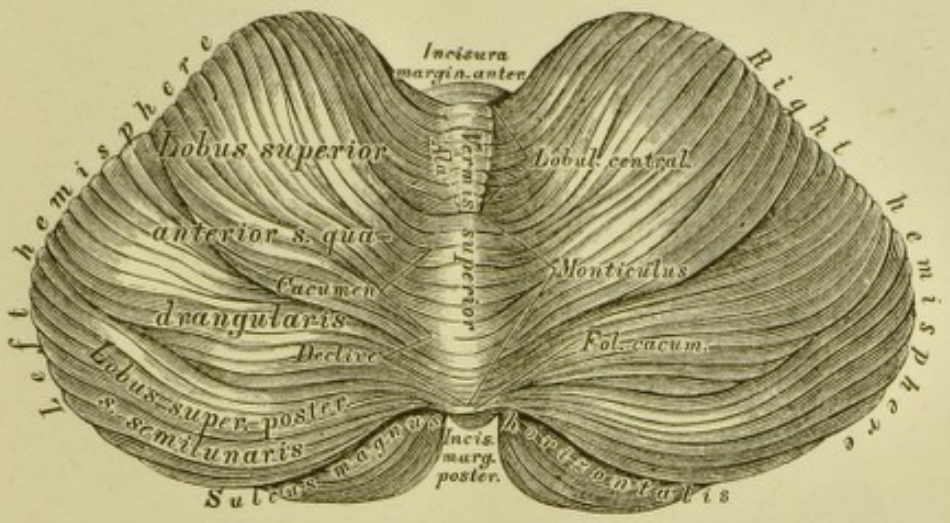
The middle portion of the cerebellum lying in the valley, is called inferior vermiform process, *Vermis inferior;* the parts entering into the composition of this body are:

a) The *Tuber valvulae* or *Commissura brevis,* uniting the inferior posterior lobes of the two sides;

b) The pyramid, connecting the digastric lobes;

c) The uvula, placed between both tonsils, and

d) The nodule, *Nodulus Malacarni,* the anterior pointed termination of the inferior vermiform process, which is connected to the peduncles of the flocculus by means of the posterior medullary velum. This velum is of a semilunar form on each side, its anterior margin being free and concave, its posterior convex margin continuous with the central white substance of the inferior vermiform process; between it and the nodule and uvula behind, is a deep fossa, called the swallow's nest.



454. The Cerebellum, view from above. Natural size.

The superior peduncles of the cerebellum, *Processus e cerebello ad testes (Processus cerebelli ad corpora quadrigemina)*, pass from the hemispheres of the cerebellum to the *Corpora quadrigemina;* they form part of the lateral boundaries of the fourth ventricle. Between the converging crura of the superior peduncles, the anterior medullary velum or valve of Vieussens, *Velum medullare anterius s. Valvula cerebelli*, is stretched, covering the canal leading from the third to the fourth ventricle (see Fig. 453).

At the upper surface, the two hemispheres of the cerebellum are connected by the superior vermiform process, *Vermis superior*, corresponding to whose anterior and posterior extremities are two notches, the *Incisura marginalis anterior* and *posterior*.

The upper surface is separated from the lower by the deep *Sulcus magnus horizontalis*. In each hemisphere there are:

a) The antero-superior or square lobe, *Lobus superior anterior s. quadrangularis*, then

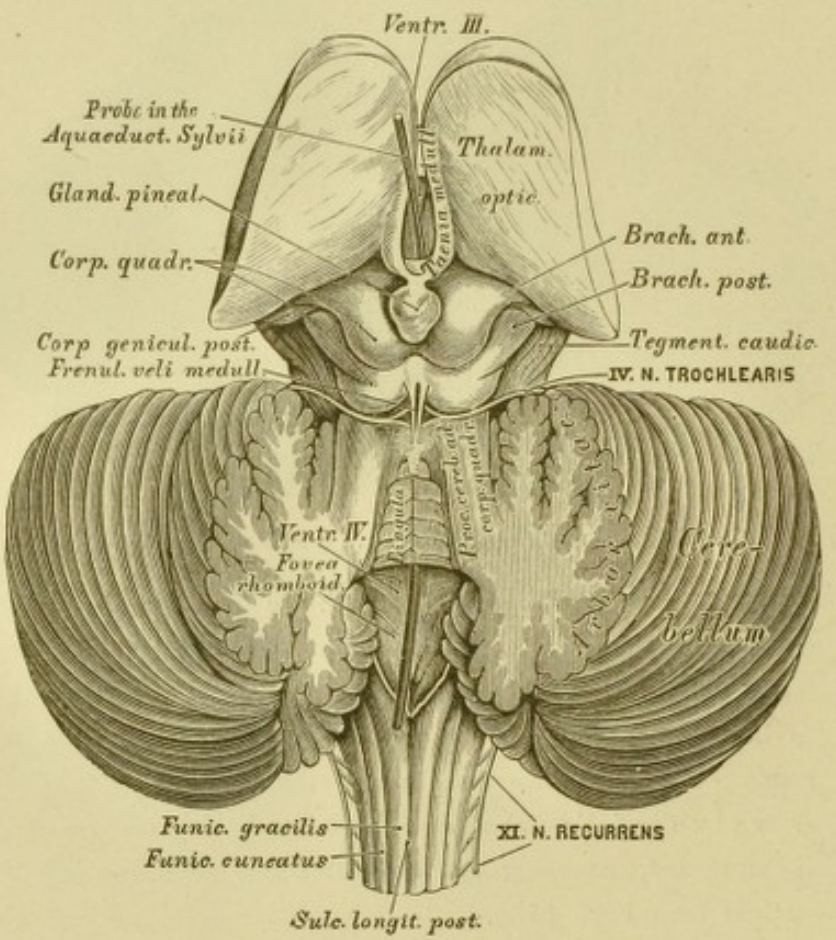
b) The postero-superior or semilunar lobe, *Lobus superior posterior s. semilunaris*.

The parallel gyri of the *Vermis superior* separate the following three structures:

a) The central lobe, *Lobulus centralis*, which has a central portion and two alae;

b) The *Monticulus*, whose highest point, *Cacumen*, is continued posteriorly into the *Declive;* a) and b) as connections of the gyri of the anterior lobe;

c) The *Folium cacuminis*, situated in the *Incisura marginalis posterior*, connecting the posterior lobes.



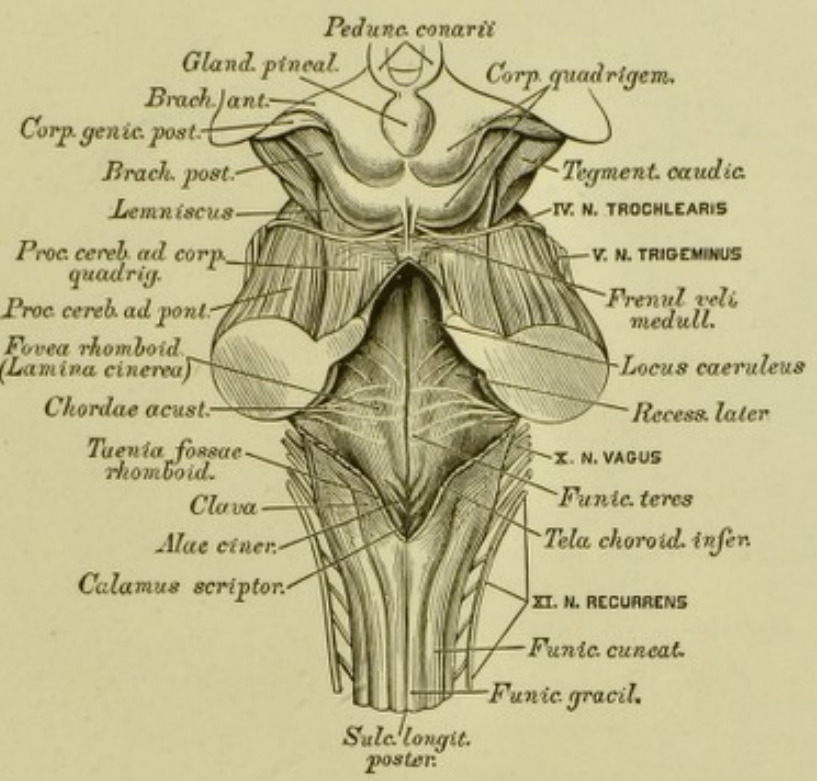
455. The Third and Fourth Ventricles of the Brain

the latter covered by the Anterior Medullary Velum. Natural size.

Below the central lobes are found the two superior peduncles of the cerebellum which run upwards and forwards towards the base of the *Corpora quadrigemina*. The anterior medullary velum is stretched between the two peduncles; its upper surface is marked by four or five transverse, grey laminae, with intervening sulci, which together constitute the *Lingula*, connected posteriorly with the central lobe. A slightly elevated ridge, the *Fraenulum veli medullaris*, descends upon the anterior part of the velum, from the median raphe of the posterior *Corpora quadrigemina;* on both sides of it may be seen the fibres of origin of the fourth nerve. Behind the *Brachium posterius* of the testes, at the side of the anterior end of the *Processus cerebelli ad corpus quadrigeminum* is found the fillet, *Lemniscus s. Laqueus* (see Fig. 456).

Sections both of the vermiform process and of the hemispheres of the cerebellum present a beautifully foliated or arborescent appearance, the *Arbor vitae vermis* and *Arbor vitae cerebelli.*

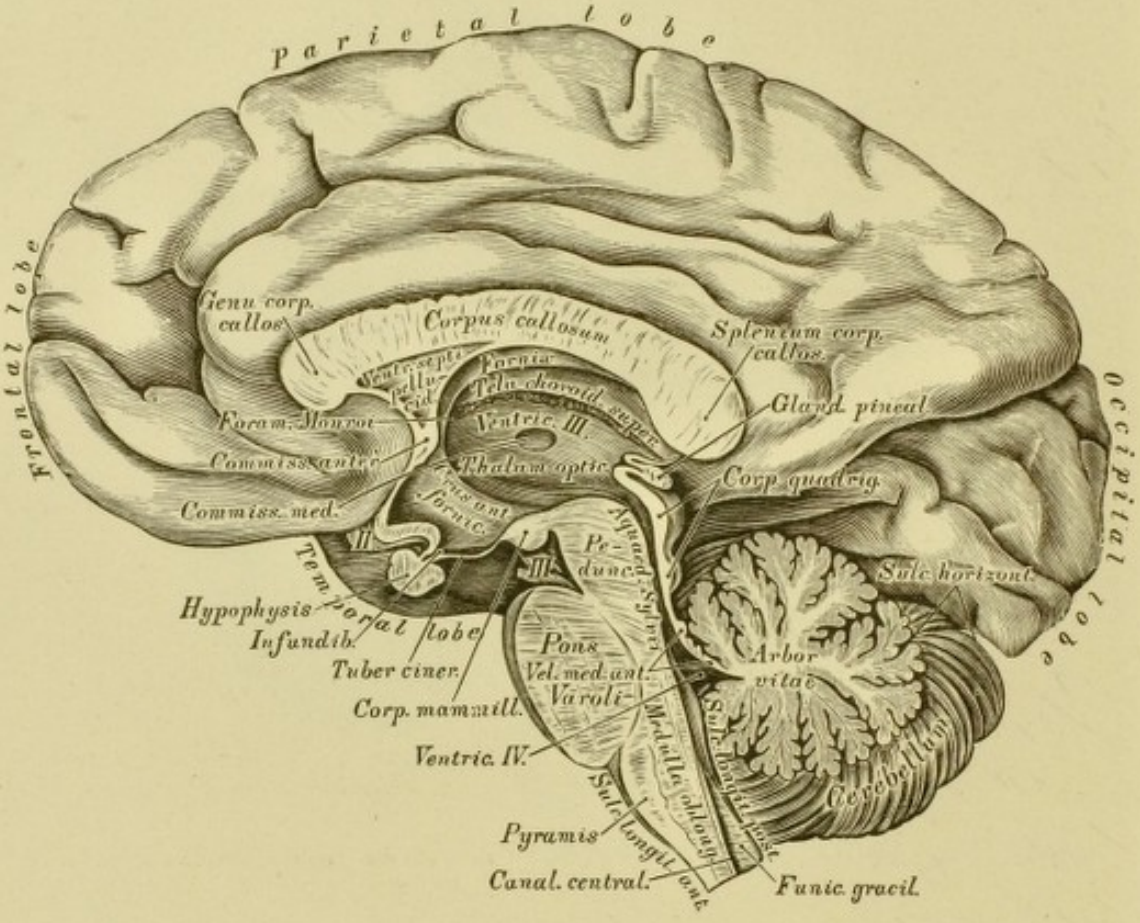
After removal of the vermiform process the upper (posterior) surface of the *Medulla oblongata*, which forms the floor of the fourth ventricle, *Ventriculus quartus*, is brought to view.



456. The Fourth Ventricle, view from above. Natural size.

The two posterior columns of the cord, which bound the posterior median fissure, are continued upwards and forwards, to reach the hemispheres of the cerebellum as restiform bodies, *Corpora restiformia;* where they enter the hemispheres, they show in section a grey nucleus, the *Tuberculum cinereum.* The posterior median fissure, *Sulcus longitudinal posterior,* diverges on each side to an angle, which is open in front, and forms with the angle of the *Processus cerebelli ad corpus quadrigeminum,* the boundary line of the *Fovea s. Fossa rhomboidea,* the floor of the fourth ventricle. The grey basal surface of the *Fovea rhomboidea* is called *Lamina cinerea foveae rhomboideae;* it is divided by a median furrow into two halves.

Where the restiform bodies begin to diverge, two narrow white cords, the *Funiculi graciles* are placed between them; these broaden out at the posterior angle of the *Fovea rhomboidea* into an expansion, the *Clava.* That part of the restiform bodies lying just outside to the *Funiculi graciles,* is called the *Funiculus cuneatus.* At both sides of the median raphé of the *Fovea rhomboidea* are the *Funiculi teretes;* these are covered posteriorly by the grey *Alae cinereae.*

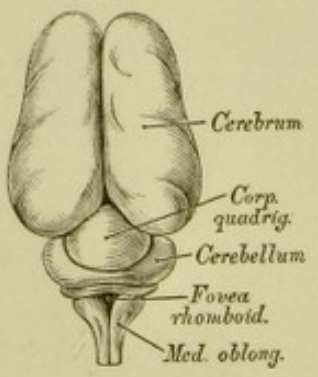


457. Sagittal Median Section of the Cerebrum, Cerebellum and *Medulla Oblongata*. $^2/_3$ natural size.

In the *Lamina cinerea* white, transverse fibres, *Chordae acusticae*, are seen (see Fig. 456), and along the clavae two bands, *Taeniae fossae rhomboideae*. The posterior angle of the *Fovea rhomboidea* is called *Calamus scriptorius;* the anterior angle (covered by the anterior medullary velum) communicates through the *Aquaeductus Sylvii* with the third ventricle. The lateral angles of the *Fossa rhomboidea* form the lateral recesses, *Recessus laterales* (see Fig. 456). The *Lamina cinerea* of the *Fovea rhomboidea* presents at the place of exit of the *Processus cerebelli ad Corpus quadrigeminum* an intensely dark color — *Locus caeruleus.*

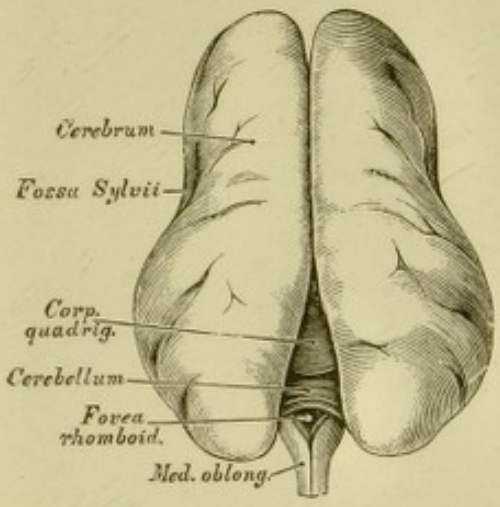
The fourth ventricle is closed posteriorly by the pia mater as *Tela choroidea inferior*, which, being fixed at the *Taeniae fossae rhomboideae*, the peduncles of the flocculus and the posterior medullary velum, forms the *Plexus choroideus ventriculi quarti.*

In transverse section of the hemispheres of the cerebellum the *Nucleus dentatus s. Corpus rhomboideum* is seen in front; it is a white nucleus with dentated borders.

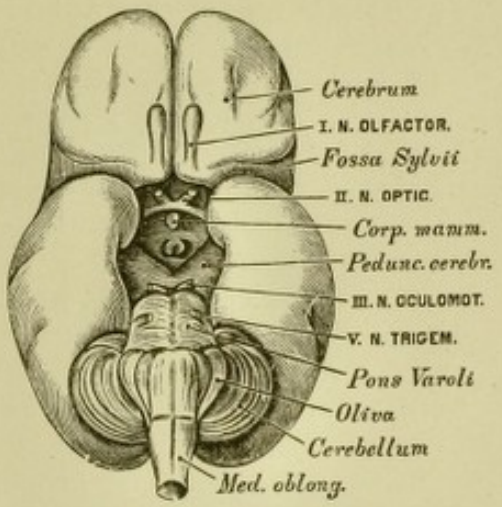


458. Brain of an Embryo of three months.
View from above.

459. Brain of an Embryo of three months.
View from below.



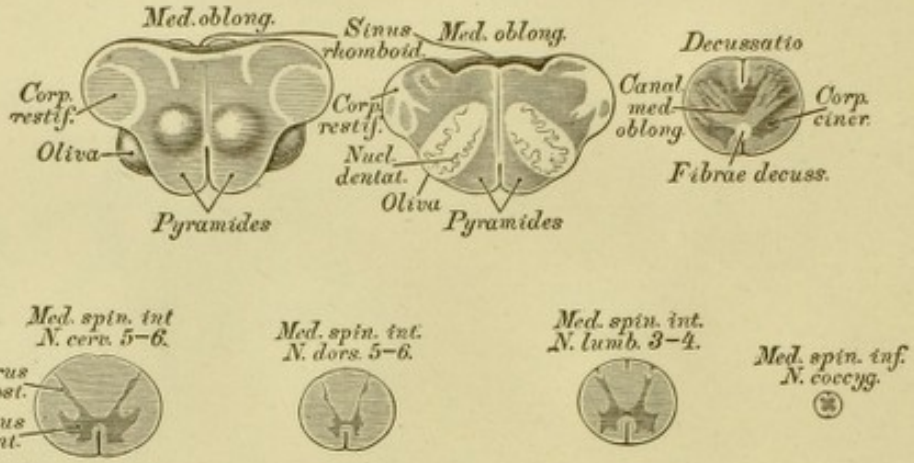
460. Brain of an Embryo of five months.
View from above.
The hemispheres of the cerebrum separated behind.



461. Brain of an Embryo of five months.
View from below.

All figures are in natural size.

The spinal cord, *Medulla spinalis*, is the cylindrical elongated part of the cerebro-spinal axis, which is contained in the vertebral canal; above, it is continued into the *Medulla oblongata*, below, it ends opposite the I. or II. lumbar vertebra as *Conus terminalis*, from which the *Filum terminale* is continued downwards to be attached with a sheath from the dura mater to the lower sacral vertebrae.



462. Transverse Sections of the *Medulla Oblongata* and Spinal Cord. After Fr. Arnold.

The spinal cord is not uniformly cylindrical, but marked by two enlargements, an upper or cervical, and a lower or lumbar, corresponding to the points of exit of the largest nerves. It is divided into two symmetrical halves, each of which consists of an external white cortex, and an internal grey nucleus; the fissures which so divide it, are on the anterior surface, along the middle line, the anterior median fissure, *Sulcus longitudinalis anterior*, and on the posterior surface, the posterior median fissure, *Sulcus longitudinalis posterior;* the anterior median fissure is marked along the whole length of the cord, the posterior, well marked only at the cervical portion and *Conus terminalis*.

The two parts of the central grey nucleus are united by the middle grey commissure, in front of it the two halves of the external white substance by the anterior white commissure; between these two commissures the small central canal of the spinal cord extends through the whole length of the cord. The relation of the grey nucleus to the white cortex varies in different situations; the shape of the former corresponds in general to an x with narrower posterior cornua and broader anterior cornua; the white matter increases in quantity from below upwards. The grey nucleus consists principally of multipolar ganglion cells; the white matter chiefly of longitudinal nerve fibres, with the transverse fibres of the roots of the spinal nerves.

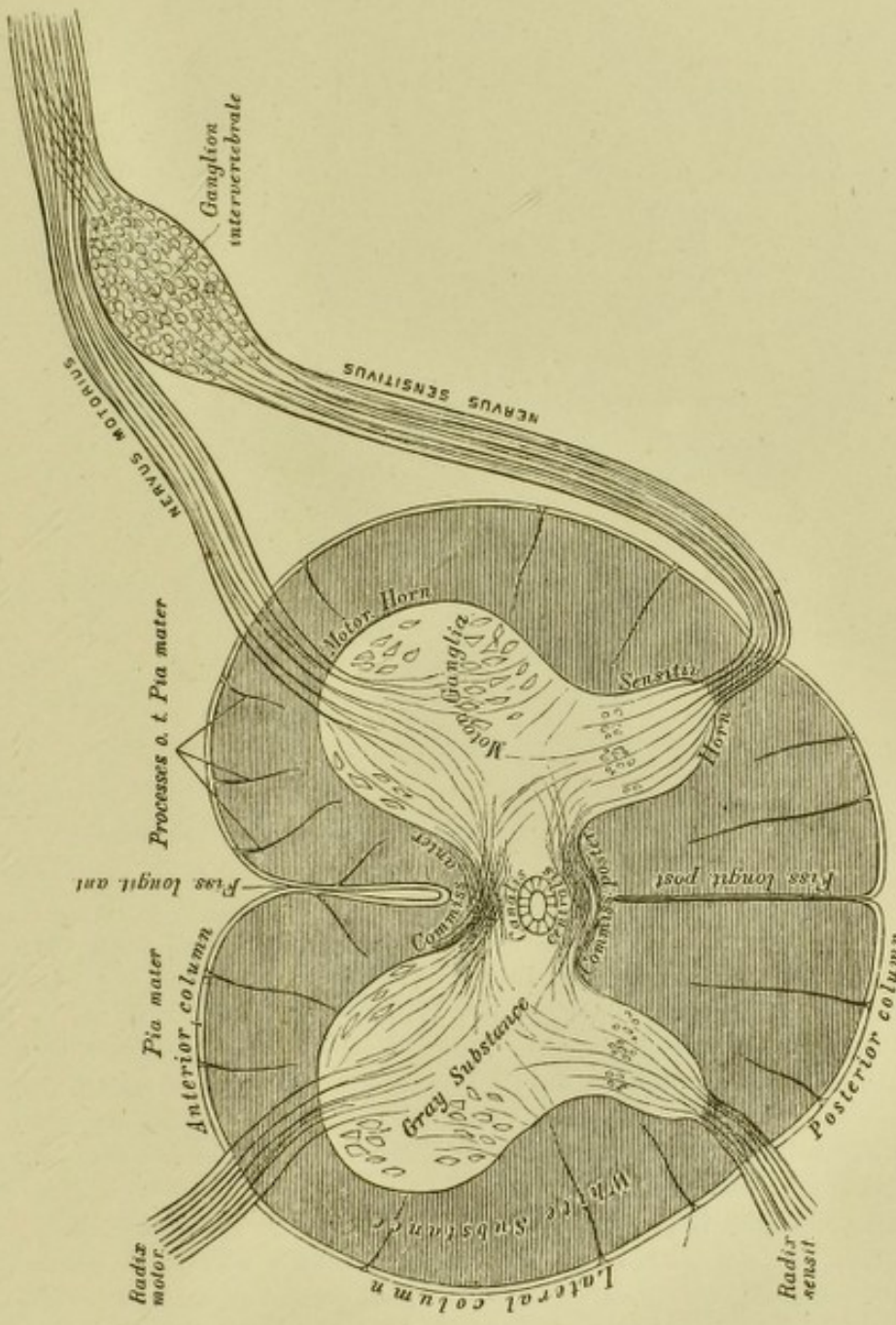
The longitudinal fibres form six columns, separated by shallow fissures; they are:

Two anterior columns, on both sides of the anterior median fissure;

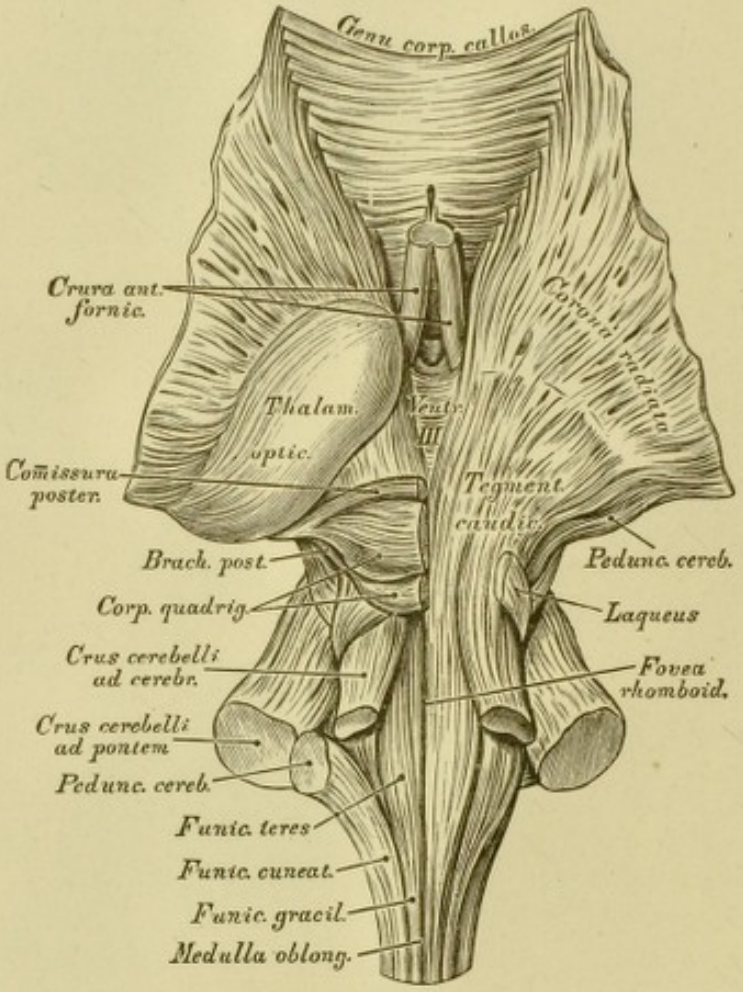
Two lateral columns, between the origins of the anterior and posterior roots of the spinal nerves;

Two posterior columns, on both sides of the posterior median fissure;

Opposite the uppermost cervical vertebrae, the pyramidal columns, which take part in the decussation, are found between the anterior columns; between the posterior columns are found the *Funiculi graciles*, which form with the cuneate funiculi the restiform bodies.



463. Diagram of the Direction of the Nerve Fibres in the Spinal Cord.



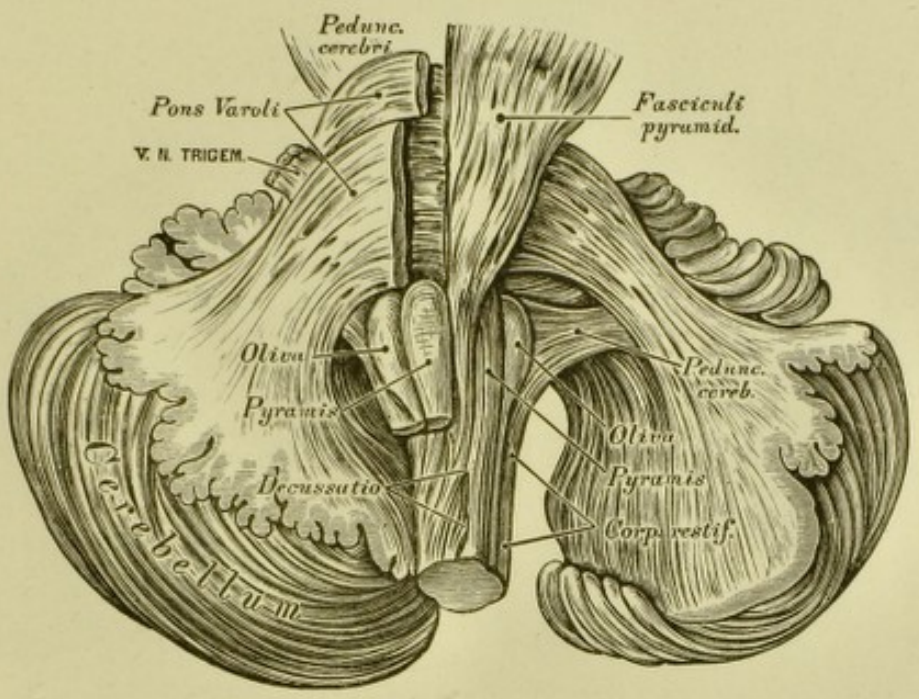
464. The Fibres of the *Truncus Cerebri.**

View from above. Natural size.

The grey substance of the brain and spinal cord consists principally of ganglion cells. In the spinal cord it forms the nucleus, is continued along the floor of the III. and IV. ventricles up to the *Tuber cinereum* and *Infundibulum*, forms a layer on the convolutions of the cerebrum and cerebellum, finally separate grey masses so-called nuclei; such nuclei are the grey masses of the olivary bodies, of the hemispheres of the cerebellum, the *Corpora quadrigemina*, the optic thalami and *Corpora striata*, the *Pons Varolii*, then the *Tuber cinereum* of the restiform bodies, the lenticular nucleus, the claustrum and amygdalae of the cerebrum.

The three pairs of columns of the cord are continued into the *Medulla oblongata* as pyramids, olivary bodies and restiform bodies, the lateral columns becoming the pyramids, the anterior the olivary bodies, and the posterior the restiform bodies. The pyramids are continued upwards into the *Pedunculi cerebri*, the olivary bodies run to the *Corpus quadrigeminum* and the restiform bodies form the *Pedunculi cerebelli*.

* See note, page 122.



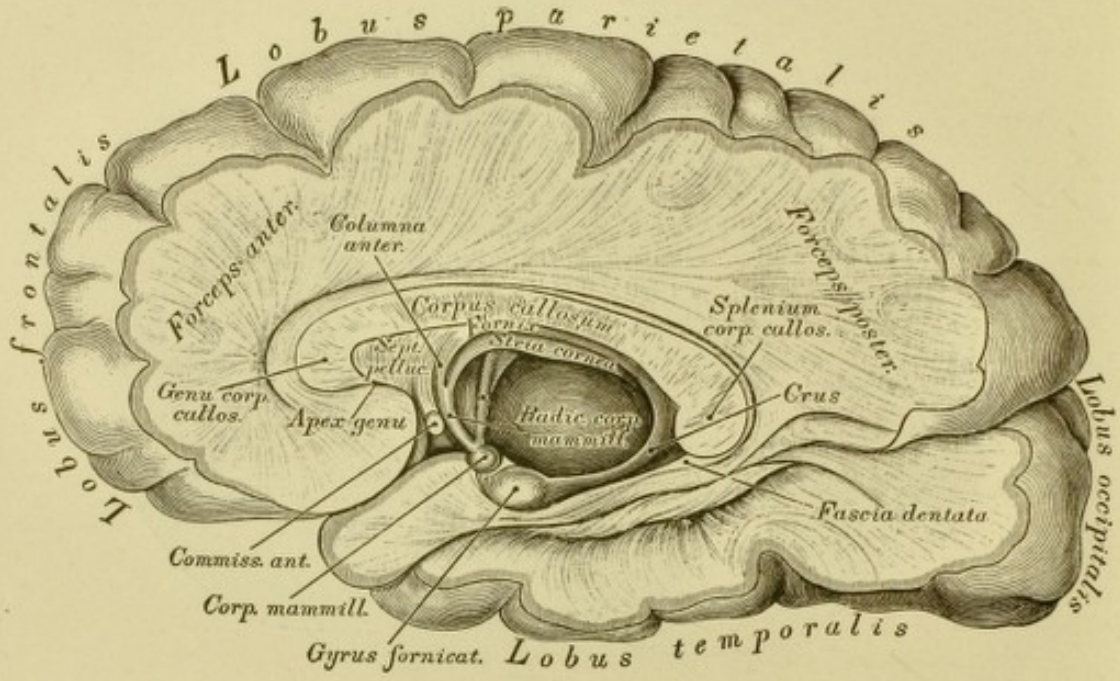
465. The Fibres of the *Truncus Cerebri.**

View from below. Natural size.

The fibres of the posterior column of the cord are continued partly into the restiform bodies, partly into the tegmentum; those of the lateral column are grouped into three bundles, of which the posterior helps to form the restiform body, while the middle forms the *Funiculus teres*, and together with the *Crus cerebelli ad cerebrum (ad Corpus quadrigeminum)* the base of the tegmentum, and the anterior becomes the pyramid. The anterior column is continued to form the olivary body, and, forming the *Lemniscus*, runs to the *Corpus quadrigeminum*.

Some of the diverging fibres end in the cerebral ganglia, while others pass through and receive additional fibres from them, and, as they emerge, radiate into the anterior, middle and posterior lobes of the hemispheres; these fibres are called *Corona radiata*. The commissural fibres or commissures connect the hemispheres with each other, different parts of the same hemisphere and the cerebellum with the cerebrum. Such commissures are: between the cerebral hemispheres the *Corpus callosum*, the anterior and posterior commissures in the third ventricle; between the hemispheres of the cerebellum the *Pons Varolii*, and vermiform process; between cerebrum and cerebellum the *Crura cerebelli ad Corpora quadrigemina;* between *Corpus quadrigeminum*, tegmentum and optic thalamus the *Brachium anticum et posticum* of the *Corpus quadrigeminum*.

* See note, page 122.



466. The Fibres of the *Pallium Cerebri.**

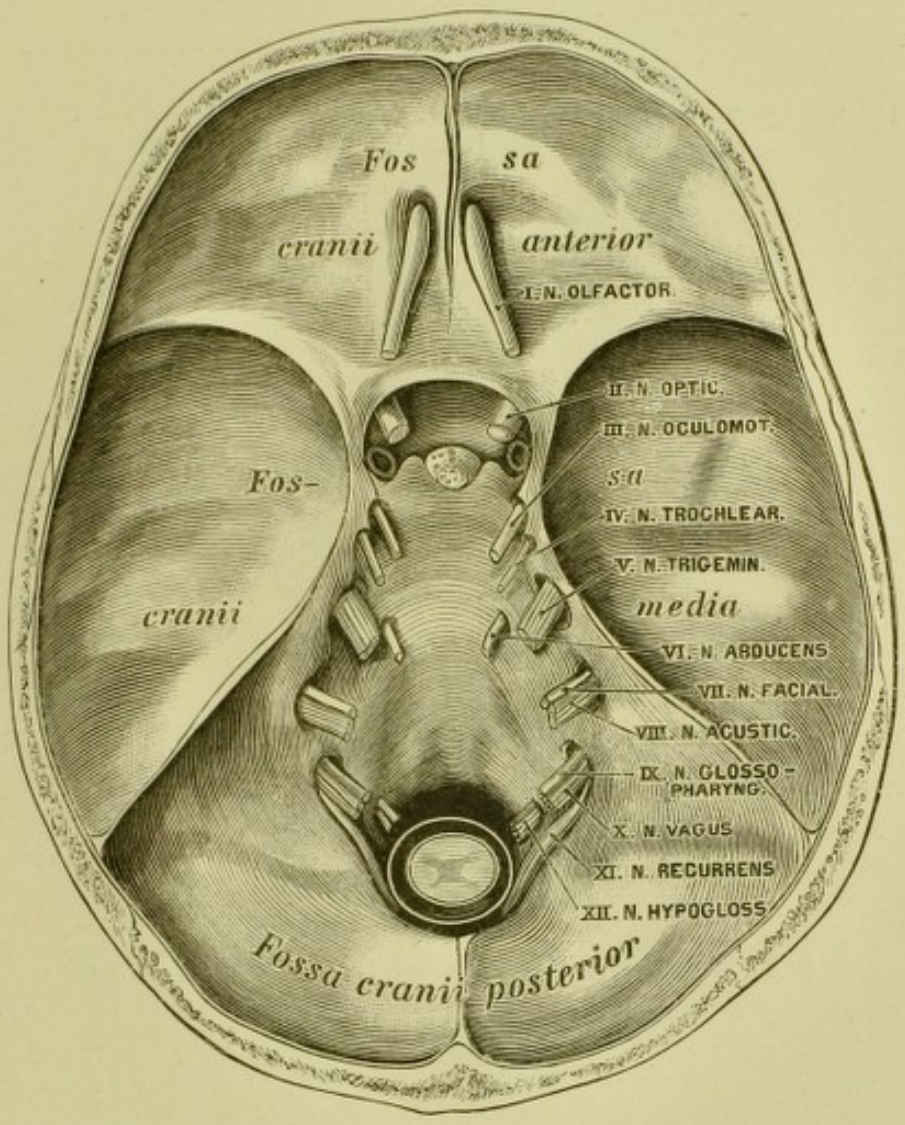
$^2/_3$ natural size.

From the *Corpus callosum* the fibres pass outwards on both sides into the cerebral hemispheres; the fibres which curve backwards into the posterior lobes are called the *Forceps posterior*, those which curve forwards and inwards to the anterior lobe, *Forceps anterior*, finally those which help to form the covering of the posterior and inferior horn of the lateral ventricles, the *Tapetum*.

The upper surface of the pallium contains the convolutions enumerated above, and is covered by a layer of grey matter up to 2 lines in thickness. On the anterior and median portions of the hemispheres is a deep notch, the *Incisura pallii*, whose floor is formed by the *Corpus callosum*, and its lateral walls by the inner surfaces of the anterior and upper lobes. Another deep notch is the Sylvian fissure, which divides the inferior lobe from the anterior and upper lobes; in it most of the arterial branches are found.

Fig. 464, 465 and 466 are drawn from alcohol specimens and with the aid of Fr. Arnold's figures.

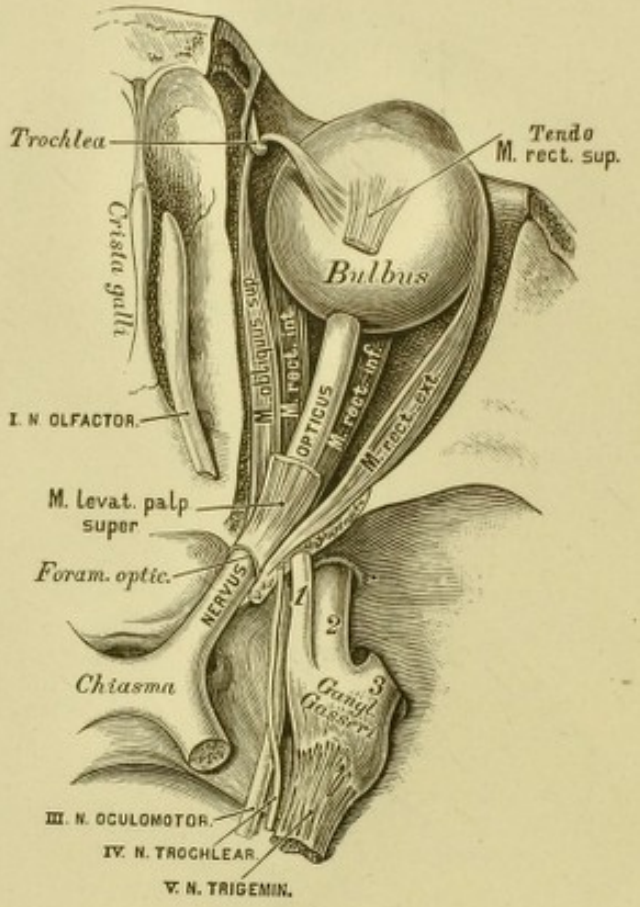
* By some German anatomists, the brain is divided into two parts: „Hirnstamm", *Truncus cerebri*, and „Hirnmantel", *Pallium cerebri*, i. e. the cerebral hemispheres. The former comprises the peduncles of the cerebrum and cerebellum and the tegmentum, the latter, the *Corona radiata*, commissures and convolutions.



467. The Cranial Nerves at the Base of the Skull.

$^2/_3$ natural size.

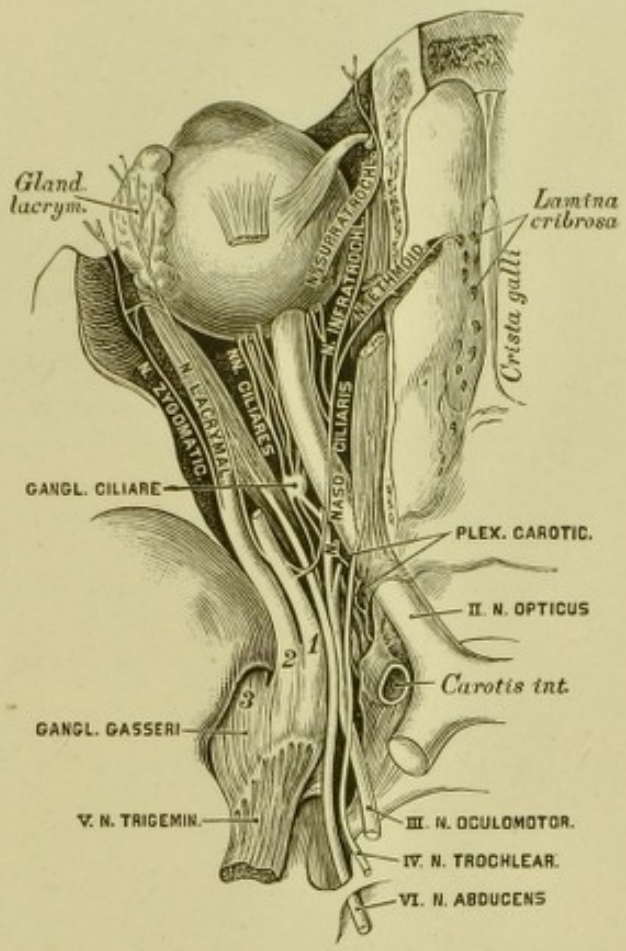
The first of the twelve pairs of cranial nerves is the olfactory, *Nervus olfactorius*. It arises at the under surface of the anterior lobe from the *Trigonum olfactorium* as a flat, prismoid band, *Tractus olfactorius*, passes forwards in a deep groove on the under surface of the anterior lobe, converging with that of the opposite side; on reaching the cribriform plate of the ethmoid bone it expands into a mass of greyish-white substance, the olfactory bulb, *Bulbus olfactorius*. From the under part of this bulb are given off two rows of filaments, about 20 in number, which pass through the cribriform foramina to the upper part of the mucous membrane of the nose. Here they form a network at the *Septum narium* and inner surfaces of the ethmoidal turbinated bones, from which very small filaments ascend to the mucous membrane. This network reaches down furthest at the *Septum narium* (see Fig. 293), at the ethmoidal labyrinth only down to the lower border of the middle turbinated bone.



468. The Olfactory and Optic Nerves.

View from above.

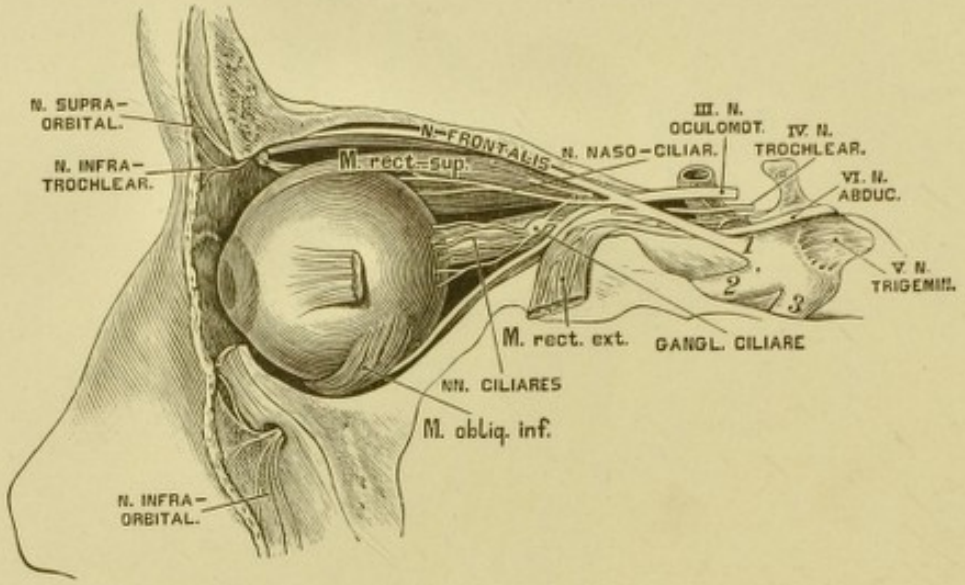
The second pair of cranial nerves is the optic nerve, *Nervus opticus;* under the name of optic tract, *Tractus opticus,* it winds obliquely across the under surface of the *Crus cerebri,* from without inwards and downwards, converging with the nerve of the opposite side, to form with it in front of the *Tuber cinereum* the chiasma or optic commissure. The greater number of the fibres of the two nerves decussate in the commissure, but some are continued from the tract to the nerve of the same side. The optic nerves, as they arise from the chiasma, are rounded cords, diverging from each other; each passes through the corresponding optic foramen of the sphenoid bone to the orbit, and continues its oblique course, inclining at the same time somewhat downwards, to the eyeball, which it enters on its posterior aspect somewhat internal to its center. Here the nerve perforates the sclerotic and choroid coats and terminates by expanding in the retina. The fibrous layer of the retina is formed by the fibres of the optic nerve (see Fig. 307). The optic nerve is surrounded by a sheath from the dura mater, which finally becomes blended with the texture of the sclerotic.



469. The Oculomotor, Trochlear and Abducent Nerves. View from above.

The third pair of cranial nerves, the oculomotor, *Nervus oculomotorius*, emerges from the *Crus cerebri* close to the *Pons Varolii*, runs obliquely forwards and outwards, and becomes imbedded in the upper wall of the cavernous sinus (here it receives some filaments from the cavernous plexus of the sympathetic nerve). It then divides into two branches which enter the orbit through the sphenoidal fissure. The smaller superior division, *Ramus superior*, supplies the *M. levator palpebrae superioris* and the *M. rectus superior;* the larger inferior, *Ramus inferior*, divides into three branches for the *M. rectus internus*, *M. rectus inferior* and *M. obliquus inferior*. From the latter, the longest branch, a short thick twig is given off to the ciliary ganglion, forming its inferior root, *Radix brevis s. motoria.*

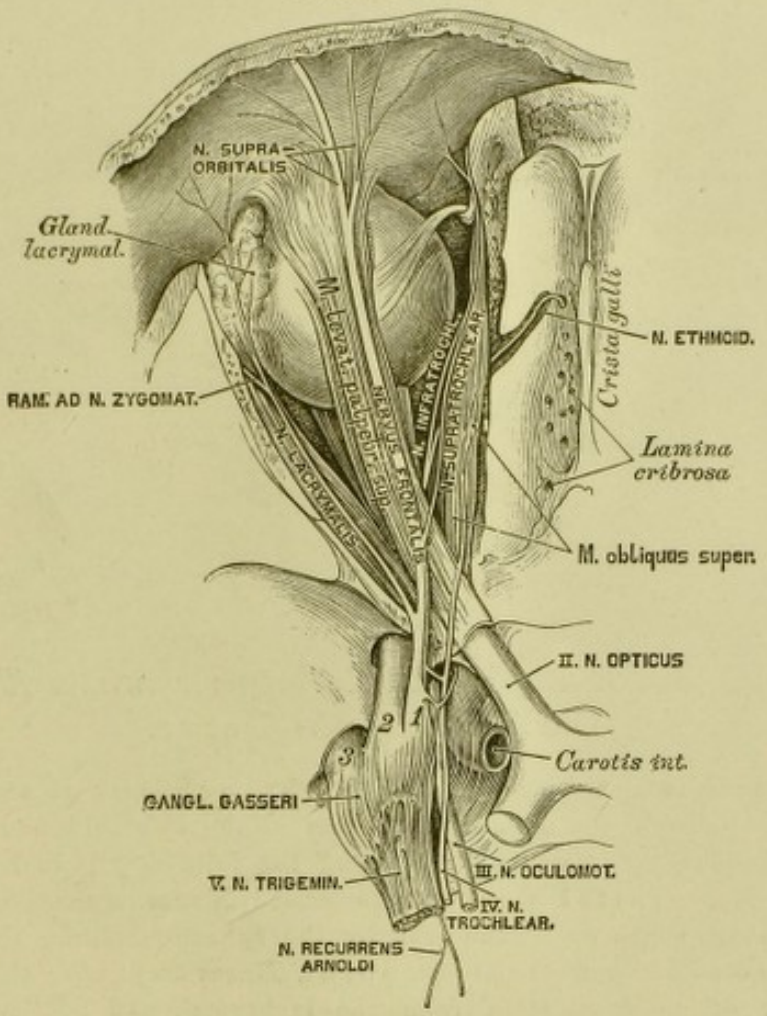
The fourth, trochlear or pathetic nerve, *Nervus trochlearis s. patheticus*, is the smallest of the cranial nerves. It arises immediately behind the *Corpus quadrigeminum*, winds around the *Processus cerebelli ad corpus quadrigeminum* and the *Pedunculus cerebri*, pierces the dura mater behind the posterior clinoid process and is here united with the ophthalmic division of the fifth nerve. It then enters the orbit through the sphenoidal fissure and passes inwards to the *M. obliquus superior.*



470. The Oculomotor, Trochlear and Abducent Nerves. View from the outside.

The sixth nerve, the abducent, *Nervus abducens*, makes its appearance at the posterior border of the *Pons Varolii*, passes forwards through the cavernous sinus, in which it lies on the outer side of the internal carotid artery *(Carotis cerebralis)*, and is joined by several filaments from the sympathetic. It then enters the orbit through the sphenoidal fissure and passes between the two heads of the *M. rectus externus*, to be distributed to the muscle, which it pierces on its ocular surface.

The fifth, trifacial or trigeminal nerve, *Nervus trigeminus*, the largest of the cranial nerves, arises by two separate roots. The larger, sensory, posterior root makes its appearance at the anterior surface of the *Crus cerebelli ad pontem;* the much smaller, motor, anterior root, between the anterior transverse fibres of the *Pons Varolii*. The two roots of the nerve pass forwards through an oval opening in the dura mater, *Cavum Meckelii*, at the superior surface of the petrous portion of the temporal bone, where the fibres of the sensory root form a large semilunar ganglion, the *Ganglion Gasseri s. semilunare*. From the convex border of this ganglion the three large branches of the trifacial nerve proceed: the I. ophthalmic branch, *Ramus ophthalmicus*, the II. superior maxillary branch, *Ramus supramaxillaris*, and the III. inferior maxillary, *Ramus inframaxillaris*.



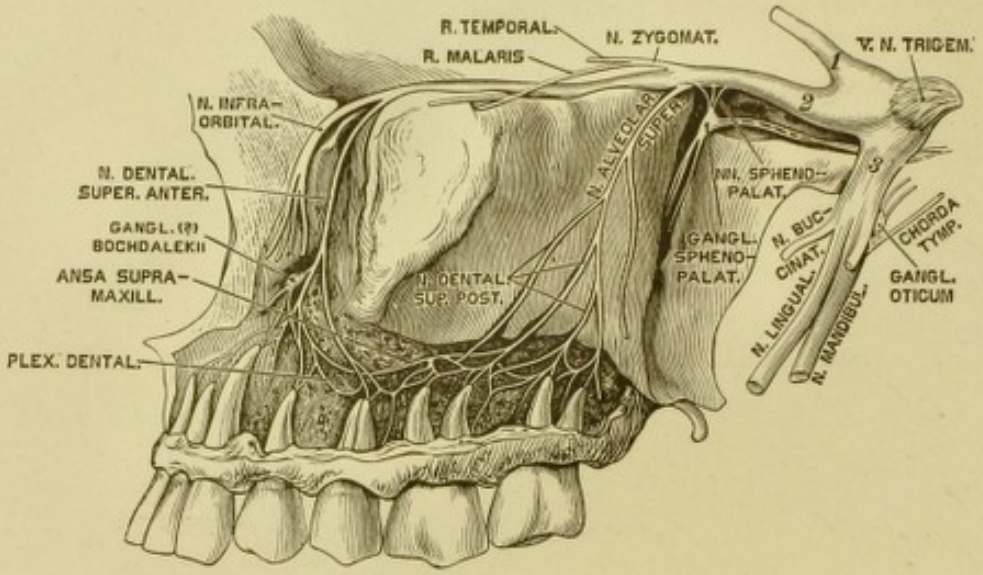
471. The First Division *(Ramus ophthalmicus)* of the Trigeminal Nerve.

The I. ophthalmic branch, the smallest of the three divisions of the fifth nerve, is a sensory nerve; it passes forwards and upwards along the outer wall of the cavernous sinus, communicates with the sympathetic nerve and *Nervus trochlearis,* and gives off a recurrent filament, *Ramus recurrens Arnoldi,* to the dura mater. Before its entrance into the sphenoidal fissure *(Fissura orbitalis superior)* it is divided into three branches; these are:

a) The lachrymal, *N. lacrymalis,* which runs along the upper border of the external rectus muscle, gives off a twig to the orbital nerve and passes to the lachrymal gland, conjunctiva and skin at the outer canthus of the eye.

b) The frontal, *N. frontalis,* situated below the roof of the orbit, divides into: the supratrochlear branch, which, running above the *M. obliquus superior,* leaves the orbit above the *Trochlea* to be distributed to the skin of the upper eyelid and the forehead; the supraorbital branch, which, usually divided into two twigs, passes through the supraorbital notch to the forehead, being distributed to the skin of the fore and upper parts of the scalp.

c) The nasal or naso-ciliary, *N. naso-ciliaris,* lies at first on the outer side of the optic nerve, passes through the origin of the external rectus muscle with the abducens nerve, forms the long root of the ciliary ganglion, *Radix longa s. sensitiva Ganglii ciliaris* (see Fig. 469), reaches the inner side of the optic nerve, giving off 1–2 ciliary nerves, and is finally divided into the ethmoidal nerve, which at first passes through the anterior ethmoidal foramen into the cranial cavity and then through the cribriform plate into the nasal cavity, supplying the *Septum narium,* external wall of nasal cavity, and finally the integument of the nose; and the infratrochlear nerve, passing below the *Trochlea* to the structures at the inner angle of the eye.



472. The Second Division *(Ramus supramaxillaris)* of the Trigeminal Nerve.

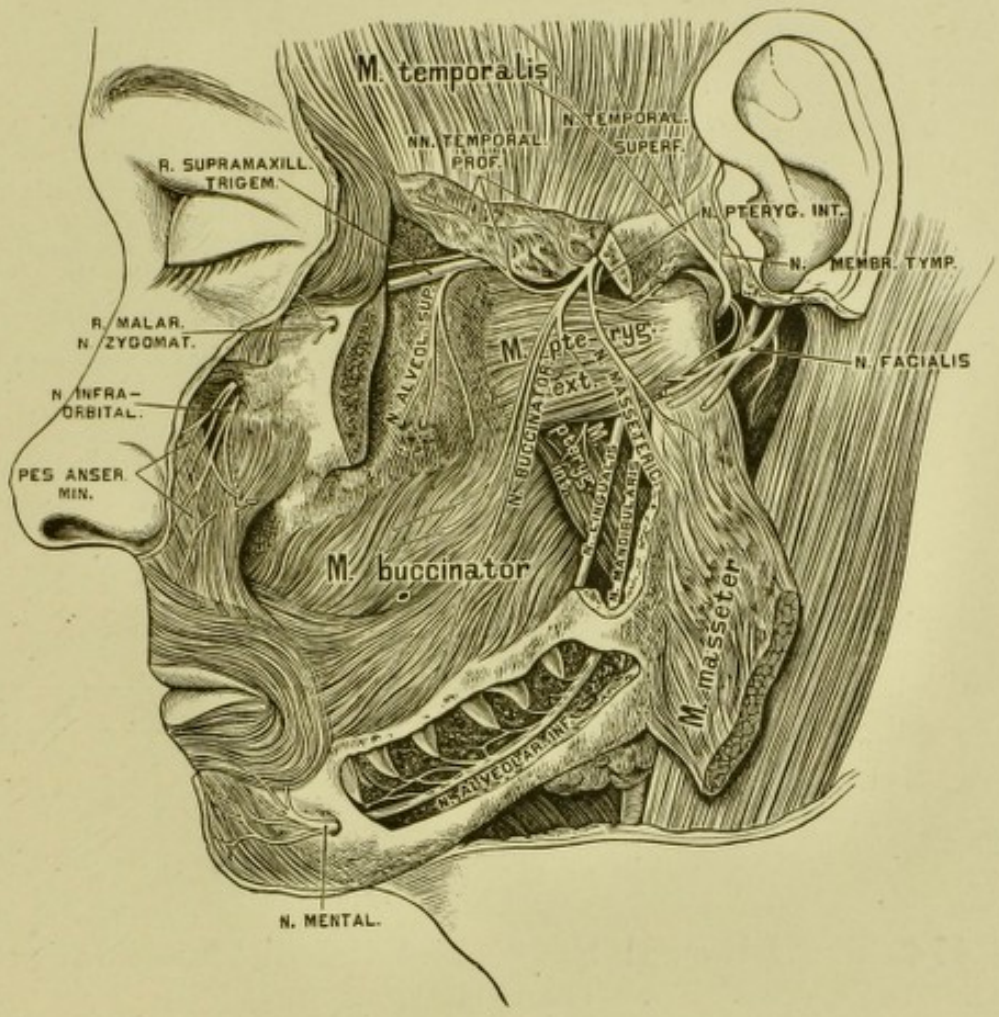
The II. superior maxillary branch, also sensory, leaves the skull through the *Foramen rotundum* of the sphenoid bone, crosses the spheno-maxillary fossa and gives off the following branches:

a) The orbital nerve, also called *Nervus zygomaticus s. subcutaneus malae*, which enters the orbit by the spheno-maxillary fissure and divides into two branches: the temporal, *Ramus temporalis;* this receives a branch of communication from the lachrymal, and passing through the *Canalis zygomaticus temporalis* enters the temporal fossa; at the anterior border of the temporal muscle it pierces the temporal fascia, and is distributed to the skin of the temple and side of the forehead; and the malar, *Ramus malaris*, which passes through the *Canalis zygomaticus facialis* to the skin of the cheek; both communicate with the *N. facialis.*

b) The superior dental or alveolar nerve, *N. alveolaris superior.* At the *Tuber maxillare* it divides into two branches, the first of which pierces the *M. buccinator* to be distributed to the mucous membrane of the mouth; the second passes through a *Foramen maxillare superius* into the upper dental canal, and runs forwards as posterior superior dental nerve to supply the mucous membrane of the antrum of Highmore and the pulp of the molar teeth. Finally it communicates with the anterior superior dental nerve.

c) The pterygo- or spheno-palatine nerves, short nerves passing to the pterygo- or spheno-palatine ganglion.

d) The infraorbital, *Nervus infraorbitalis*, is the direct continuation of the superior maxillary nerve; it passes through the infraorbital canal to the face and forms the *Pes anserinus minor*, whose twigs supply the skin of the lower eyelid, the cheek, nose and upper lip, and inosculate freely with the *N. facialis.* One branch, the anterior superior dental nerve, forms the *Ansa supramaxillaris* and the *Plexus dentalis.*



473. The Third Division *(Ramus inframaxillaris)* of the Trigeminal Nerve.

The III. inferior maxillary branch, both sensory and motor, leaves the skull through the *Foramen ovale* of the sphenoid bone and divides immediately after, into two groups.

The first, chiefly motor group divides into the following branches:

a) The masseteric, *Nervus massetericus*, passes outwards through the sigmoid notch of the lower jaw, enters the masseter and supplies it and the articulation of the jaw;

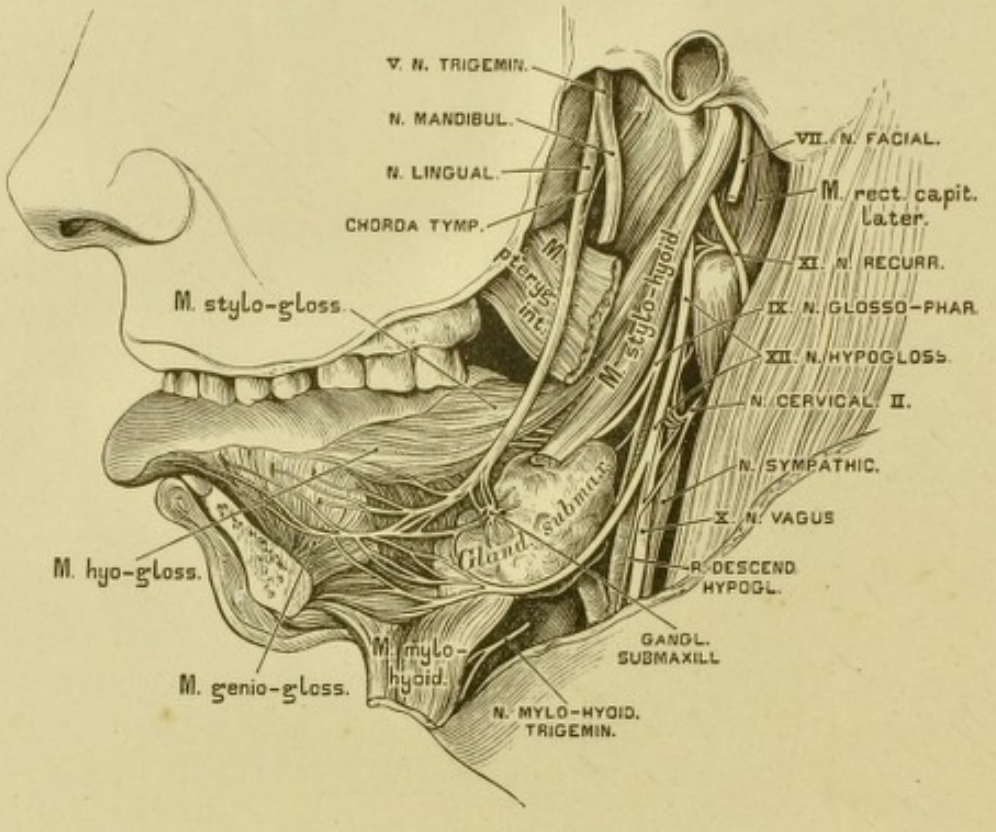
b) The deep temporal, *Nervi temporalis profundi*, to the *M. temporalis;*

c) The buccal or *Nervus buccinatorius*, to the *M. buccinator;*

d) The two pterygoid, *Nervi pterygoidei*, an internal and an external for the two *MM. pterygoidei.*

The second, chiefly sensory group, gives off the following branches:

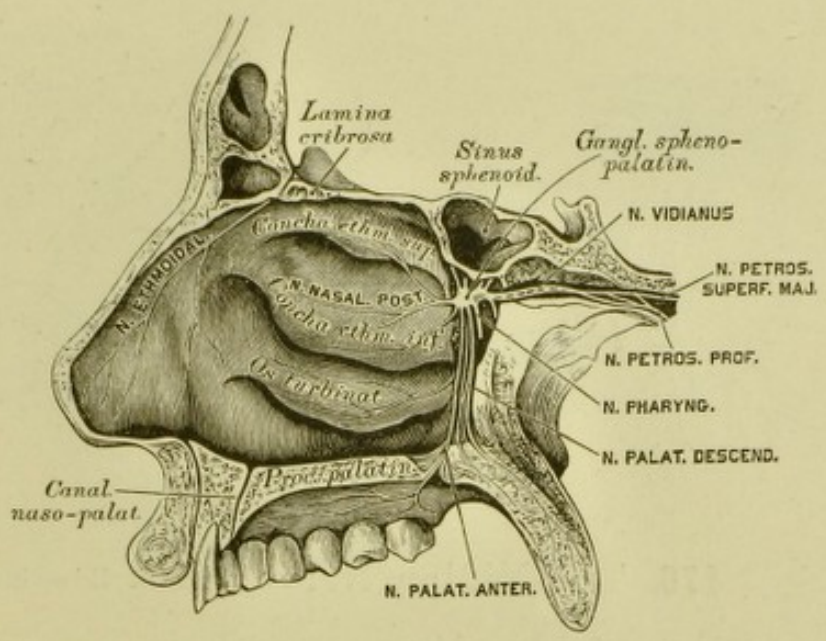
a) The auriculo-temporal, *N. auriculo-temporalis s. temporalis superficialis;* this arises by two roots, between which the middle meningeal artery *(Art. meningea media)* (see Fig. 477) passes, and divides behind the condyle of the lower jaw into two branches, the posterior for the *M. attrahens auriculae*, the skin of the auricle and partly the external auditory meatus, and the anterior for the integument of the temporal region.



474. The Lingual Nerve and the Submaxillary Ganglion.

b) The gustatory or lingual nerve, *Nervus lingualis*, unites with the *Chorda tympani* and passes with it along the outer side of the *M. stylo-glossus* and *M. hyo-glossus* obliquely forwards and downwards; it sends branches to the *Arcus palato-glossus*, to the mucous membrane at the floor of the mouth, to the submaxillary ganglion and to the sublingual gland. Finally it is divided into from eight to ten lingual or terminal branches, which perforate the muscular structure of the tongue and terminate in the papillae (with the exception of the *Papillae vallatae* and many *P. filiformes*).

c) The inferior dental nerve *s. Nervus mandibularis*, situated behind the *N. lingualis*, and connected with it by one or two filaments, passes along the outer side of the *M. pterygoideus internus* to the inner opening of the inferior dental canal; its branches are: the mylo-hyoid, *N. mylo-hyoideus*, for the mylo-hyoid muscle and anterior belly of the digastric; the dental branches which supply the molar and bicuspid teeth together with the adjoining part of the gum; the incisor branch, which supplies filaments to the canine and incisor teeth; finally the mental branch, *N. mentalis*, which emerges from the bone by the mental foramen, and supplies the integument, mucous membrane and muscles of the lower lip.



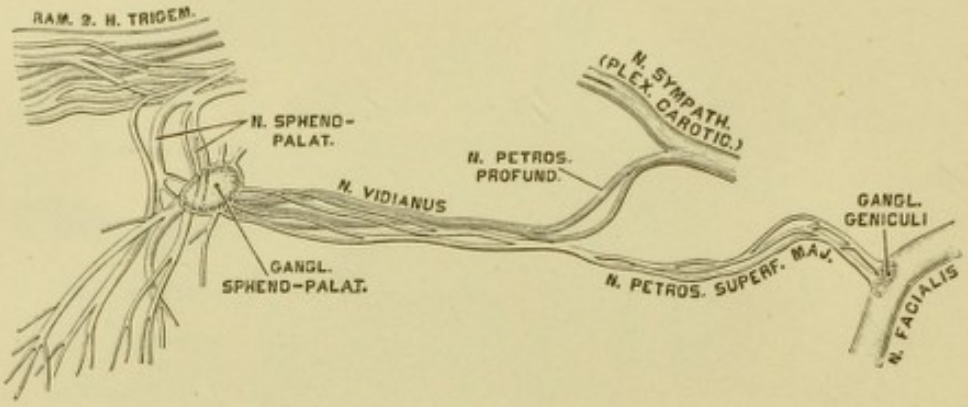
475. The Spheno-Palatine Ganglion.

The largest ganglion of the trigeminal nerve is the Gasserian or semilunar ganglion, *Ganglion Gasseri* (see Fig. 471), somewhat crescentic in shape and formed only by the posterior sensory root of the fifth nerve.

The ophthalmic, lenticular or ciliary ganglion, *Ganglion ciliare* (see Fig. 469 and 470), about the size of a pin's head, is situated in the orbit between the external rectus muscle and the optic nerve. Its roots are: the short root, *Radix brevis* (motor) derived from the oculomotor nerve; the long root, *Radix longa* (sensory) derived from the nasal nerve, and the sympathetic root, *Radix sympathica*, from the carotid plexus. From the ciliary ganglion 10—16 ciliary nerves arise; they are disposed in two bundles, which pierce the sclerotic, pass between the latter and the choroid to the ciliary muscle, and supply this muscle, the iris and cornea.

The spheno-palatine or Meckel's ganglion, *Ganglion spheno-palatinum s. pterygo-palatinum (Meckelii)*, is deeply placed in the spheno-maxillary fossa close to the spheno-palatine foramen, and is connected by a few short filaments *(Nervi spheno-palatini)* with the II. division of the trigeminus. Its branches are:

a) The ascending or orbital branches, *Ramuli orbitales*, which enter the orbit by the spheno-maxillary fissure, and supply the periosteum.



476. The Vidian Nerve after E. Bischoff.

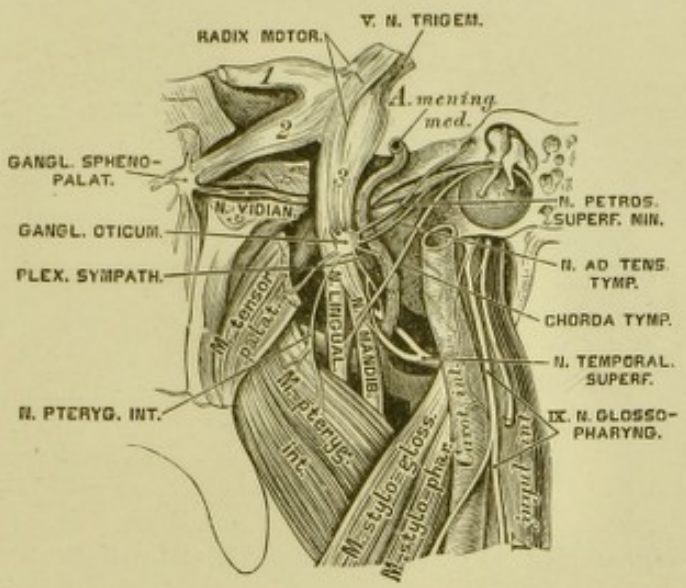
b) The Vidian nerve, *Nervus Vidianus*, consists of two bundles, composed of grey and white nerve fibres; it passes through the Vidian canal from before backwards, and divides at its posterior extremity into two. The grey bundle goes to or rather comes from the *Plexus caroticus* of the sympathetic, and is called the deep petrosal nerve, *N. petrosus profundus;* the white bundle forms the great superficial petrosal, *N. petrosus superficialis major;* this latter passes through the *Fibrocartilago basilaris* into the cranium, enters the *Hiatus canalis Fallopiae* and joins the geniculate ganglion of the facial nerve.

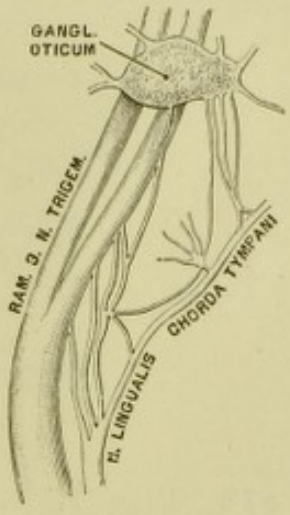
c) The pharyngeal branches, *Rami pharyngei*, to the mucous membrane of the upper portion of the pharynx.

d) The *Nervi septi narium* to the upper wall of the posterior nares and *Septum narium;* the longest of these is called naso-palatine nerve, *Nervus naso-palatinus Scarpae*, and runs along the *Septum narium* to the *Canalis naso-palatinus* and through it to the hard palate and gums of the incisor teeth.

e) The posterior nasal nerves, *Nervi nasales posteriores*, to the ethmoidal turbinated bones and the posterior parts of the outer wall of the nares.

f) The descending palatine nerves, *N. palatini descendentes*, emerge through the posterior palatine foramina, and supply the hard and soft palate, the uvula, the *M. levator palati* and *M. azygos uvulae*. The largest of them, the anterior palatine, *Nervus palatinus anterior*, emerges upon the mucous membrane of the hard palate, and finally communicates with the *N. naso-palatinus Scarpae*.





477. The Otic Ganglion. **477a.** The Otic Ganglion after Rüdinger.

The supramaxillary ganglion, *Ganglion supramaxillare (Bochdalekii)*, is illustrated in Fig. 472; it is doubtful whether this really is a ganglion.

The otic ganglion, *Ganglion oticum (Arnoldi)*, lies below the *Foramen ovale* on the inner surface of the inferior maxillary nerve, connected with the nerve by a few filaments; it is pierced by the internal pterygoid nerve and its branch, which passes to the *M. tensor palati mollis*. Its branches are:

a) Nerve to the tensor tympani, *N. ad tensorem tympani;*

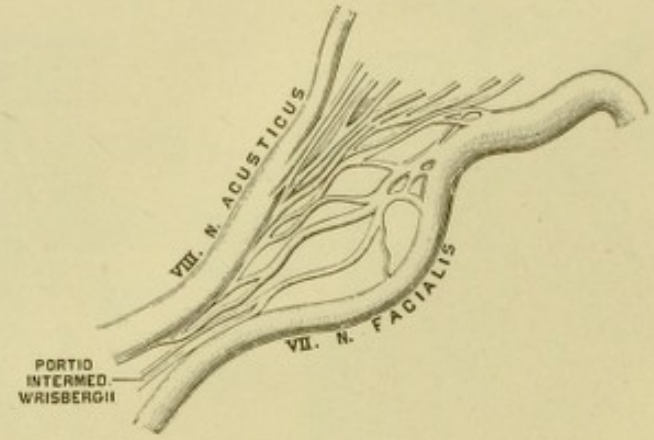
b) Small superficial petrosal nerve, *N. petrosus superficialis minor;* this nerve runs through a small canal in the great wing of the sphenoid bone, and with the great superficial petrosal nerve to the genu of the *N. facialis*, where it gives off a twig to the geniculate ganglion, and sends a second down to the tympanic cavity; this latter connects it with the *N. Jacobsonii* (see Fig. 482);

c) A small branch to the *N. ad tensorem veli palatini;*

d) A small twig to the auricular branch of the auriculo-temporal nerve;

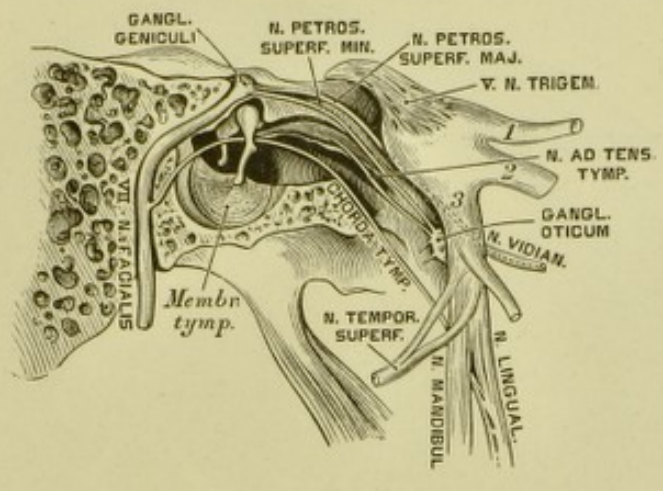
e) A small branch from the *Plexus sympathicus* of the middle meningeal artery.

The submaxillary or lingual ganglion, *Ganglion submaxillare s. linguale* (see Fig. 474), is placed above the deep portion of the submaxillary gland, near the lingual nerve, with which it is connected by several filaments. Its branches supply the submaxillary gland, and accompany the lingual nerve to the mucous membrane of the tongue.



478. The *Portio intermedia Wrisbergii* after E. Bischoff.

The seventh or facial nerve, *Nervus facialis,* is the great motor nerve of the face. It arises from the lateral tract of the *Medulla oblongata* by two roots; the anterior root from the restiform body, the posterior as *Portio intermedia* of Wrisberg from the floor of the fourth ventricle. Both trunks lie in a groove of the auditory nerve, with which the *Portio intermedia* is connected. At the bottom of the internal auditory meatus the facial nerve leaves the auditory; it enters the *Aquaeductus Fallopii* and follows the windings of that canal; after having passed at first horizontally outwards, it bends sharply backwards, forming the genu; here it presents a reddish enlargement, the geniculate ganglion, *Ganglion geniculi.* This ganglion receives the great superficial petrosal nerve, and a twig of the small superficial petrosal, also filaments from the sympathetic plexus accompanying the middle meningeal artery. From the genu in the *Aquaeductus Fallopii,* the direction of the canal and the facial nerve lying in it, is backwards and finally downwards to the stylo-mastoid foramen. Behind the genu, two branches are given off from the facial nerve; the smaller, tympanic branch, leaves the facial trunk opposite the pyramid of the tympanic cavity, to supply the stapedius muscle (see Fig. 482); the larger, the *Chorda tympani,* leaves the trunk above the stylo-mastoid foramen, passes through a small canal, the *Canaliculus chordae,* into the tympanic cavity, then between the handle of the malleus and long process of the incus to the Glaserian fissure, and finally unites with the lingual nerve, to which it supplies motor fibres.



479. The Facial Nerve within the Petrous Bone.

After the facial nerve has left the stylo-mastoid foramen, it gives off the following branches:

a) The posterior auricular nerve, *Nervus auricularis posterior profundus*, which, inosculating with the auricular branch of the pneumogastric and the small occipital nerve, supplies the *M. retrahens auriculae*, the *M. occipitalis*, and the posterior part of the occipito-frontalis muscle;

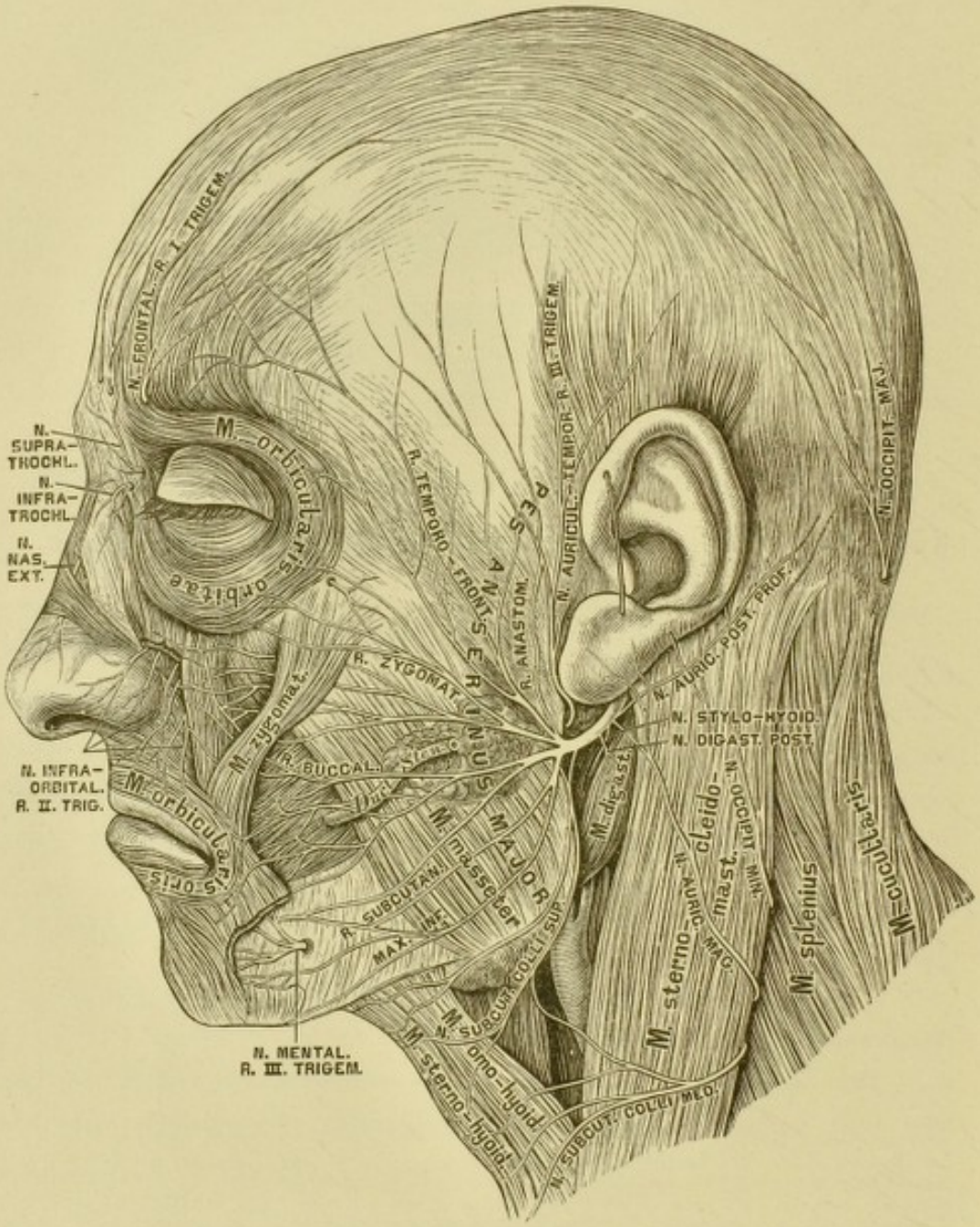
b) The stylo-hyoid, *N. stylo-hyoideus*, and the posterior digastric, *N. digastricus posterior;*

c) Communicating branches to the auriculo-temporal branch of the inferior maxillary nerve.

The facial nerve then pierces the parotid gland, which, at the same time it supplies with very small filaments. Behind the ramus of the lower jaw it terminates by dividing into two parts, temporo-facial and cervico-facial; these give off 8—10 branches, which, by communication, form the *Pes anserinus major*. The following groups are then formed:

a) Temporal branches, *Rami temporo-frontales;* these communicate with the auriculo-temporal nerve, the deep temporal nerves, the frontal and the lachrymal nerves, and supply the *MM. attrahens* and *levator auriculae*, the *M. temporalis*, the *M. orbicularis palpebrarum* and the *M. corrugator supercilii.*

b) Malar branches, *Rami zygomatici;* these join with the *N. zygomaticus malae*, the lachrymal and supraorbital nerves, and supply the *M. zygomaticus*, *M. orbicularis* and *M. levator labii superioris et alae nasi.*

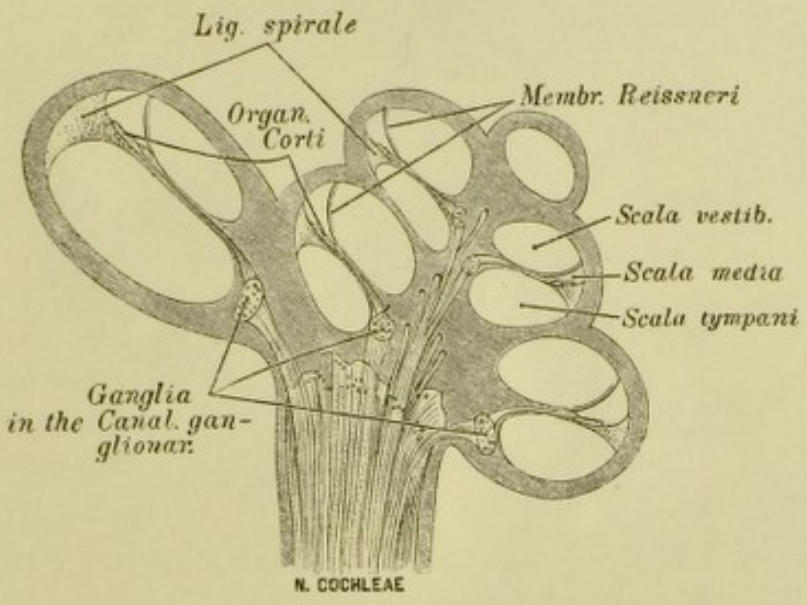


480. The Facial Portion of the Facial Nerve.

c) Buccal branches, *Rami buccales;* these communicate with the infraorbital nerve and the buccal branch of the inferior maxillary nerve, and supply the muscles of the upper lip and nose.

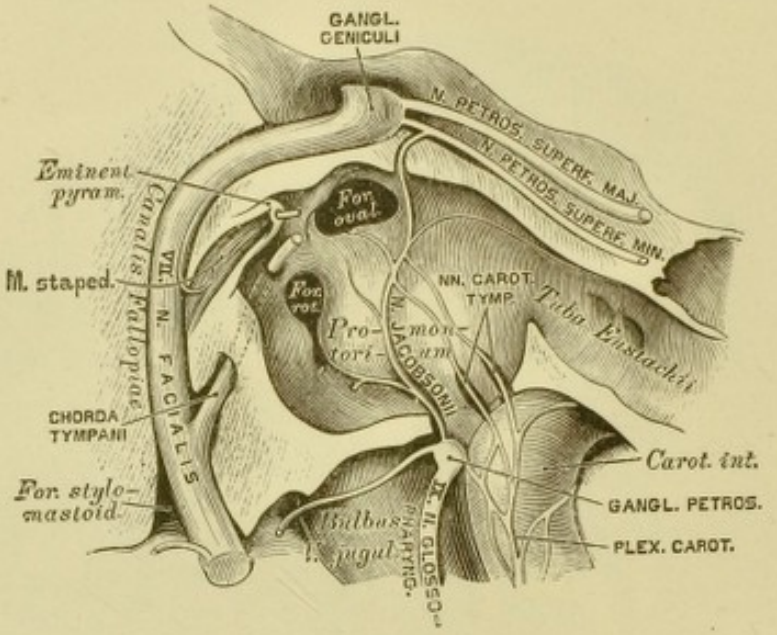
d) Supra-maxillary branches, *Rami subcutanei maxillae inferioris,* communicate with the buccal branch of the inferior maxillary nerve and the mental nerve, and supply the muscles of the lower lip.

e) Infra-maxillary branch, *Nervus subcutaneus colli superior,* communicates with the superficial cervical nerve from the cervical plexus and the great auricular nerve, and supplies the *Platysma myoides.*

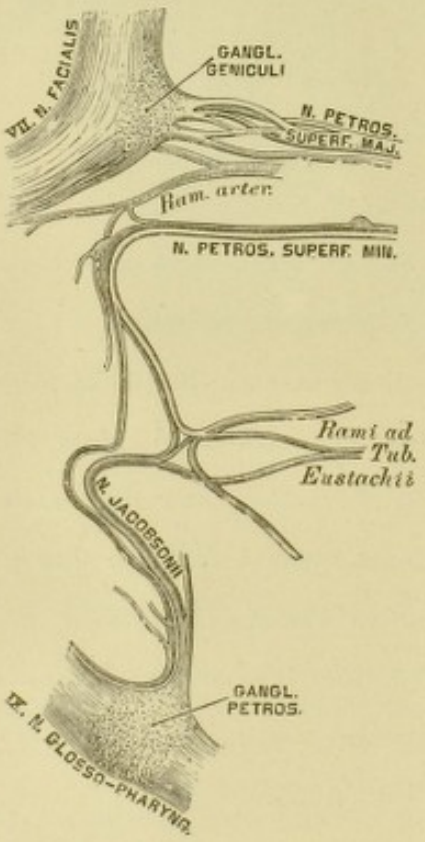


481. Section of the Cochlea, with the Expansion of the *Nervus cochleae.* After Rüdinger.

The auditory nerves, *Nervi acustici,* form the eighth pair of cranial nerves. The nerve appears on both sides between *Flocculus* and *Pedunculus cerebelli,* together with the facial nerve, for which it forms a groove. Both nerves enter the internal auditory meatus; the facial nerve passes to the *Aquaeductus Fallopiae;* the auditory nerve divides into two branches, the larger cochlear branch, *N. cochleae,* and the smaller vestibular branch, *N. vestibuli.* The former passes forwards through the foramina of the *Tractus foraminulentus* to the *Lamina spiralis,* and ends in the organ of Corti; the latter divides into several branches, which pass to the *Sacculus sphaericus*, *Sacculus ellipticus* and the three ampullae of the semicircular canals (see Fig. 325).



482. The Nerve of Jacobson in the Tympanic Cavity. (Enlarged.)

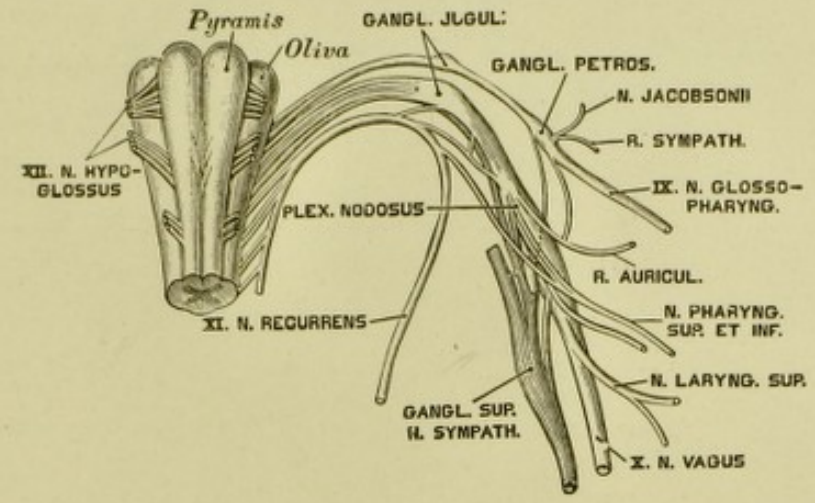


482 a. The Tympanic Plexus. After E. Bischoff.

The ninth cranial nerve is the glosso-pharyngeal nerve, *Nervus glosso-pharyngeus*. It passes through the jugular foramen in a separate sheath of the dura mater and forms here the jugular ganglion, *Ganglion jugulare*, which is not constant; in the *Fossula petrosa* of the petrous bone is the petrous ganglion, *Ganglion petrosum*, always present, which communicates with the sympathetic nerve and the auricular branch of the pneumogastric. From this petrous ganglion, Jacobson's nerve, the tympanic branch of the ninth nerve, arises; this nerve runs forwards in the tympanic cavity, in a groove of the promontory, sends twigs to the mucous membrane of the tympanic cavity and to the Eustachian tube, is united by means of the *Nervi carotico-tympanici* with the carotid plexus, and finally passes into the small superficial petrosal nerve.

In the neck the glosso-pharyngeal nerve sends branches of communication to the pneumogastric nerve, to the carotid plexus, and the digastric and stylo-hyoid branches of the facial nerve; also pharyngeal branches to the muscles of the pharynx (see Fig. 486).

Finally the nerve gives off lingual branches, which pass to the tongue and supply the *Arcus glosso-palatinus*, the tonsils, the anterior surface of the epiglottis and the root of the tongue, and finally end in the *Papillae vallatae*.

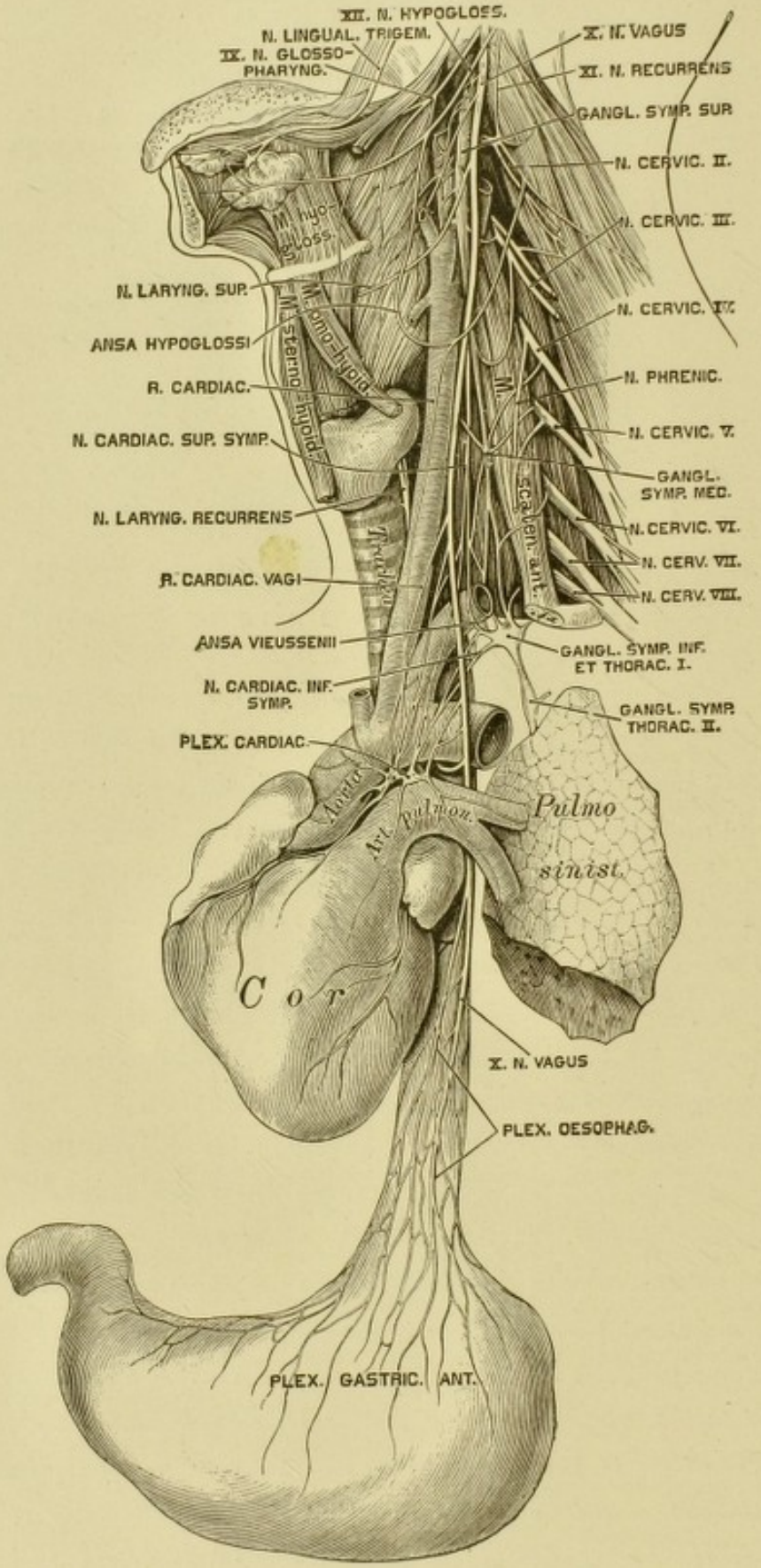


483. Diagram of the Origin of the Ninth, Tenth, Eleventh and Twelfth Pairs of Cranial Nerves.

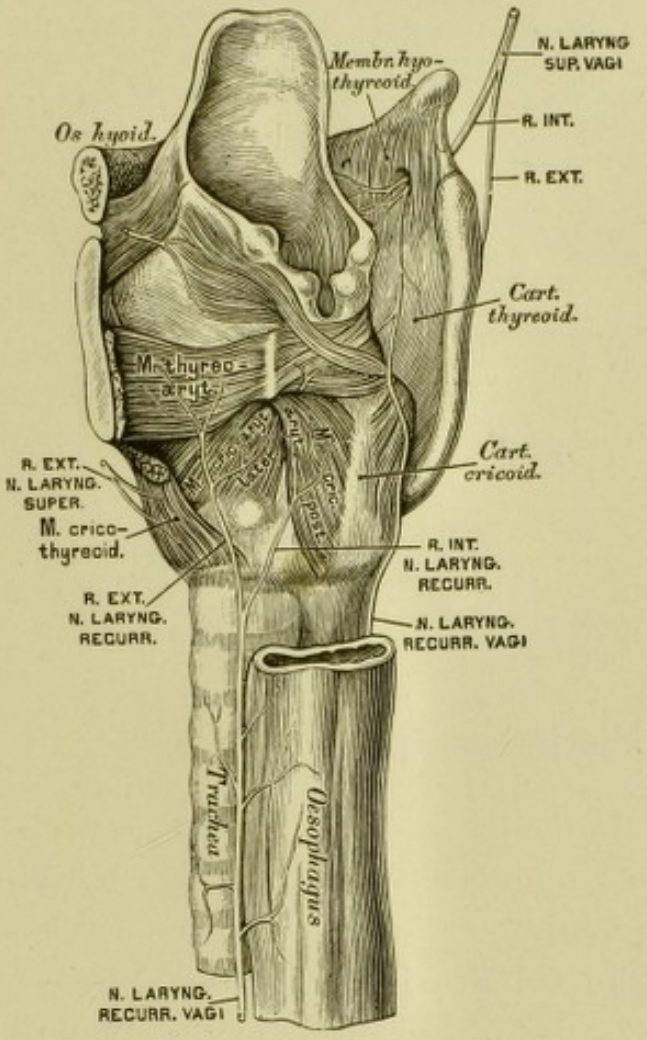
The tenth pair of cranial nerves are the two pneumogastric nerves, *Nervi vagi*. Arising from the *Medulla oblongata*, the vagus passes out of the cranium through the jugular foramen, in company with the glosso-pharyngeal and spinal accessory nerves.

1. The cervical portion presents in the jugular foramen the *Ganglion jugulare*, or ganglion of the root of the pneumogastric, which is connected with the first cervical ganglion, *Ganglion cervic. primum (superius)* of the sympathetic nerve; below the jugular ganglion the *Vagus* communicates freely with neighbouring nerves, and thereby the lower ganglion or ganglion of the trunk or *Plexus nodosus* about $^1/_2$ inch in length, is formed; then the nerve descends between the common carotid artery and internal jugular vein, into and through the thorax. Its branches are:

a) Auricular branch, *Ramus auricularis vagi*, Arnold's nerve, which arises from the jugular ganglion; it receives a branch from the petrous ganglion of the glosso-pharyngeal nerve, passes outwards behind the jugular vein, reaches the *Aquaeductus Fallopii*, crosses the facial nerve, with which it is connected by two filaments, and passes through the *Canaliculus mastoideus* behind the pinna, where it partially communicates with the deep auricular branch of the facial nerve, partly supplies the posterior wall of the external auditory meatus.



484. The Left Pneumogastric and its Communications.



485. The Superior and Recurrent Laryngeal Nerves.

b) Branches of the eleventh and twelfth cranial nerves send motor fibres to the vagus in the *Plexus nodosus,* which soon after leave as pharyngeal and laryngeal branches, *Rami pharyngei* and *laryngei.*

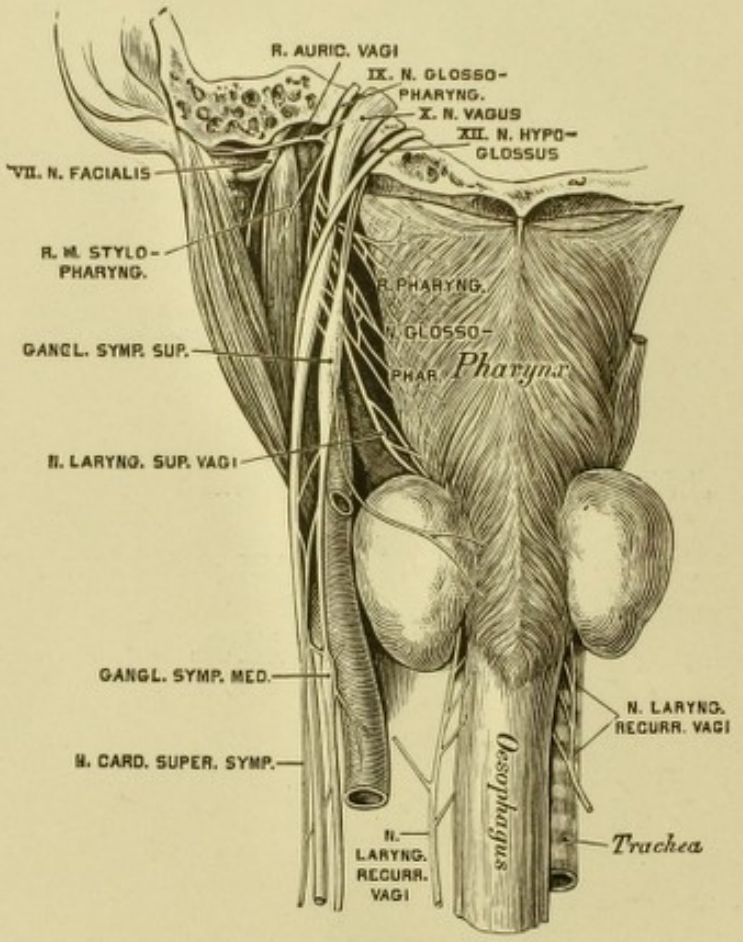
c) From the *Plexus nodosus* branches of communication pass to the superior cervical ganglion of the sympathetic and to the plexus of the superior cervical nerves; further the

d) Superior and inferior pharyngeal nerve, *Nervus pharyngeus superior et inferior,* whose branches form, in connection with those of the glosso-pharyngeal and sympathetic nerves, the *Plexus pharyngeus.*

e) Superior laryngeal nerve, *N. laryngeus superior,* passes along the inner side of the internal carotid artery to the larynx and divides into an external and internal branch, *R. externus* and *internus;* the former ends in the inferior constrictor and crico-thyroid muscles; the latter pierces, together with the laryngeal artery, the thyro-hyoid membrane, and supplies the posterior surface of the epiglottis and mucous membrane of the larynx down to the glottis. The internal ramus always inosculates with the recurrent laryngeal nerve of the vagus.

f) Filaments of communication to the descending ramus of the hypoglossal and the internal carotid plexus.

g) Two to six cardiac branches to the cardiac plexus.



486. The Glosso-Pharyngeal, Pneumogastric and Hypoglossal Nerves. From behind.

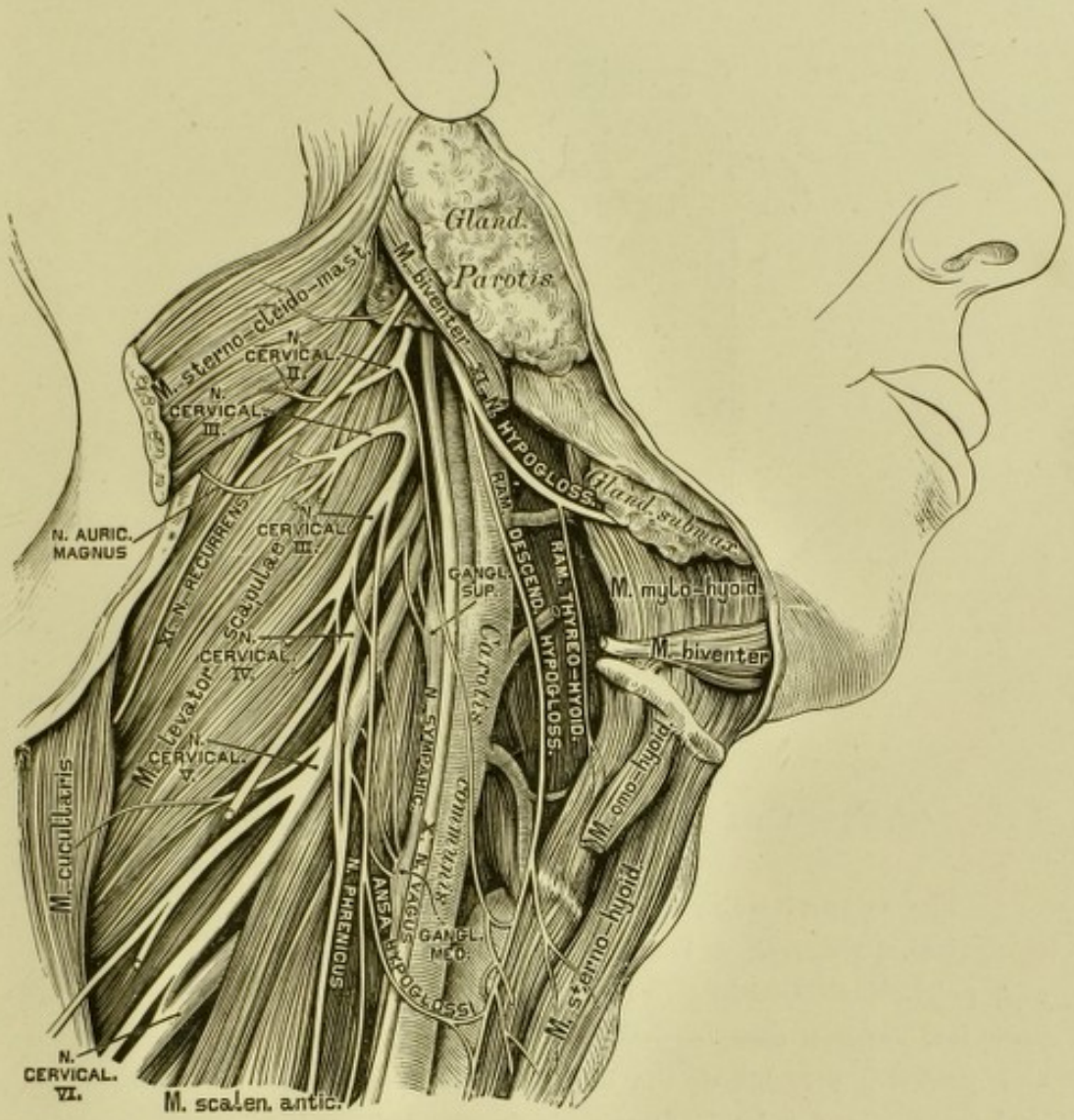
2. The thoracic portion of the vagus lies at first to the outer side of the common carotid artery; on the right side it crosses over the right subclavian artery, on the left side over the arch of the aorta; each nerve then passes behind the root of each lung, the right vagus passing behind the oesophagus, the left in front of it. The branches are:

a) Inferior or recurrent laryngeal, *Nervus laryngeus recurrens.* The right (shorter) winds around the right subclavian artery, the left (longer) around the arch of the aorta; both nerves ascend in the groove between the trachea and oesophagus to the larynx, and supply its muscles.

b) Anterior and posterior pulmonary or bronchial, *Nervi bronchiales anteriores et posteriores.* The former form with the cardiac nerves of the sympathetic the anterior pulmonary plexus, *Plexus bronchialis anterior,* the latter with branches of the thoracic ganglia of the sympathetic the posterior pulmonary plexus, *Plexus bronchialis posterior;* they are distributed to the anterior and posterior aspects of the root of the lung.

c) Oesophageal plexus, *Plexus oesophageus,* at the anterior and posterior aspects of the oesophagus.

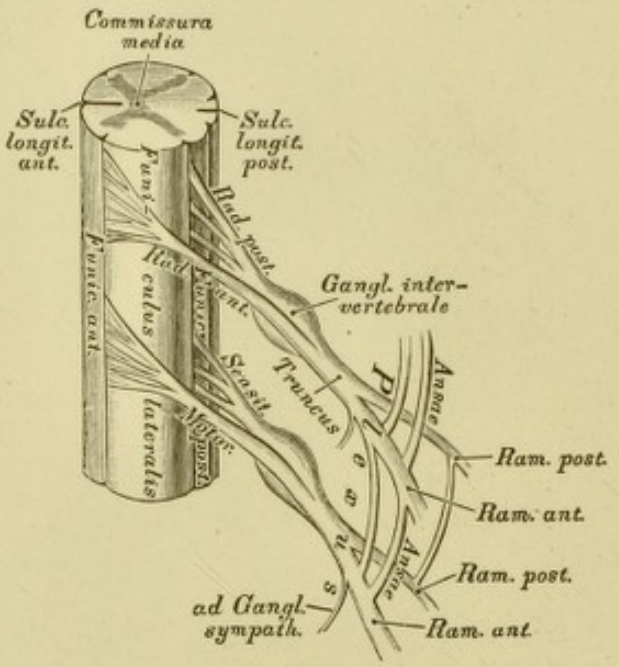
3. The abdominal portion of the vagus is formed by the twigs leaving the oesophageal plexus, which, by their communication, form the anterior and posterior gastric plexus, *Plexus gastricus anterior et posterior,* at the anterior and posterior aspects of the stomach; the former communicates with the hepatic plexus, the latter with the coeliac plexus, it sending filaments to the spleen, pancreas, small intestines and kidney.



487. The Spinal Accessory and Hypoglossal Nerves at the neck.

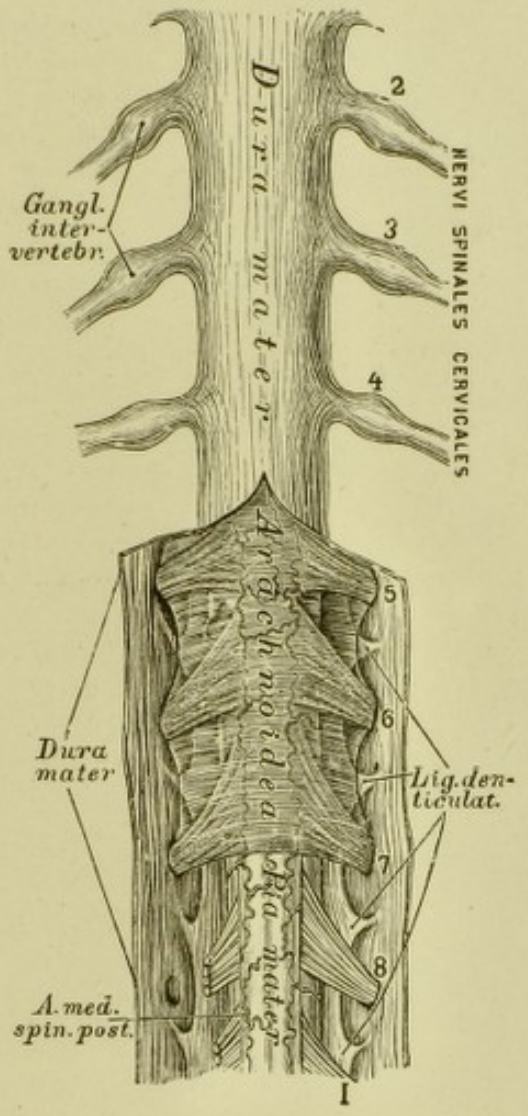
The eleventh cranial nerve is the spinal accessory, *Nervus recurrens s. accessorius Willisii.* It arises from the lateral tract of the spinal cord as low down as the sixth or seventh cervical vertebra by a number of filaments, passes through the *Foramen magnum* into the skull, leaves it with the pneumogastric by the jugular foramen and is divided into an anterior or accessory portion for the *Plexus nodosus,* and a posterior or spinal portion, which pierces the sterno-cleido-mastoid muscle and terminates in the trapezius *(M. cucullaris).*

The twelfth cranial or hypoglossal nerve, *N. hypoglossus* (motor) arises from the *Medulla oblongata* and leaves the skull by the anterior condyloid foramen. In the neck, where the nerve lies at first behind the vagus, internal carotid artery and internal jugular vein, it curves forwards, then at the *M. hyoglossus* upwards, and divides into branches at the posterior margin of the *M. mylohyoideus,* which supply all the muscles of the tongue. Beneath the anterior condyloid foramen it sends communicating branches to the first cervical ganglion of the sympathetic, to the *Plexus nodosus* of the vagus and to the upper cervical nerves, and somewhat lower the descendens noni branch, *R. cervicales descendens,* arises, which forms with branches of the second and third cervical nerves, the *Ansa hypoglossi.*



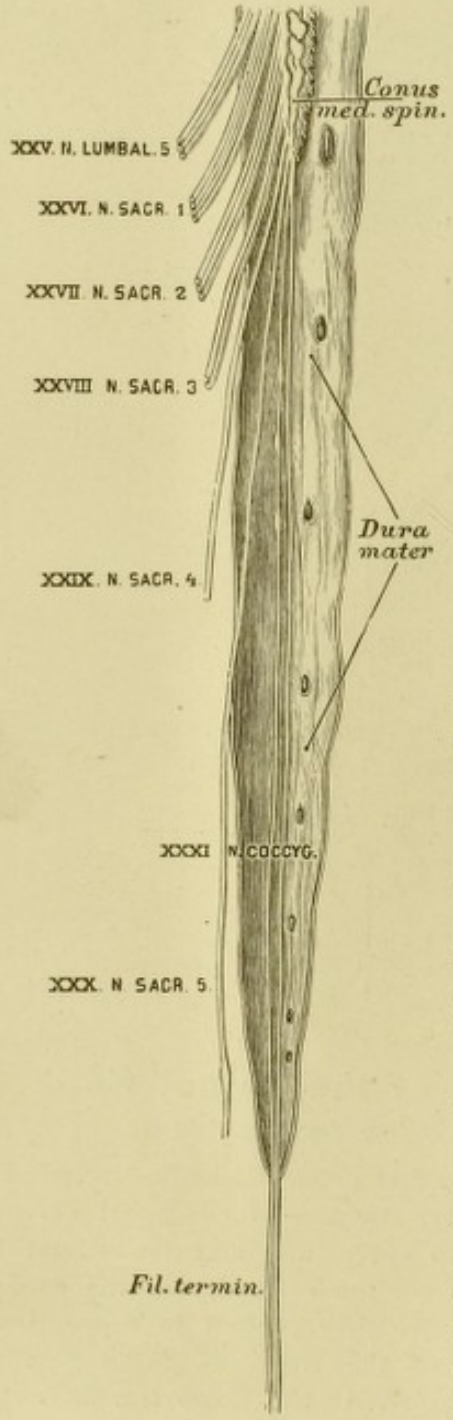
488. Diagram of the Origins of the Spinal Nerves.

The spinal nerves, *Nervi spinales*, are 31 pairs, and these are: 8 cervical, 12 dorsal, 5 lumbar, 5 sacral and 1 (very rarely 2) coccygeal pairs. Each spinal nerve has two roots, an anterior, smaller, and a posterior, larger; they appear as flat fibrous bundles at the anterior and posterior margins of the lateral tract, pass through the intervertebral foramen and unite to form a single rounded cord. The posterior root only, is marked by a ganglion, the *Ganglion intervertebrale*, formed in the intervertebral foramen. This root is sensory, the anterior, motor. The single cord formed by the two roots divides again, into an anterior and a posterior division or branch, both of which receive motor, as well as sensory fibres. The anterior larger division communicates with the neighbouring sympathetic ganglion, and the neighbouring anterior divisions of the spinal nerves, whereby loops, *Ansae*, are formed, which are present everywhere except at the dorsal nerves, where they are not constant. These ansae unite to form plexuses, *Plexus cervicalis*, *lumbalis* and *sacralis*. The posterior divisions, irregularly united with the neighbouring branches, pass backwards to the muscles and skin of the back; they, however, supply only the long muscles of the back, the broad muscles being supplied by nerves from the plexus of the anterior divisions of the spinal nerves.



489. The Cervical Portion of the Spinal Cord with its Membranes. View from behind.

The spinal cord extends only to the first or second lumbar vertebra. The length of the roots of the lumbar, sacral and coccygeal nerves therefore, increases rapidly from nerve to nerve, and may be estimated by the distance of the foramen of exit from the extremity of the cord; owing to their length and the appearance they present in connection with the spinal cord, the aggregation of the roots of these nerves has been named horse's tail, *Cauda equina.* At the *Conus terminalis* of the spinal cord the pia mater is continued as *Filum terminale*, down to the lower end of the impervious sheath of the dura mater, which runs down to the end of the sacral canal. The intervertebral ganglia of the cervical, dorsal and lumbar nerves lie within the intervertebral foramina; those of the sacral nerves in the spinal canal external to the dura mater; those of the coccygeal nerve within the latter. The largest nervous divisions of the spinal cord are the sacral nerves, which form the sacral plexus, *Plexus sacralis.*



490. The Lower Extremity of the Spinal Cord.

After Fr. Arnold.

The first cervical nerve emerges between the occipital bone and atlas as s u b o c c i p i t a l n e r v e; the e i g h t h through the intervertebral foramen between the seventh cervical and first dorsal vertebra. The anterior divisions of the cervical nerves pass in front of or between the bundles of the *M. scalenus medius* and *M. levator scapulae*, forwards and outwards; the four upper form the c e r v i c a l p l e x u s, *Plexus cervicalis*, the four lower with the greater portion of the first dorsal, the b r a c h i a l p l e x u s, *Plexus brachialis*. — The p o s t e r i o r d i v i s i o n of the first cervical nerve, the i n f r a o c c i p i t a l n e r v e, supplies the posterior straight and oblique muscles of the head, the *M. biventer cervicis* and *M. complexus*. The p o s t e r i o r d i v i s i o n of the second cervical nerve supplies the muscles of the neck (with the exception of the trapezius), and passes as g r e a t o c c i p i t a l n e r v e, *N. occipitalis magnus*, to the skin at the back of the head.

The branches of the cervical plexus are:

1. Three or four filaments to the upper cervical ganglion of the sympathetic nerve.

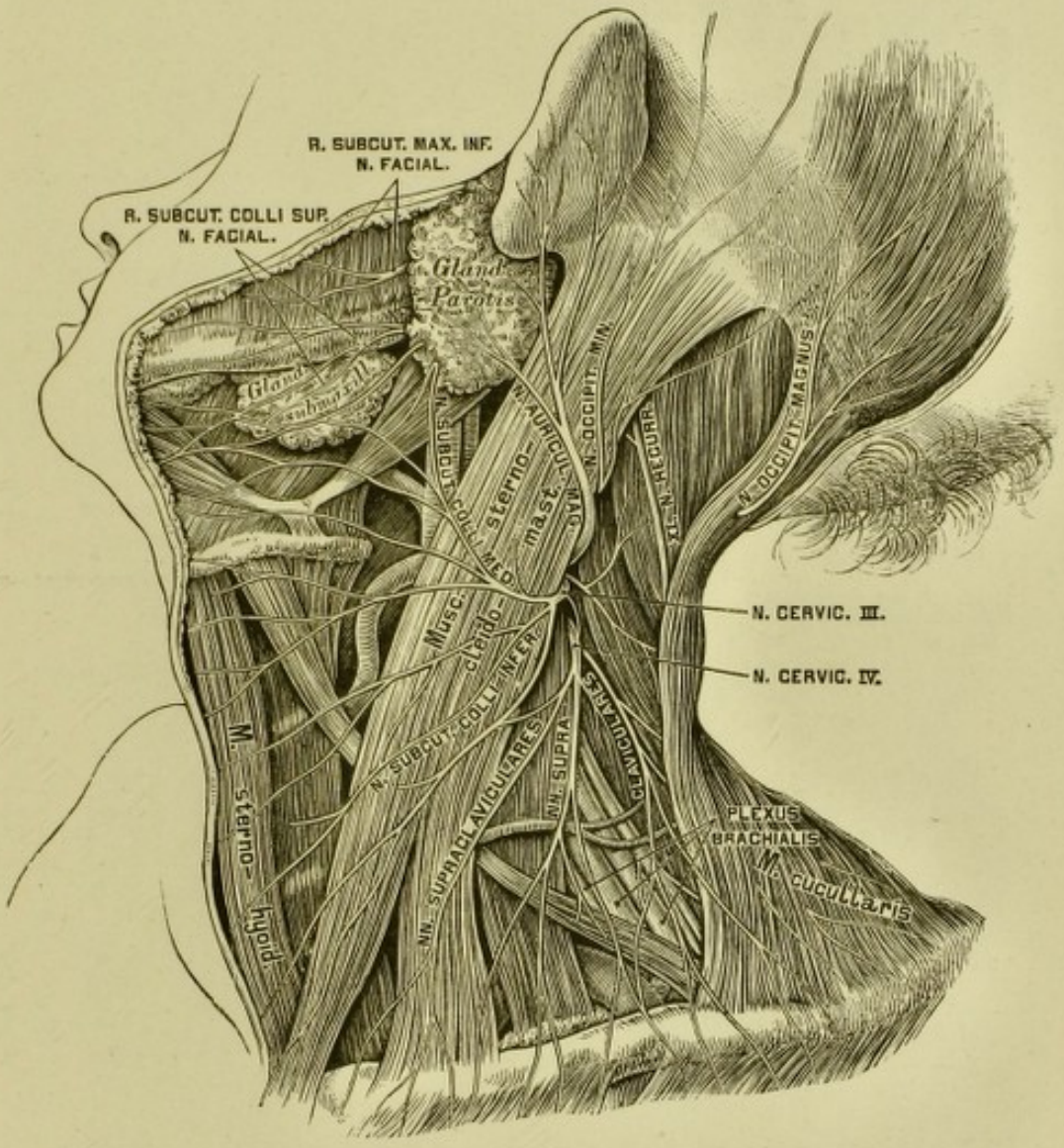
2. Filaments to the ganglion of the trunk of the pneumogastric, to the hypoglossal and its branch, the *Descendens noni*, as *Ansa hypoglossi*.

3. Filaments to the spinal accessory nerve.

4. Branches for the following muscles: *Scaleni*, *Longus colli*, *Rectus capit. ant. major et minor* and *Levator scapulae*.

5. *N. occipitalis minor*, which ascends along the posterior border of the sterno-cleido-mastoid muscle to the back of the head; it communicates with the great occipital nerve and deep auricular branch of the facial nerve.

6. *N. auricularis magnus*, which emerges at about the middle of the posterior margin of the *M. sterno-cleido-mastoideus*, ascends upon that muscle to the parotid gland, and divides into an a u r i c u l a r b r a n c h, *R. auricularis*, and a m a s t o i d b r a n c h, *R. mastoideus*.



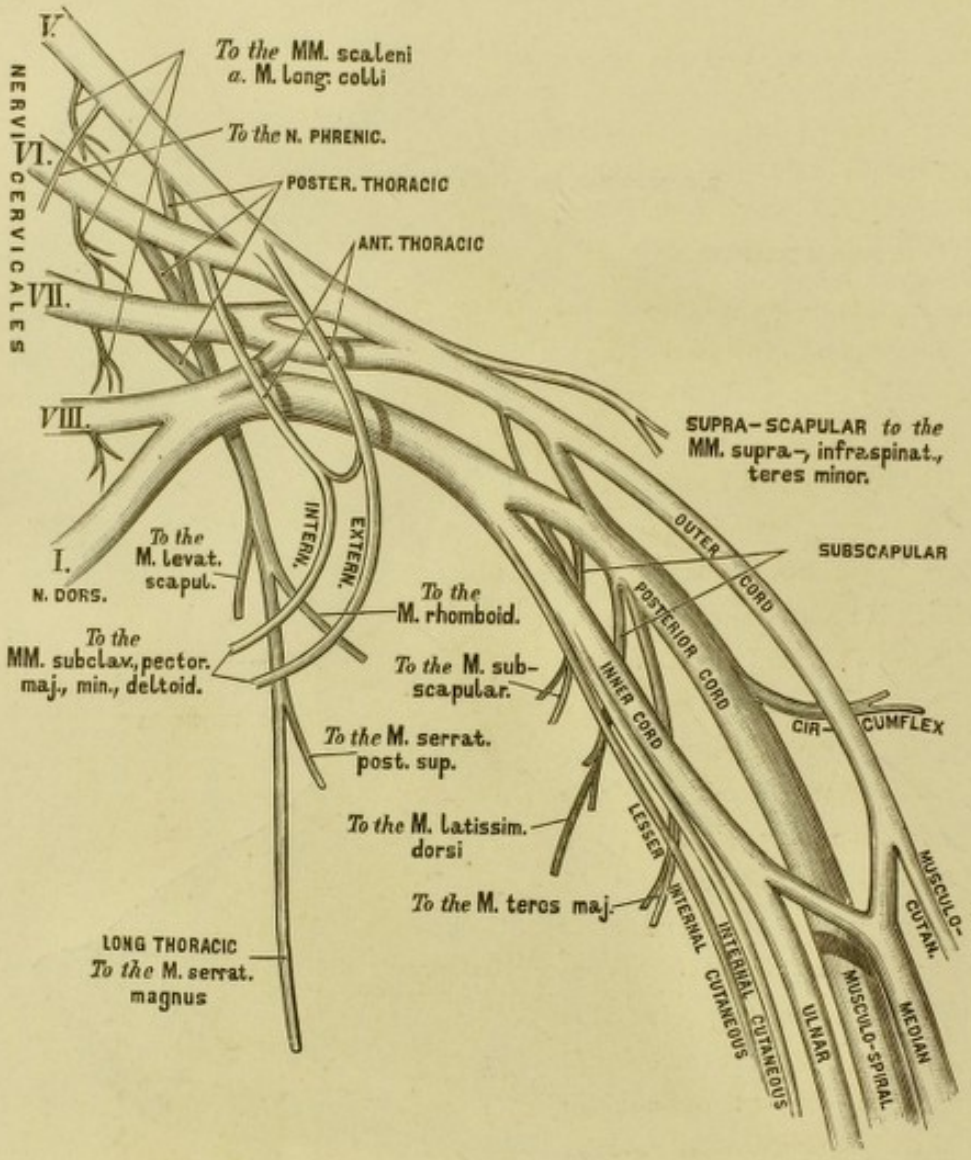
491. The Superficial Nerves of the Neck.

7. *N. superficialis s. subcutaneus colli* turns around the *M. sterno-cleido-mastoideus* from behind forwards, and divides into two branches, an ascending, *N. subcutaneus colli medius,* and a descending, *N. subcutaneus colli inferior;* the former accompanies the external jugular vein and communicates with the cervico-facial division of the facial nerve. Both supply integument and platysma.

8. Supraclavicular nerves, *Nervi supraclaviculares,* three or four in number, descend to the clavicle and supply the skin of the anterior thoracic and acromial regions.

9. Phrenic nerve, *N. phrenicus* (internal respiratory nerve of Bell), arises from the third and fourth cervical nerves, descends in front of the *M. scalenus anticus* to the chest, and communicates with the brachial plexus and the middle and inferior sympathetic ganglia. It enters the thorax between *Vena innominata* and subclavian artery and passes between the pericardium and pleura to the diaphragm, whose *Pars costalis* and *Pars lumbalis* it supplies.

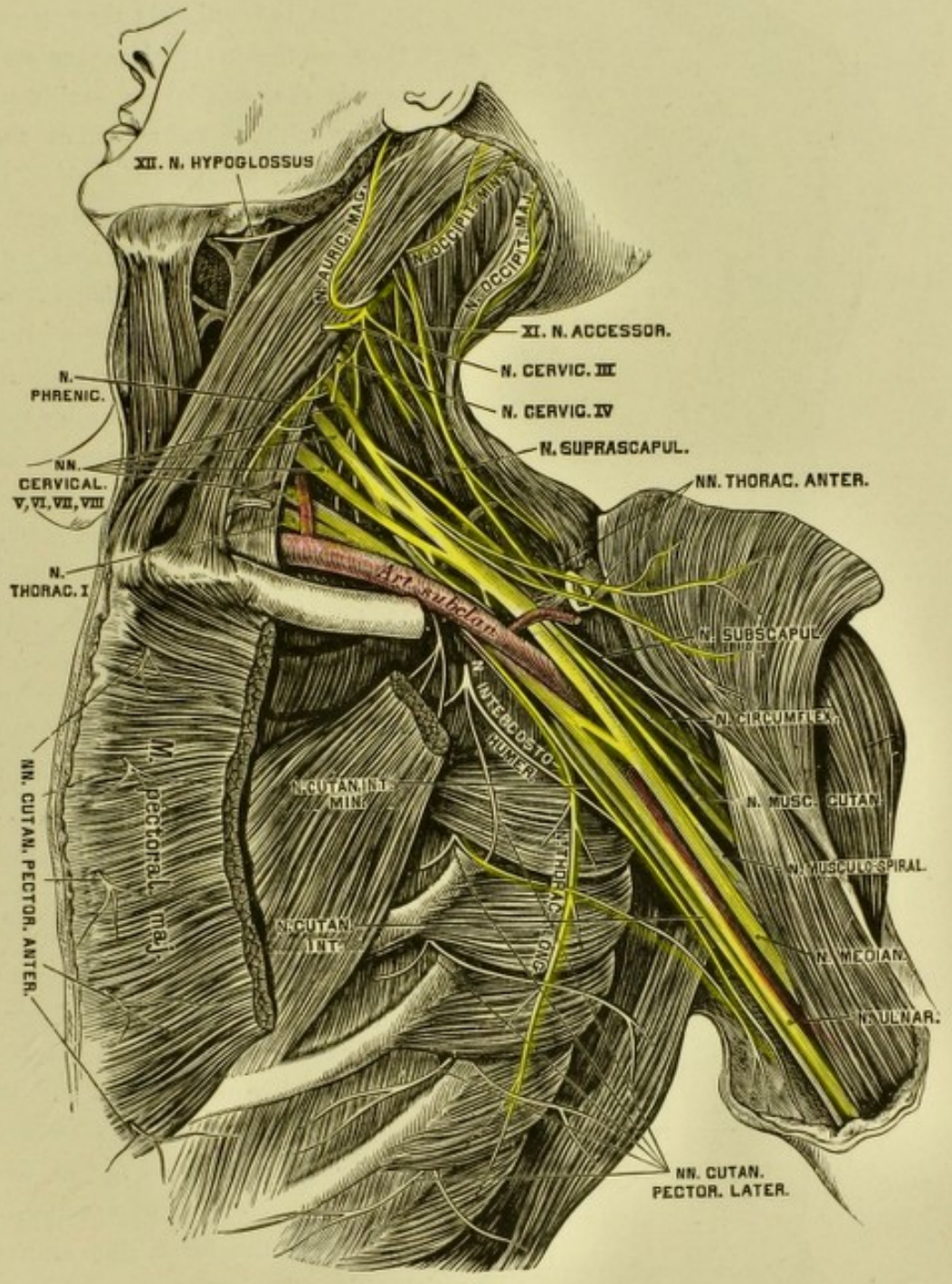
The posterior branches of the lower cervical nerves pass to the deep muscles and skin of the neck.



492. Diagram of the Supra- and Infraclavicular Portions of the Brachial Plexus.

The brachial plexus is formed by the anterior branches of the four lower cervical nerves and the greater part of the first dorsal. The manner in which the nerves are disposed in the plexus, is liable to a great deal of variation, the more frequent arrangement, however, is the following: the fifth and sixth cervical nerves join together to form an upper trunk, the eighth cervical and first dorsal unite to form a lower trunk, while the seventh cervical forms by itself a middle trunk. Soon after passing the outer border of the scaleni muscles, each trunk divides into an anterior and a posterior branch. The anterior branches of the upper and middle trunks unite together to form the upper or outer cord of the plexus; the anterior branch of the lower trunk forms by itself the lower or inner cord, and the posterior branches of all three trunks unite to form the middle or posterior cord. Sometimes the nerves blend so as to form only two principal trunks, from which the three cords are given off.

The brachial plexus is divided into a supraclavicular and an infraclavicular portion, *Pars supra- et Pars infraclaviculares*. The former lies in the *Fossa supraclavicularis*, and its branches, besides those for the *MM. scaleni* and *M. longus colli*, are the following:

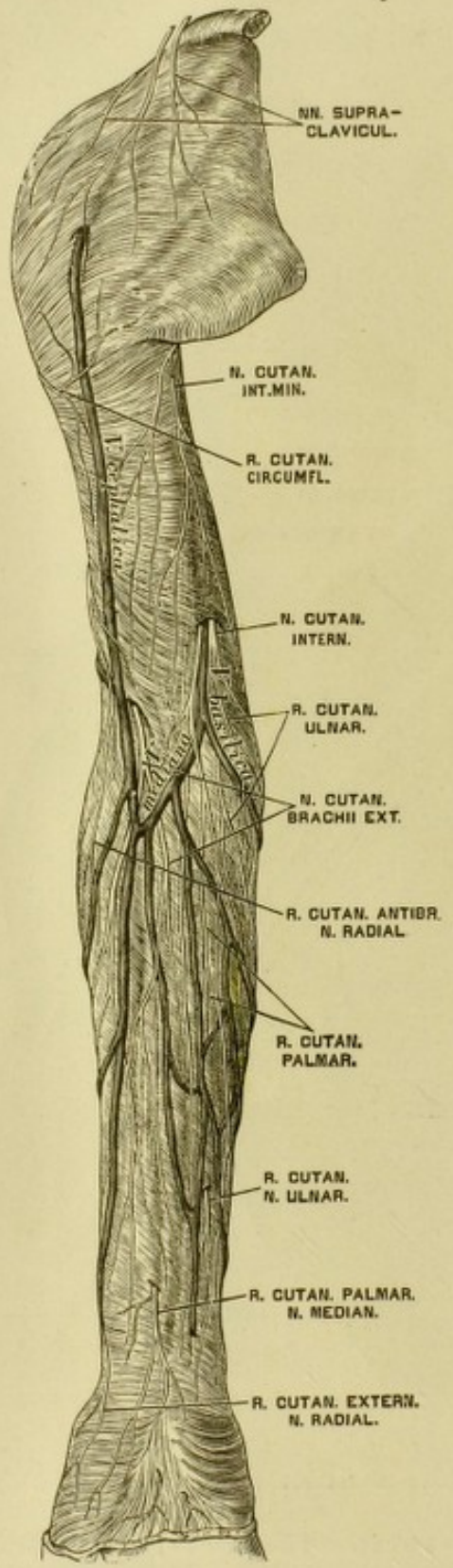


493. The Deep Nerves of the Neck, Brachial Plexus.

1. The anterior and posterior thoracic, *Nervi thoracici anteriores et posteriores,* the former of which are the external and internal;

2. The suprascapular, *Nervus suprascapularis;*

3. The three subscapular, *Nervi subscapulares.* The muscles supplied by all these branches are shown in Fig. 492.



494. The Cutaneous Nerves of the Upper Extremity, at the flexor surface.

The infraclavicular portion of the brachial plexus surrounds the subclavian (axillary) artery with three cords, at the outer, inner and posterior sides. It forms the following branches:

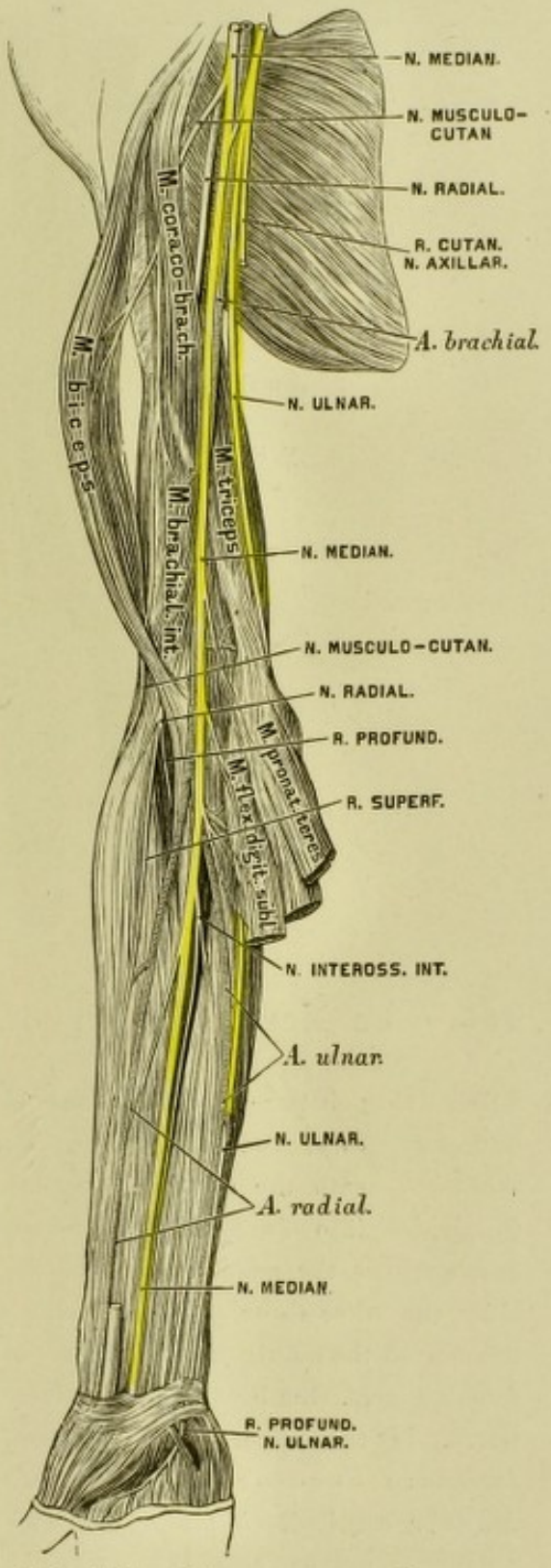
1. Lesser internal cutaneous, *N. cutaneus brachii internus,* arises from the inner cord, passes down behind the axillary vein, communicates with a branch of the second dorsal nerve, the intercosto-humeral, pierces the fascia of the upper arm at the inner surface, and is distributed to the integument of the arm down to the elbow-joint.

2. Internal cutaneous, *N. cutaneus brachii medius* arises from the inner cord, runs on the inner side of the axillary, then the basilic vein, pierces with the latter the fascia of the upper arm, and divides into two branches, an anterior, *R. cutaneus palmaris,* and a posterior, *R. cutaneus ulnaris.* The anterior descends on the anterior surface of the ulnar side of the forearm, distributing filaments to the integument as far as the wrist, the posterior passes downwards on the inner side of the basilic vein at the ulnar side of the forearm and communicates with the dorsal branch of the ulnar nerve; it distributes filaments to the integument on the inner and posterior surfaces of the forearm.

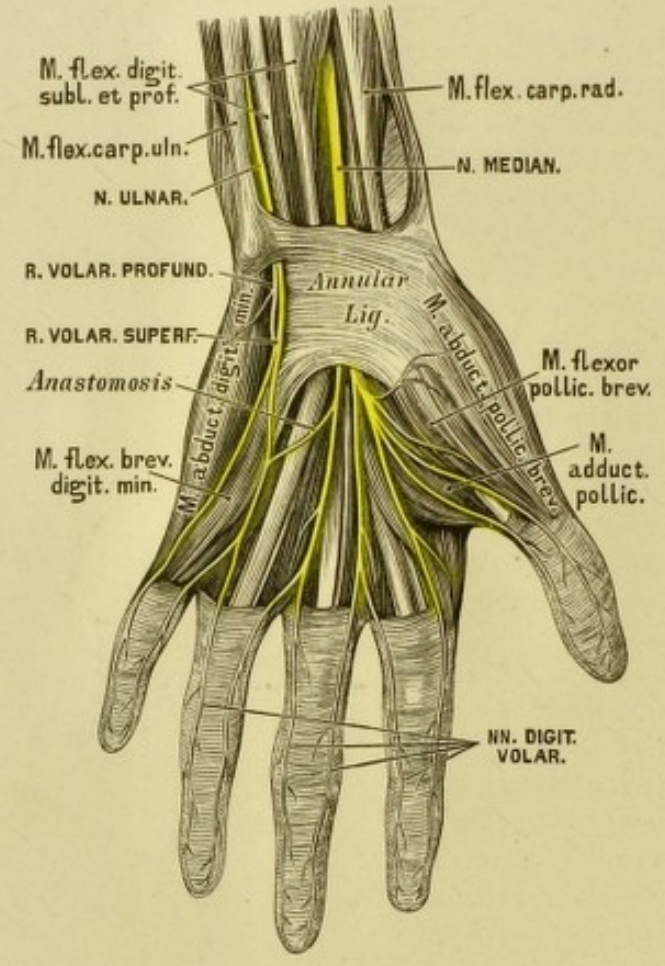
3. External or musculo-cutaneous, *N. cutaneus brachii externus s. musculo-cutaneus* arises from the outer cord of the brachial plexus. It perforates the *M. coraco-brachialis*, passes obliquely between *M. biceps* and *M. brachialis anticus* to the elbow, where it pierces the fascia of the upper arm, accompanies the cephalic vein to the back of the hand and communicates with the dorsal branch of the radial nerve. It supplies the *MM. coraco-brachialis, biceps* and *brachialis anticus*, and the integument on the radial side of the forearm.

4. Circumflex, *N. circumflexus s. axillaris*, arises from the posterior cord of the plexus, and winds around the neck of the humerus in company with the posterior circumflex artery; it supplies the capsule of the shoulder-joint; with a cutaneous branch the posterior region of the shoulder and upper arm; with muscular branches the *M. teres minor* and *M. deltoides* (see Fig. 499).

5. Median nerve, *N. medianus*, arises by two roots, one from the outer and one from the inner cord of the brachial plexus; these embrace the lower part of the axillary artery (see Fig. 493). It descends in the *Sulcus bicipitalis internus*, lying at first to the outer side of the brachial artery, then crosses the vessel above the elbow and lies to its inner side, and beneath the *M. pronator radii teres* and *M. flexor carpi radialis*, to within two inches above the annular ligament, where it becomes more super-

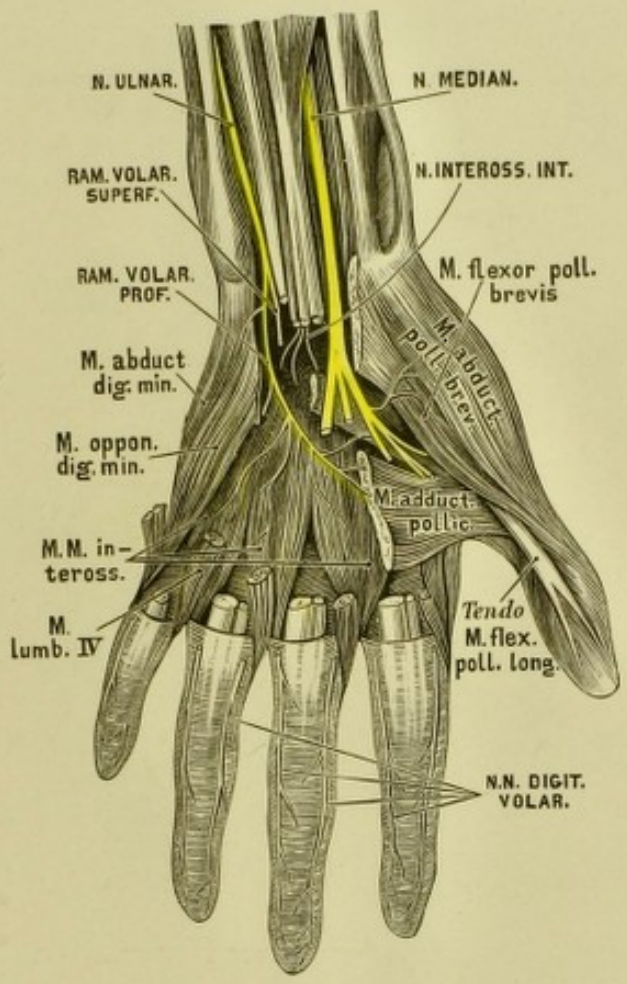


495. The Nerves at the Flexor Surface of the Upper Extremity.



496. The Nerves at the Palmar Side of the Hand.

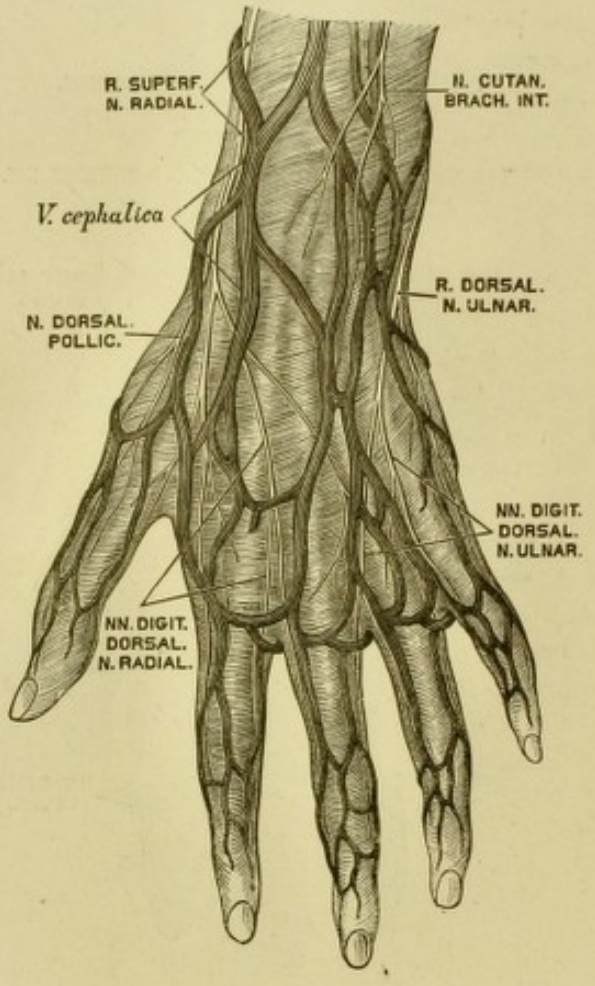
ficial, lying between the tendons of the *MM. flexor digitorum sublimis* and *flexor carpi radialis*. It then passes with the tendons of the *flexor sublimis* beneath the annular ligament into the palm of the hand, where it divides into four digital branches, *Nervi digitorum volares*. The first supplies the small muscles of the thumb and the skin on its radial side; the other three supply the first three *MM. lumbricales*, and the integument on the contiguous sides of the thumb, and the second, third and fourth fingers. One branch communicates with the volar branch of the ulnar nerve. In the upper arm the median nerve has no branches; in the forearm: muscular branches for the superficial flexor muscles (except *M. flexor carpi ulnaris*); a communicating branch for the external cutaneous nerve; also the anterior or internal interosseous, *N. interosseus internus*, which passes down to the *M. pronator quadratus*; finally a palmar cutaneous branch, *N. cutaneus antibrachii palmaris* (see Fig. 494).



497. The Nerves at the Palmar Side of the Hand.

6. Ulnar nerve, *N. ulnaris,* arises from the inner cord of the brachial plexus, lies at first to the inner side of the axillary artery and vein, pierces the internal intermuscular septum, passes down between the inner condyle of the humerus and olecranon, then between the two heads of the *M. flexor carpi ulnaris,* runs between it and *M. flexor digitorum profundus,* and passes on the inner side of the ulnar artery to the wrist. It supplies the *M. flexor carpi ulnaris* and inner half of the *M. flexor profundus digitorum* and with a cutaneous branch, the ulnar side of the forearm. Above the wrist it divides into a dorsal and palmar branch, *R. dorsalis* and *R. volaris.*

The dorsal branch passes to the back of the hand, pierces the fascia and divides into five digital branches, *Nervi digitorum dorsales,* which supply both sides of the little and ring fingers and the ulnar side of the middle finger, down to the second phalanges. The palmar branch passes by the side of the pisiform bone above the annular ligament into the palm of the hand and divides into a superficial and a deep branch, *R. superficialis* and *R. profundus.* The former sends branches to the ulnar side of the little finger, and adjoining sides of the little and ring fingers; the latter supplies the muscles of the little finger, the *MM. interossei,* the *M. lumbricalis IV, Adductor pollicis* and inner head of the *M. flexor brevis pollicis.*



498. The Nerves at the Dorsal Side of the Hand.

7. Musculo-spiral nerve*, the largest branch of the brachial plexus, has its origin from the posterior cord of the plexus. At first it lies behind the axillary artery, winds round the back of the humerus, passing from the inner to the outer side of the bone, between the external and internal heads of the *M. triceps;* it pierces the external intermuscular septum and descends between the *M. brachialis anticus* and *M. supinator longus* to the front of the external condyle; its muscular branches supply the *MM. triceps, anconaeus, supinator longus, extensor carpi radialis longior* and *brachialis anticus.* It sends cutaneous branches to the inner and extensor surfaces of the upper- and forearm. It ends by dividing into two branches:

a) The radial nerve lies a little to the outer side of the radial artery, concealed beneath the *M. supinator longus;* a few inches above the wrist it pierces the deep fascia and divides into two branches, an external, smaller, supplying the integument of the radial side and ball of the thumb, and an internal, larger, whose branches supply the adjoining sides of the thumb, index and middle fingers, and, with the dorsal branch of the ulnar nerve, the contiguous sides of the middle and ring fingers.

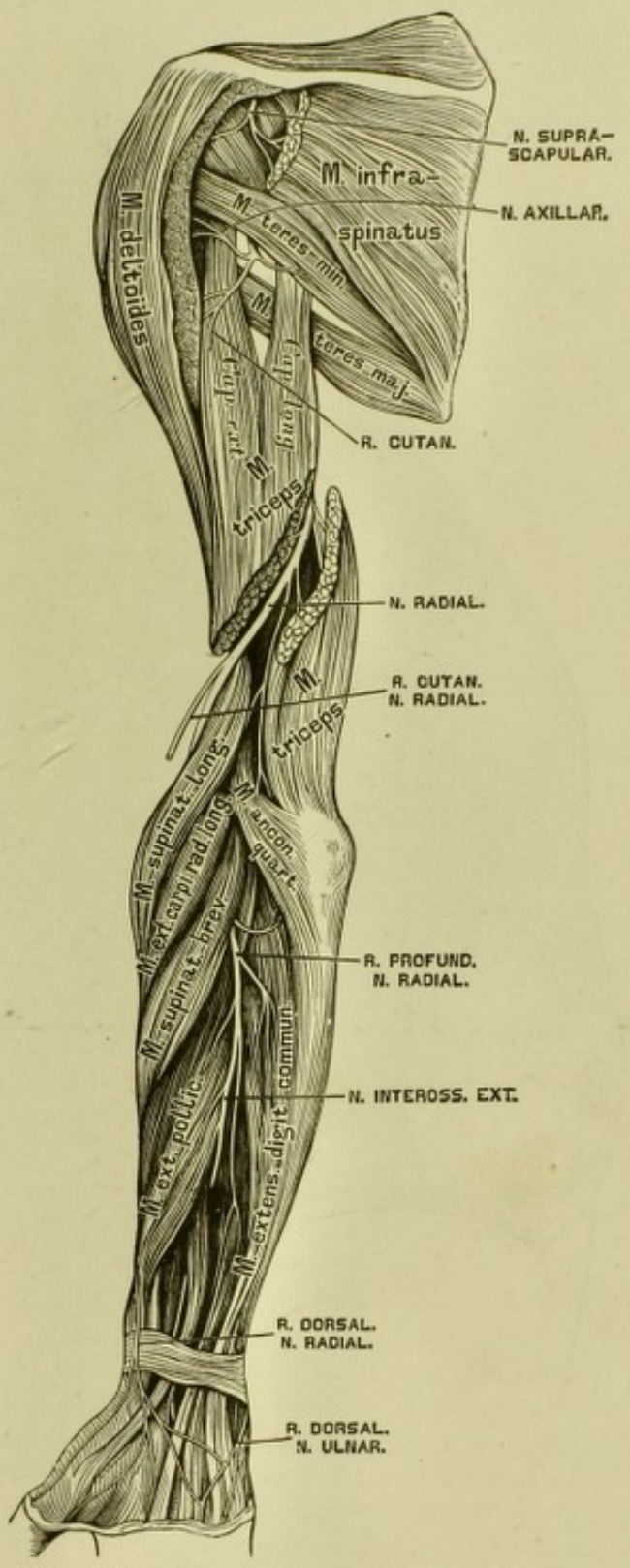
b) The posterior interosseous nerve, passes through the fibres of the *M. supinator brevis* to the outer side of the forearm; its muscular branches supply the *MM. extensor carpi radialis brevior, supinator brevis, extensor communis digitorum, extensor minimi digiti, extensor carpi ulnaris,* the 3 extensors of the thumb and the *extensor indicis.* It also sends the *R. interosseous externus* down to the capsule of the wrist-joint.

* This nerve is sometimes known as the radial nerve; its terminal branches are then called the superficial (radial) and the deep (posterior interosseous).

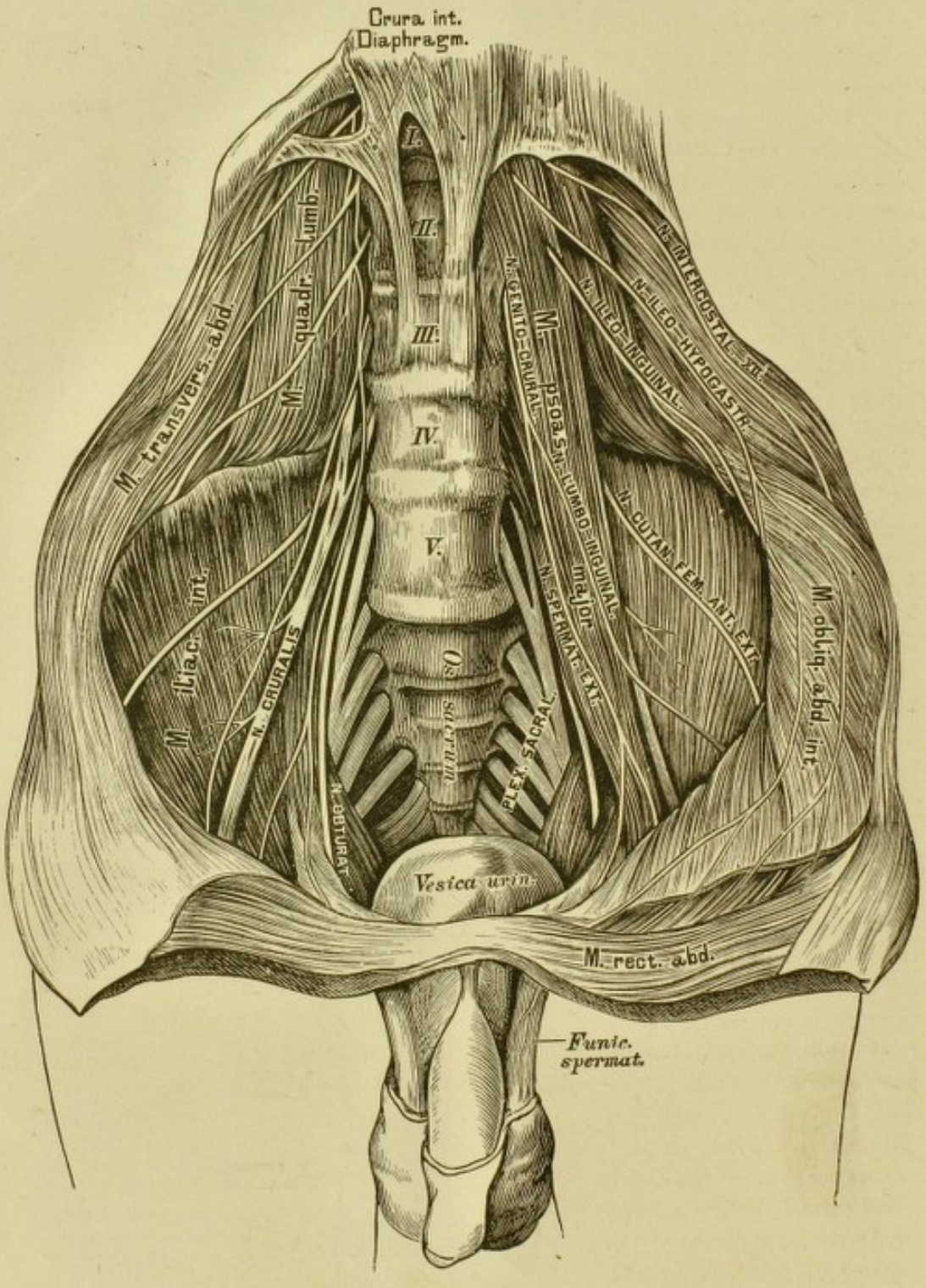
Of the twelve dorsal nerves, *Nervi dorsales s. thoracici*, the first passes out of the intervertebral foramen between the first and second dorsal vertebrae, the twelfth between the last dorsal and first lumbar. Immediately after their exit they divide into larger, anterior, and smaller, posterior divisions. The posterior divisions divide into internal and external branches; both supply the muscles and skin of the back. The anterior divisions, the intercostal nerves, *Nervi intercostales*, pass forwards in the intercostal spaces, each giving off a lateral cutaneous branch, *N. cutaneus pectoralis lateralis*. The upper six lateral cutaneous branches divide again into anterior and posterior, *Nervi cutanei laterales pectoris anteriores et posteriores*, the former to the integument of the chest and mamma, the latter to the integument of the back.

After having given off the lateral cutaneous branches, the intercostal nerves continue their course forwards, supply the intercostal muscles, pierce the *M. pectoralis major* near the sternum, and are lost as anterior cutaneous nerves of the chest, *Nervi cutanei pectoris anteriores*, in the integument of the mamma and front of the chest.

The anterior branches of the six lower lateral cutaneous nerves pass to the anterior abdominal wall, the posterior to the skin of the back as *Nervi cutanei laterales abdominis anteriores et posteriores*.



499. The Nerves at the Extensor Surface of the Upper Extremity.



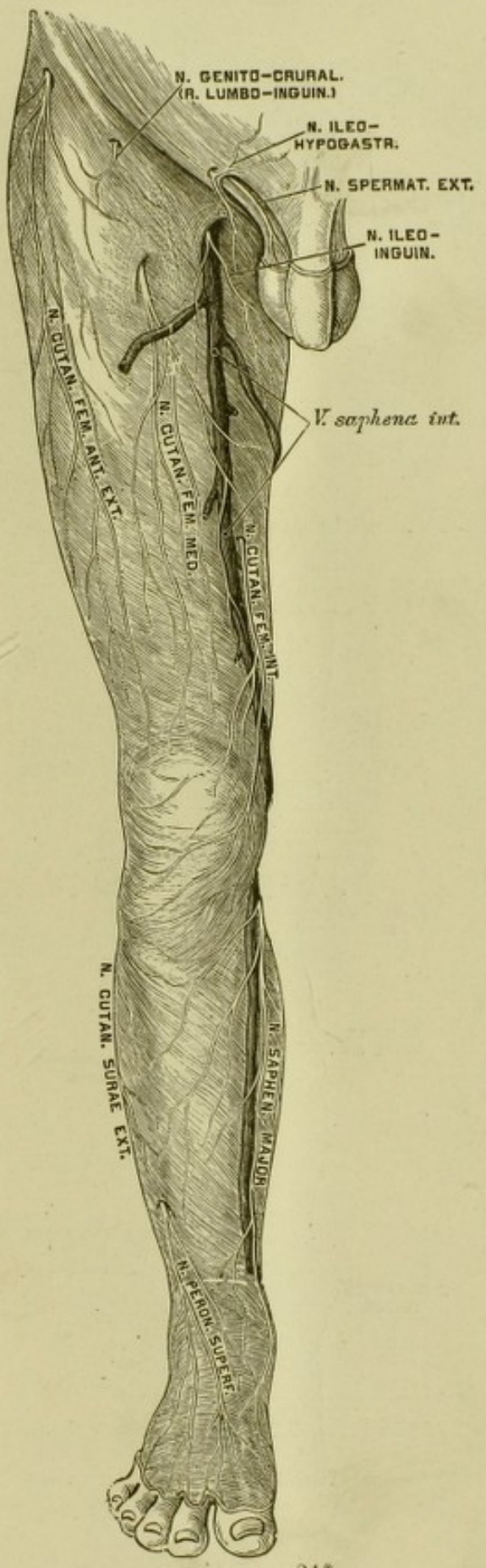
500. The Branches of the Lumbar Plexus.

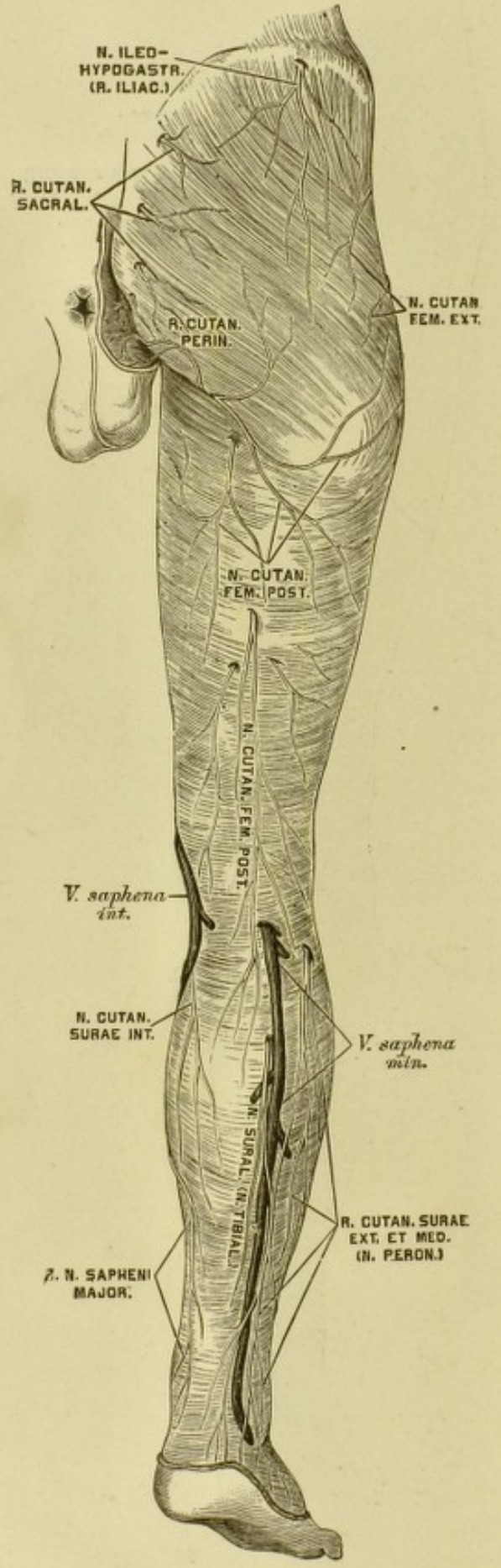
501. The Cutaneous Nerves at the Anterior Surface of the Lower Extremity.

Of the five lumbar nerves, *Nervi lumbales*, the first leaves the intervertebral foramen between first and second lumbar vertebrae, the last between fifth lumbar and base of the sacrum. The posterior, smaller branches supply the following muscles: *Erector spinae*, *Intertransversales*, *Multifidus spinae* and *Interspinales*, and the skin of the lumbar and gluteal regions. The anterior, larger branches form the lumbar plexus, *Plexus lumbalis*, which gives off the following branches:

1. Ileo-hypogastric, *N. ileo-hypogastricus*, mixed nerve, arises from the first lumbar nerve, and supplies the *MM. transversus abdominis* and *obliquus internus*. Between transversalis and internal oblique muscles it divides into two branches, the iliac, *R. iliacus*, to the integument of the gluteal region, and the hypogastric, *R. hypogastricus*, to the hypogastric region.

2. Ileo-inguinal, *N. ileo-inguinalis*, sensory, also arises from the first lumbar nerve, perforates the *M. transversus abdominis* above Poupart's ligament, passes into the inguinal canal and terminates in the integument of the scrotum and upper and inner part of the thigh in the male, and in the labium in the female, with the *Nervi scrotales et labiales anteriores*.





502. The Cutaneous Nerves at the Posterior Surface of the Lower Extremity.

3. Genito-crural, *N. genito-cruralis*, mixed nerve, arises from the second lumbar nerve, and divides into two branches, the genital or external spermatic, *N. pudend. s. spermaticus externus*, which descends along the back of the spermatic cord, and supplies the *M. cremaster* and *Tunica dartos;* and the crural or lumbo-inguinal, *N. lumbo-inguinalis*, to the skin of the thigh.

4. External cutaneous, *N. cutaneus femoris anterior externus*, from the second and third lumbar nerves, pierces the *Fascia lata* beneath the anterior superior spine of the ilium and sends branches to the outer side of the thigh as far down as the knee.

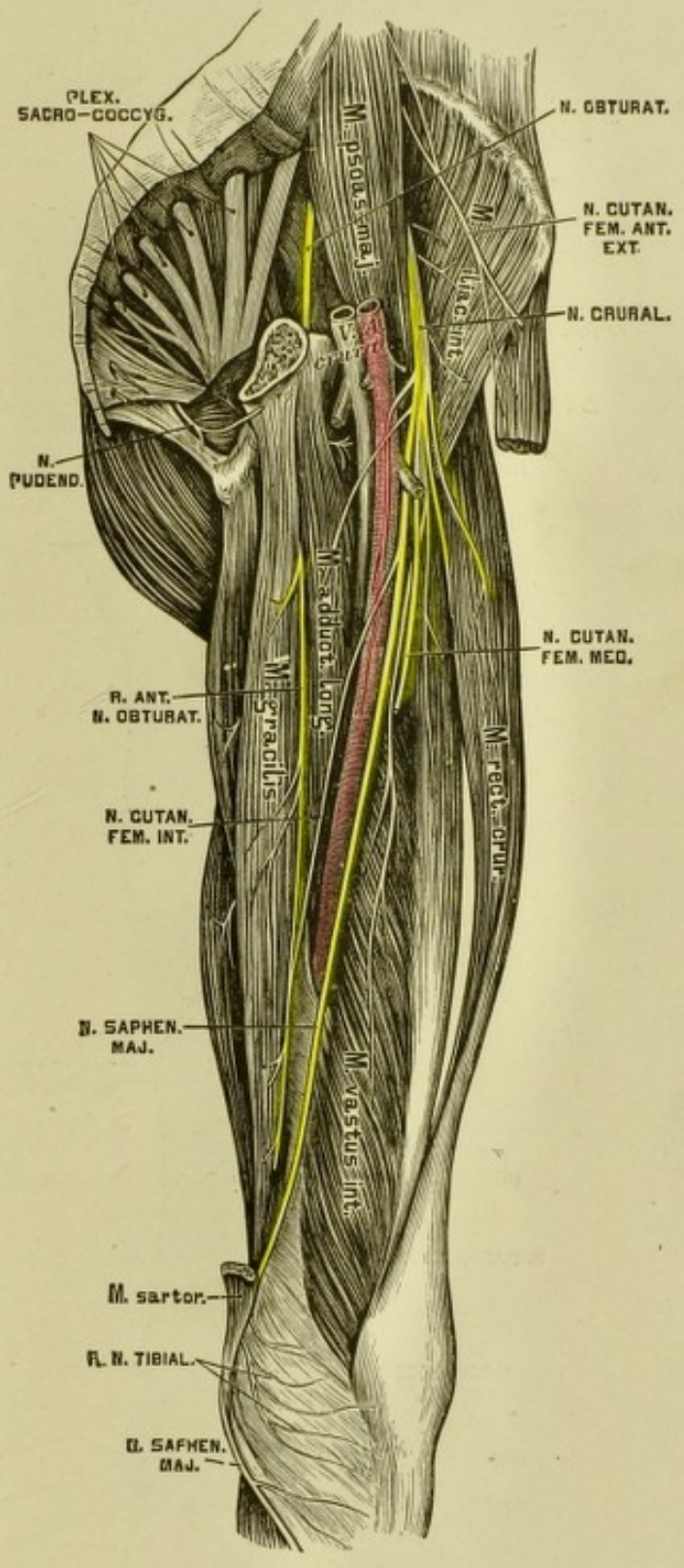
5. Obturator, *N. obturatorius*, from the second, third and fourth lumbar nerves, passes through the obturator foramen, supplies the *M. obturator externus*, and divides into an anterior and a posterior branch. The posterior branch goes to the *M. obturator externus* and *M. adductor magnus;* the anterior branch to the *M. gracilis*, *M. adductor longus* and *brevis*, pierces the *Fascia lata*, and sends filaments along the inner surface of the thigh, as far down as the knee-joint.

6. Anterior crural, *N. cruralis* (*femoralis*), arises from the loop between the second, third and fourth lumbar nerves, and is the largest nerve of the lumbar plexus. It passes between the *M. psoas* and *M. iliacus internus* through the *Lacuna muscularis* to the thigh and divides into cutaneous and muscular branches. The former are:

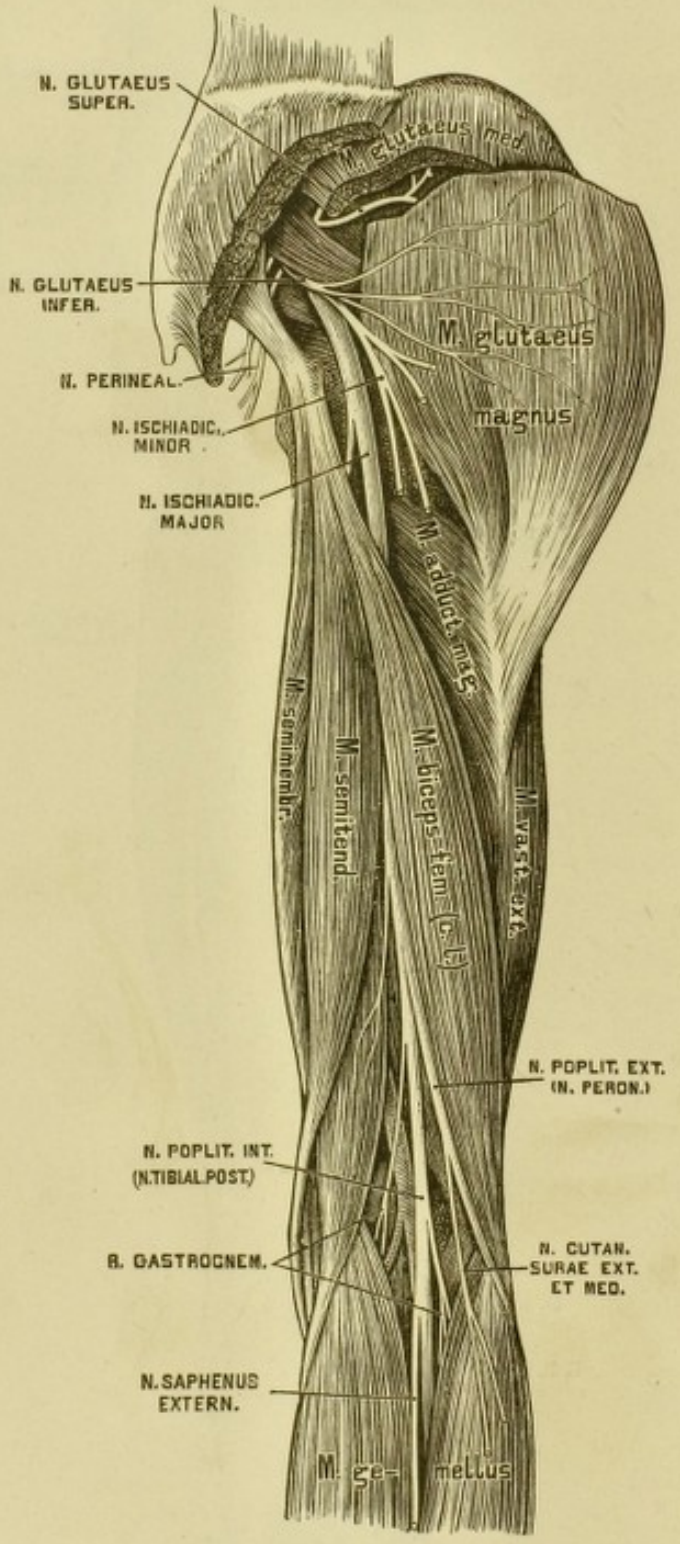
a) The middle cutaneous, *N. cutaneus femoris medius*, perforates the *M. sartorius* and passes to the middle of the anterior surface of the thigh.

b) The internal cutaneous, *N. cutaneus femoris internus*, pierces the *Fascia lata* in the middle of the thigh, communicates with the anterior branch of the obturator nerve, and passes to the inner side of the thigh.

c) The long or internal saphenous, *N. saphenus major*, passes down with the femoral artery to the opening in the adductor tendon, and runs between *M. vastus internus* and *M. adductor magnus* to the inner side of the knee-joint. Behind the tendon of the sartorius it passes through the *Fascia lata* and accompanies the internal saphenous vein down to the foot. It gives off the *N. cutaneus surae internus* to the calf of the leg, passes to the inner border of the foot, where it supplies the integument and communicates with the internal branch of the musculo-cutaneous nerve.



503. The Anterior Crural Nerve.



504. The Great Sciatic Nerve.

The muscular branches of the anterior crural nerve supply the muscles on the front of the thigh, with the exception of the adductors and gracilis.

The five sacral nerves, *Nervi sacrales*, are the largest of the spinal nerves, the coccygeal nerve, however, the smallest. The posterior divisions of these nerves pass through the posterior sacral foramina and *Hiatus sacro-coccygeus*, and unite to form the *Plexus sacralis posterior*, which supplies cutaneous branches to the sacral and coccygeal regions. The large, anterior divisions pass through the anterior sacral foramina and the *Foramen sacro-coccygeum*, and form the *Plexus sacro-coccygeus*.

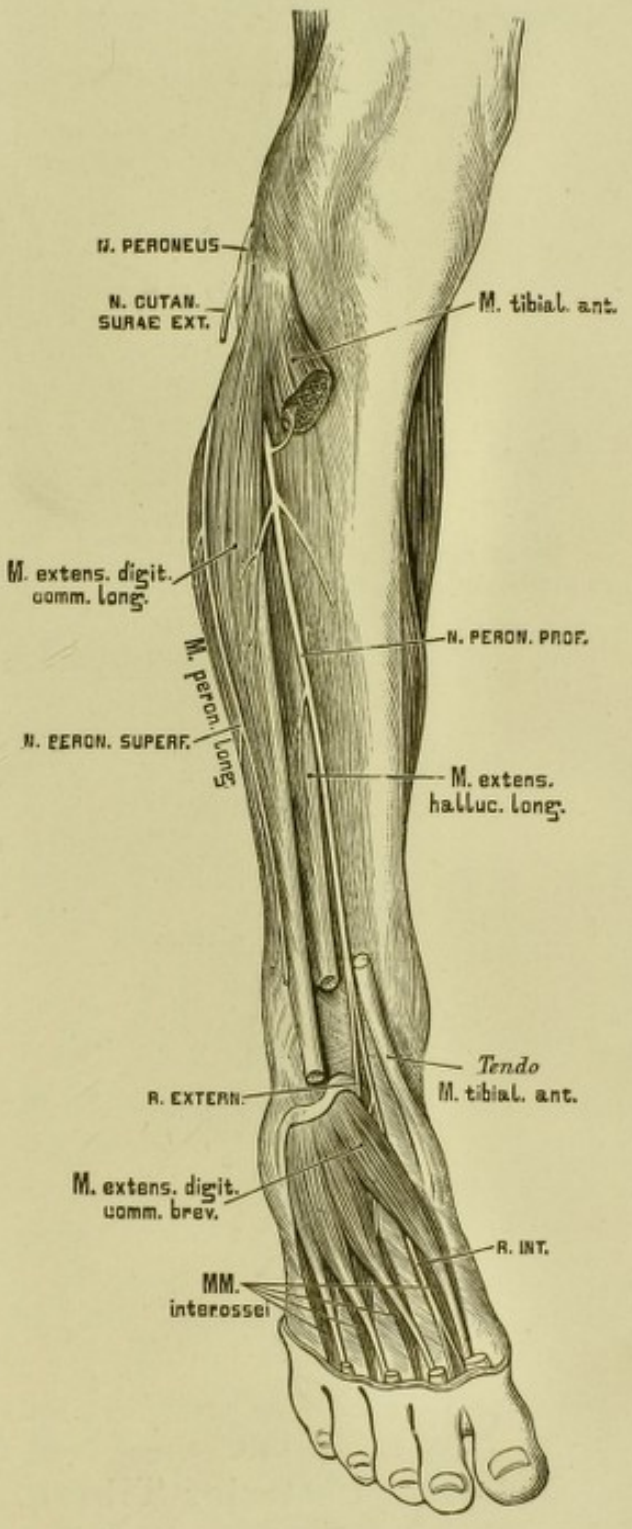
The *Plexus sacro-coccygeus* divides into the *Plexus ischiadicus*, *pudendalis* and *coccygeus*. The *Plexus ischiadicus* and *pudendalis* are usually classified under the name of the sacral plexus. The branches of the *Plexus ischiadicus* (of the sacral plexus with the exception of the pudic nerve and its branches) within the pelvis, are muscular filaments supplying the *M. pyriformis* and *M. obturator internus*. Outside of the pelvis the branches are following:

1. The superior gluteal, *N. glutaeus superior*, which passes through the great sacro-sciatic foramen above the pyriformis muscle and sends filaments to the *M. glutaeus medius, minimus* and *M. tensor vaginae femoris.*

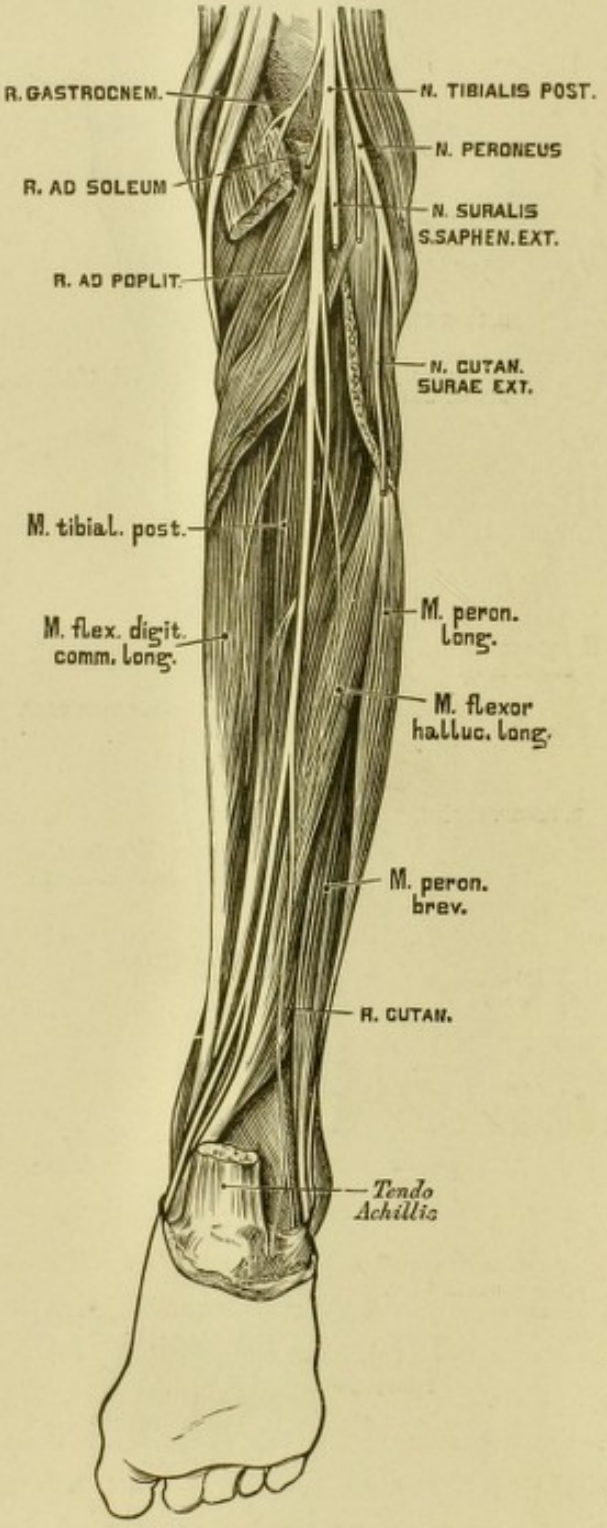
2. The inferior gluteal, *N. glutaeus inferior*, passes through the great sacro-sciatic foramen below the pyriformis muscles and supplies the *M. glutaeus maximus.*

3. The small sciatic *s. N. cutaneus femoris posterior*, also passes below the pyriformis to the buttock, and sends branches partly above the lower border of the *M. glutaeus maximus* to the skin of the buttock, partly to the posterior side of the thigh.

4. The great sciatic *s. N. ischiadicus*, passes through the great sacro-sciatic foramen below the pyriformis muscle to the gluteal region, supplies the *MM. gemelli, obturator internus* and *quadratus femoris*, and passes between the great trochanter and tuberosity of the ischium to the back of the thigh.



505. The Peroneal Nerve.



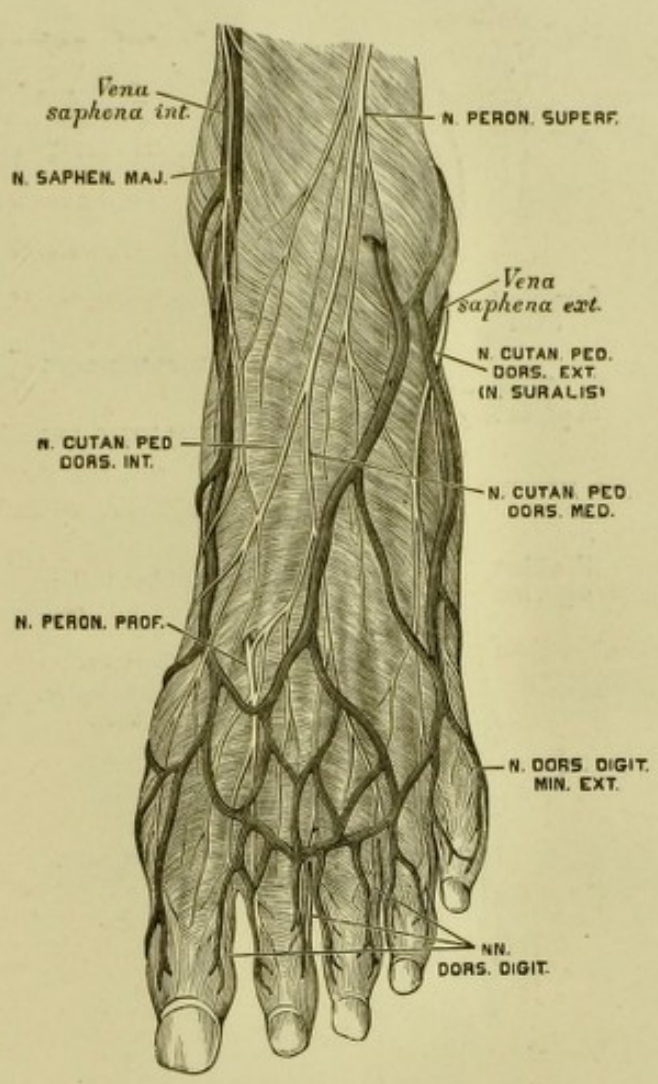
506. The Posterior Tibial Nerve.

The great sciatic nerve divides at a varying point into two branches, which, in the popliteal space are known as the external and internal popliteal, further down are called the peroneal and posterior tibial nerves.

1. The external popliteal or peroneal nerve descends to the fibula, and sends off articular branches to the knee-joint and cutaneous branches, the *N. cutaneus surae externus et medius* to the skin. It then divides into two branches, a superficial, the musculo-cutaneous, and a deep, the anterior tibial.

a) The musculo-cutaneous branch, *(N. peroneus superficialis)* passes forwards between the *MM. peronei* and *extensor longus digitorum*, pierces the deep fascia and is finally divided into an external branch, *N. cutaneus pedis dorsalis medius*, communicating with the short saphenous nerve, and an internal, *N. cutaneus pedis dorsalis internus*, communicating with the great saphenous nerve. They form the seven dorsal nerves of the toes (Fig. 507).

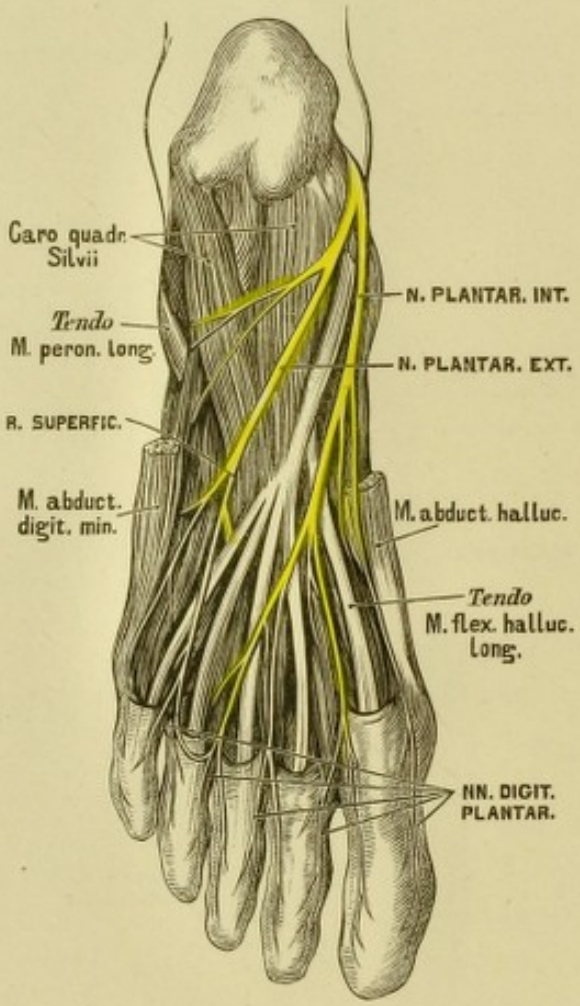
b) The anterior tibial branch *(N. peroneus profundus)* passes forwards to the fore part of the interosseous membrane, and gives off muscular branches for the *MM. tibialis anticus, extensor longus digitorum, peroneus tertius* and



507. The Nerves at the Dorsum of the Foot.

extensor proprius pollicis; it at first accompanies the anterior tibial artery, lying to its outer side, then lies in front of it and again at its outer side at the ankle-joint, from where it passes to the dorsum of the foot. It divides into an external branch for the *M. extensor digitorum brevis* and an internal branch, which, communicating with the internal division of the musculo-cutaneous nerve, supplies the adjacent sides of the large and second toe.

2. The internal popliteal, *N. popliteus internus*, descends along the back of the thigh through the middle of the popliteal space, to the lower part of the *M. popliteus*, where it passes with the artery beneath the arch of the soleus, and becomes the posterior tibial. Its branches are the external or short saphenous nerve, *N. suralis* or *N. communicans poplitei* which receives a communicating branch from the external popliteal nerve and is distributed to the integument along the outer

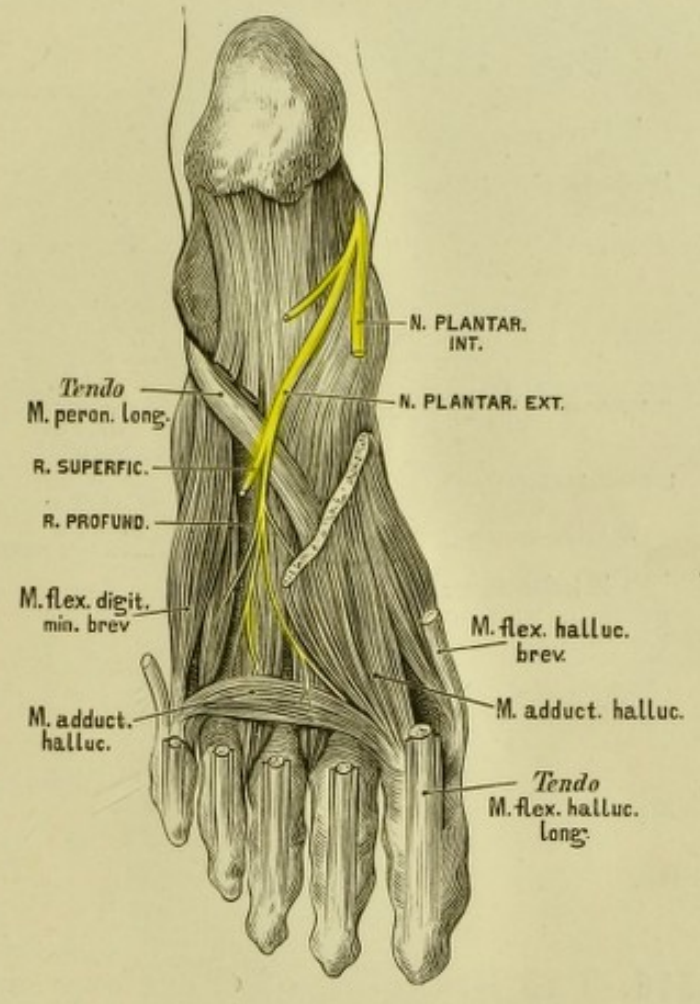


508. The two Plantar Nerves.

side of the foot and little toe, and at the dorsum of the foot is called *N. cutaneus pedis dorsalis externus*, and muscular branches to the *MM. gastrocnemius, plantaris, soleus* and *popliteus*.

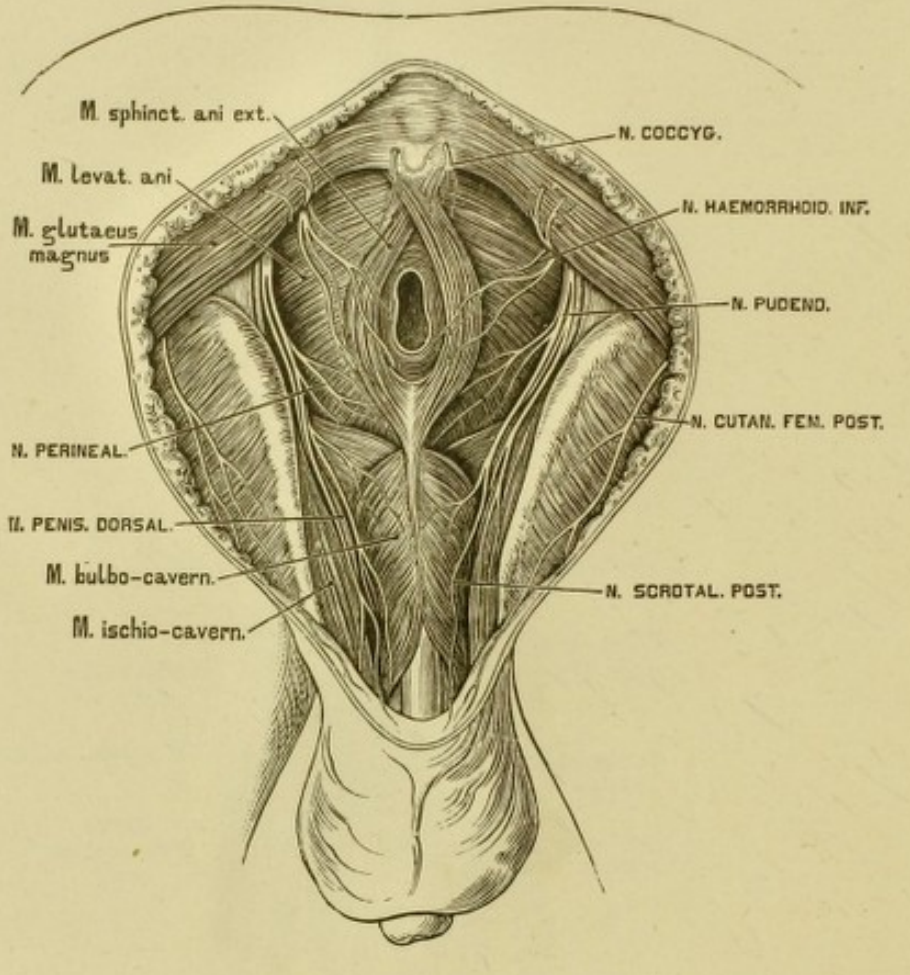
The posterior tibial nerve, *N. tibialis posticus*, lies at first to the inner side of the posterior tibial artery, which it soon crosses and then lies to its outer side as far as the ankle. In the interval between the inner malleolus and the heel, it divides into the external and internal plantar nerves. Its muscular branches supply the *MM. tibialis posticus, flexor longus digitorum* and *flexor longus pollicis*.

a) The internal plantar, *N. plantaris internus*, lies between *M. abductor pollicis* and *M. flexor digitorum brevis;* it divides into seven plantar digital nerves, *Nervi digitales plantares*, distributed to both sides of the three inner toes and to the inner side of the fourth toe.



509. The Deep Branch of the External Plantar Nerve.

b) The external plantar, *N. plantaris externus*, lies between *MM. flexor brevis digitorum* and *flexor accessorius*, and is divided into a superficial and a deep branch. The superficial separates into three digital branches, which supply the little and outer side of the fourth toes; this branch communicates with the internal plantar nerve. The deep or muscular branch accompanies the external plantar artery and supplies all the interossei (except those in the fourth metatarsal space), the two outer lumbricales, the *Adductor pollicis* and the *Transversus pedis* muscles.



510. The Branches of the *Plexus pudendalis.*

The *Plexus pudendalis,* lying at the lower border of the *M. pyriformis,* gives off the following branches:

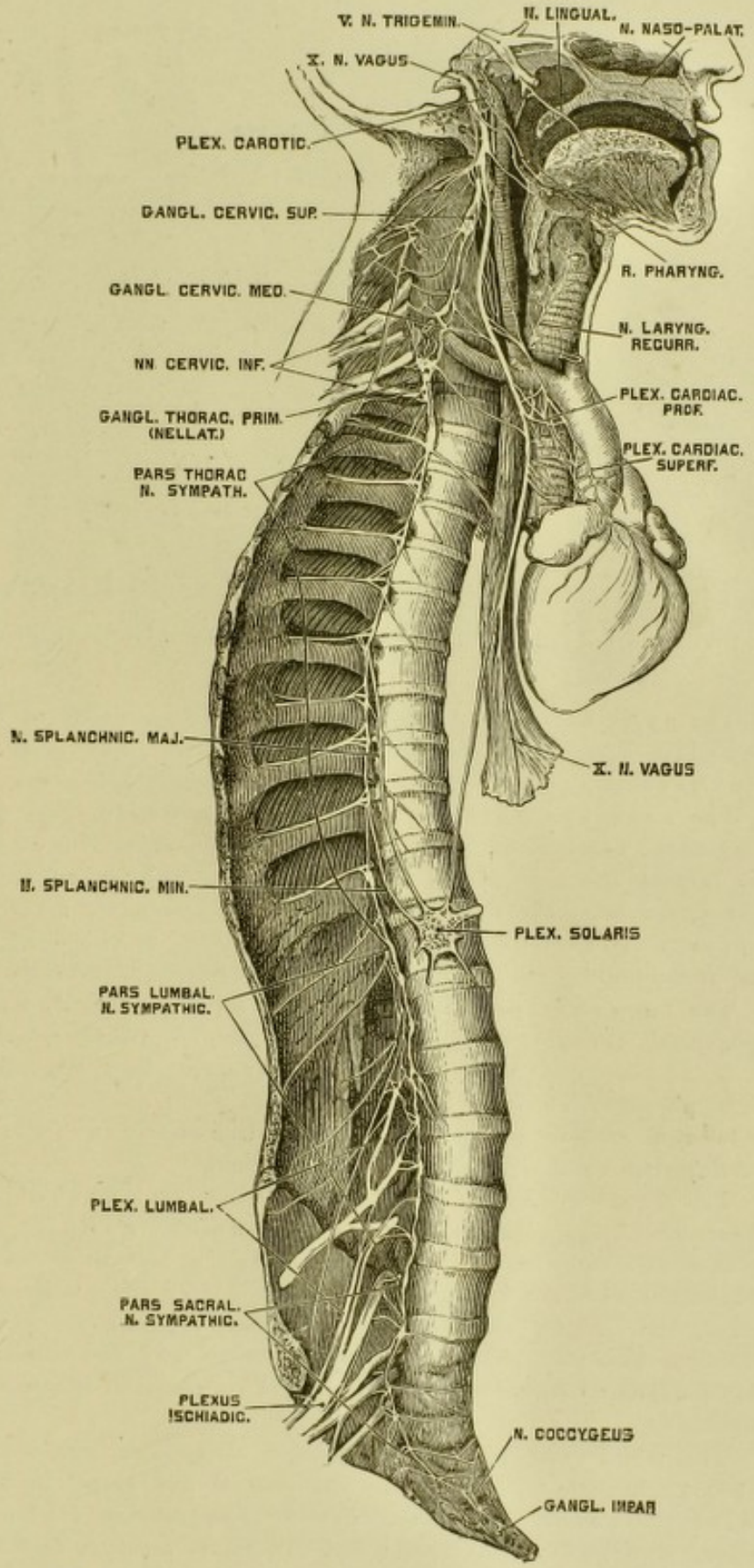
1. The middle and inferior haemorrhoidal nerves, *N. haemorrhoidalis medius et inferior,* which, communicating with each other and the pelvic plexuses of the sympathetic, supply the base of the bladder, the vagina, the *M. levator* and *sphincter ani ext. et int.*

2. The pudic nerve, *N. pudendus,* leaves the pelvis through the great sacro-sciatic foramen and reenters it through the lesser sacro-sciatic foramen; it gives off two terminal branches:

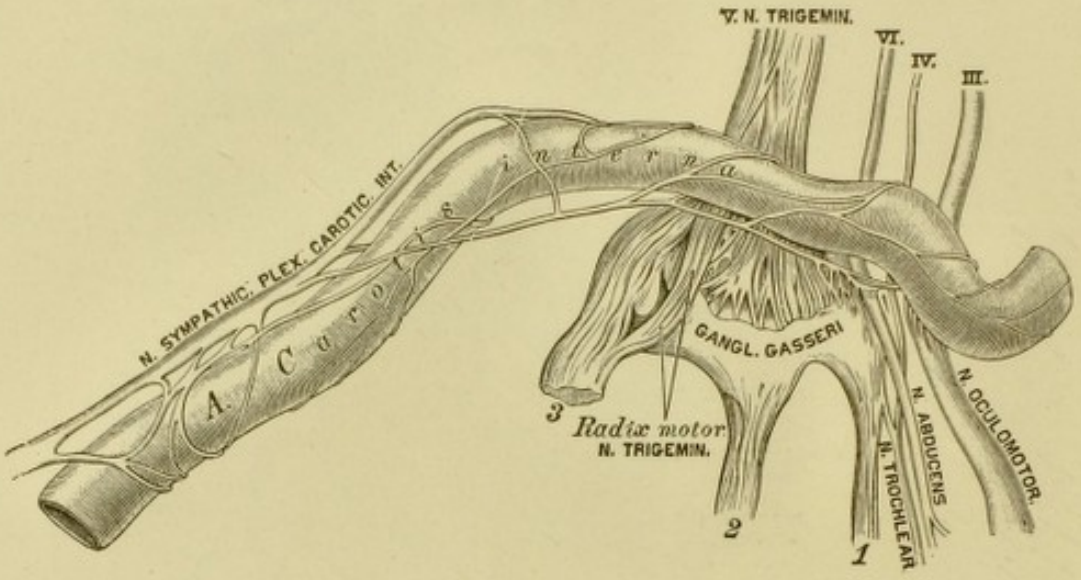
a) The perineal nerve, *N. perinealis,* which passes to the perinaeum and supplies the integument, the *MM. transversi perin., accelerator urinae (bulbo-cavernosus)* and *sphincter ani ext.,* and the scrotum *(Nervi scrotales posteriores);* in the female it supplies the labia and *Vestibulum vaginae (Nervi labiales posteriores).*

b) The dorsal nerve of the penis, *N. penis dorsalis,* which passes between *MM. accelerator urinae* and *erector penis* beneath the pubic symphisis, from there to the penis; in the female to the clitoris.

The *Plexus coccygeus* ends in the *M. sphincter ani ext., levator ani* and in the skin of the anus.



511. The Right Sympathetic Nerve.



512. The Communication of the Carotid Plexus with some of the Cranial Nerves. After Rüdinger.

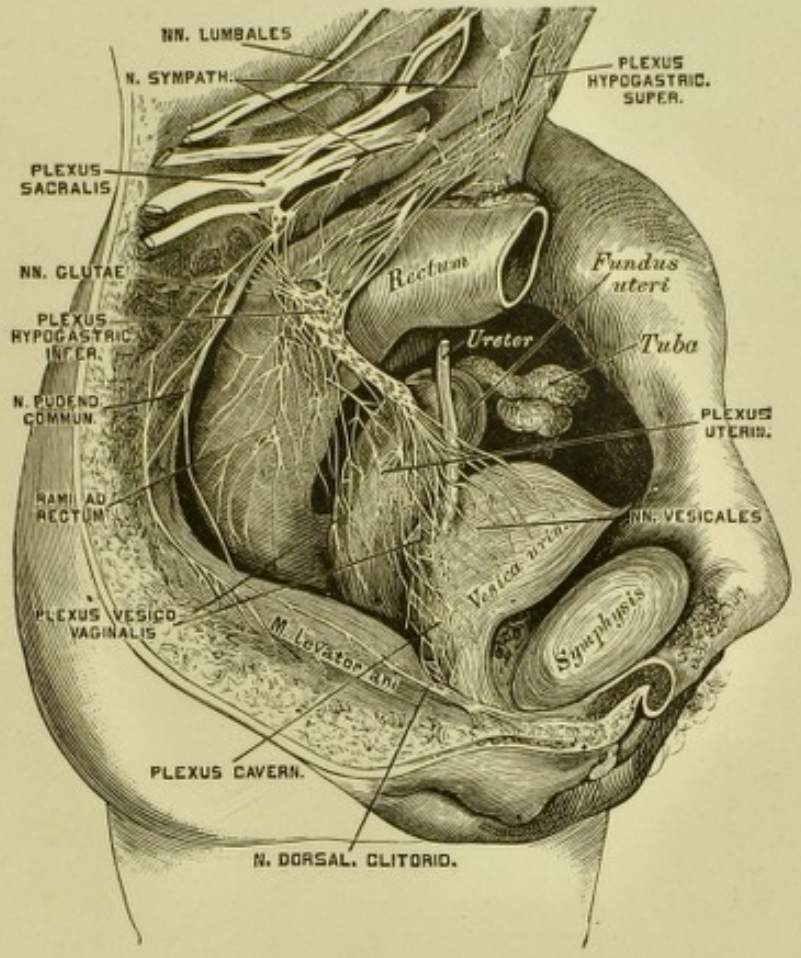
The sympathetic nerve, *N. sympatheticus*, consists of a series of ganglia, connected together by intervening cords, and of a number of plexuses.

The cervical portion of the sympathetic, *Pars cervicalis N. sympathici*, consists of three ganglia on each side. The superior is the largest, the middle is sometimes absent, the inferior is frequently joined with the first thoracic ganglion. The latter gives off the inferior cardiac nerve, *N. cardiacus inferior*, to the deep cardiac plexus, the middle gives off the middle cardiac, *N. cardiacus medius*.

The thoracic portion of the sympathetic, *Pars thoracica N. sympathici*, consists of eleven thoracic ganglia, which communicate with each other and with the intercostal nerves; they strengthen the thoracic plexuses. The first thoracic ganglion gives off the *N. cardiacus imus* to the cardiac plexus. The two splanchnic nerves, *Nervi splanchnici*, pass to the plexuses of the abdomen.

The lumbo-sacral portion of the sympathetic, *Pars lumbo-sacralis N. sympathici* has four or five lumbar ganglia, *Ganglia lumbalia*, and the same number of sacral ganglia, *Ganglia sacralia*, which are connected with the lumbar nerves. They supply the plexuses of the abdomen, the *Ganglia sacralia* also the *Plexus hypogastricus inferior*. At the coccyx, the two gangliated cords converge, and are connected by means of a loop, in which a single ganglion, *Ganglion coccygeum impar*, is found.

The plexuses of the sympathetic nerve are formed not only by the sympathetic, but also by the cranial and spinal nerves. The cranial plexuses are: the *Plexus caroticus internus* (called in the cavernous sinus: *Plexus cavernosus*) and the *Plexus caroticus externus*.



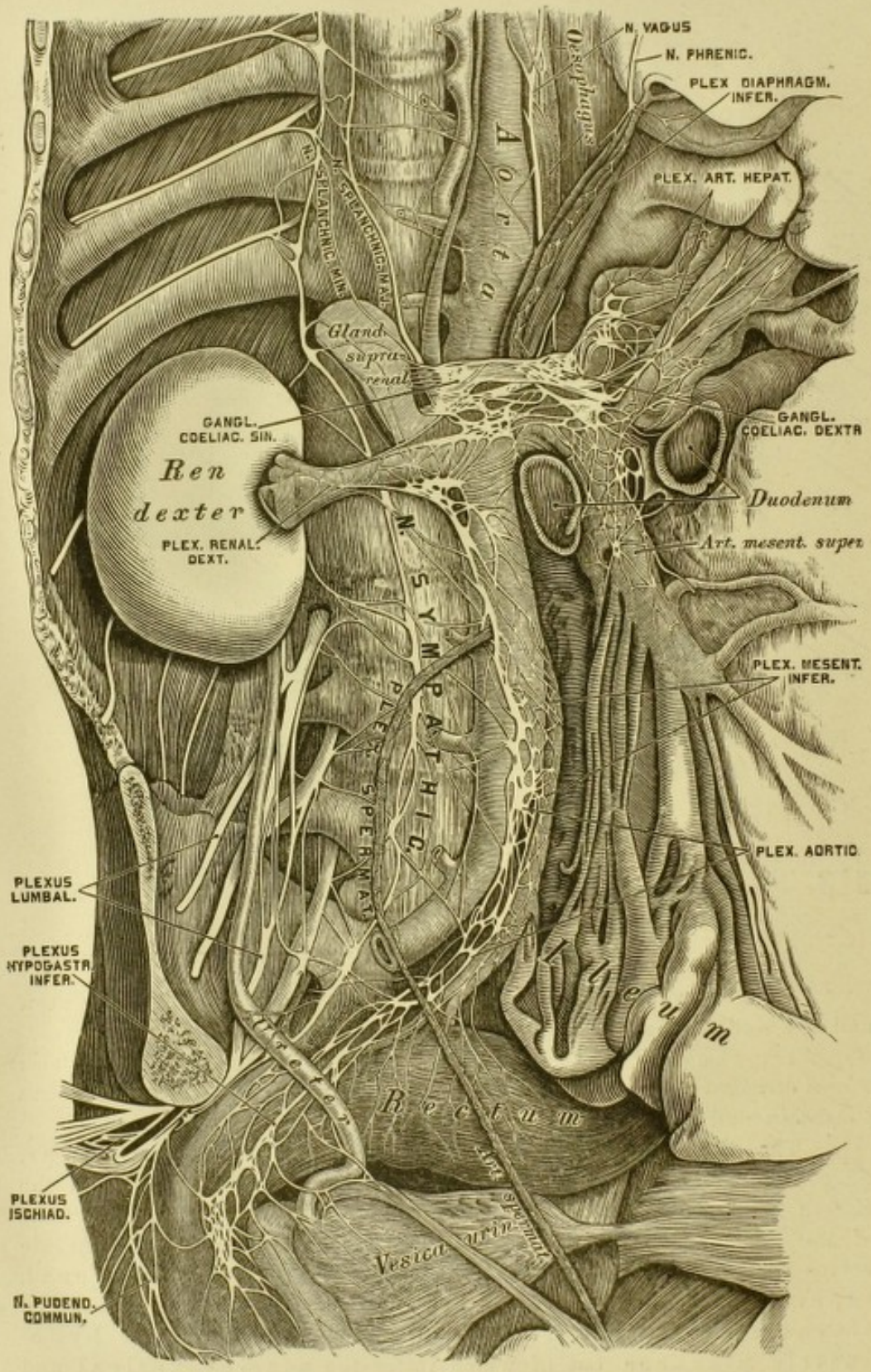
513. The Pelvic Plexuses of the Sympathetic Nerve in the female.

The cervical plexuses surround the arteries of the neck and are called *Plexus laryngeus, thyreoideus inferior* and *vertebralis.*

The thoracic plexuses belong partly to the vascular system: *Plexus cardiacus* and *aorticus,* partly to the lungs and oesophagus: *Plexus pulmonalis* and *oesophageus.*

The abdominal and pelvic plexuses are: Solar plexus, *Plexus epigastricus s. solaris,* the largest plexus, which supplies all the viscera in the abdominal cavity, situated behind the stomach and in front of the aorta and crura of the diaphragm; it receives both splanchnic nerves coming out of the thorax; the phrenic, suprarenal, renal, superior mesenteric, spermatic and inferior mesenteric plexuses; then the aortic, abdominal and inferior hypogastric plexuses out of which latter the uterine, vesical and cavernous plexuses are given off in the female.

The branches and communications of the sympathetic nerve are evident from Fig. 511—514.

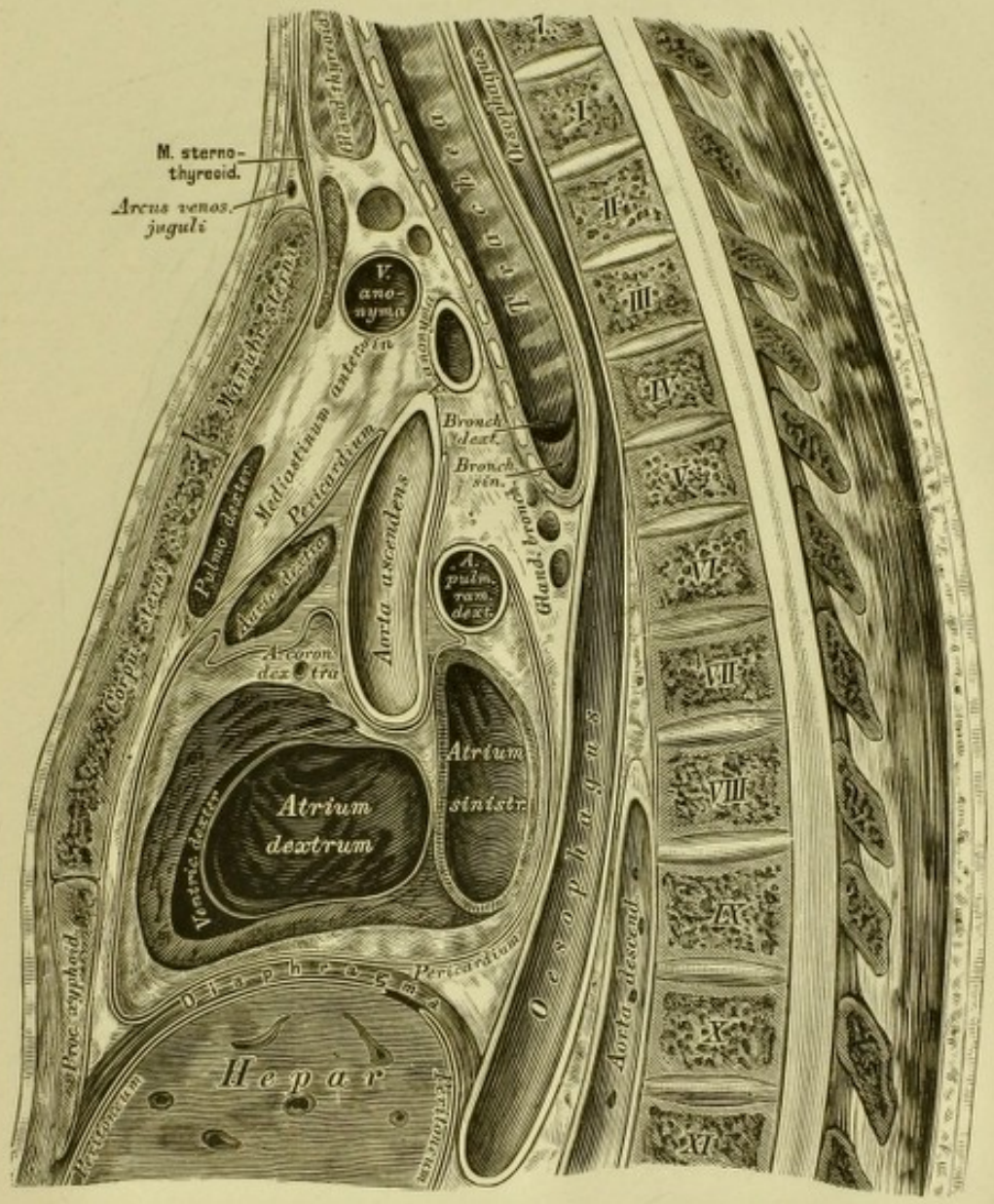


514. The Abdominal and Pelvic Plexuses of the Sympathetic Nerve. After Rüdinger.

VI.

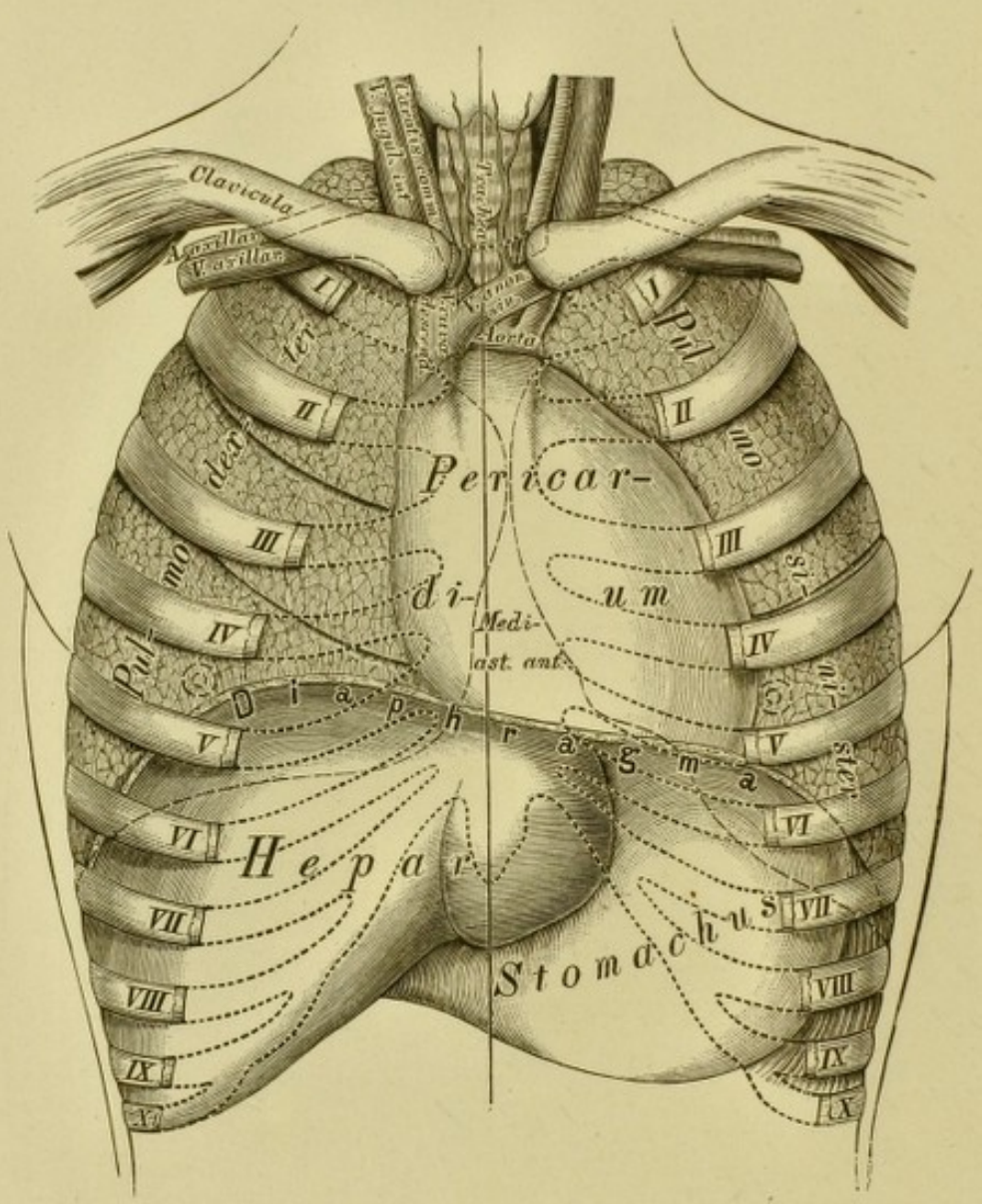
VASCULAR SYSTEM.

TOPOGRAPHY.



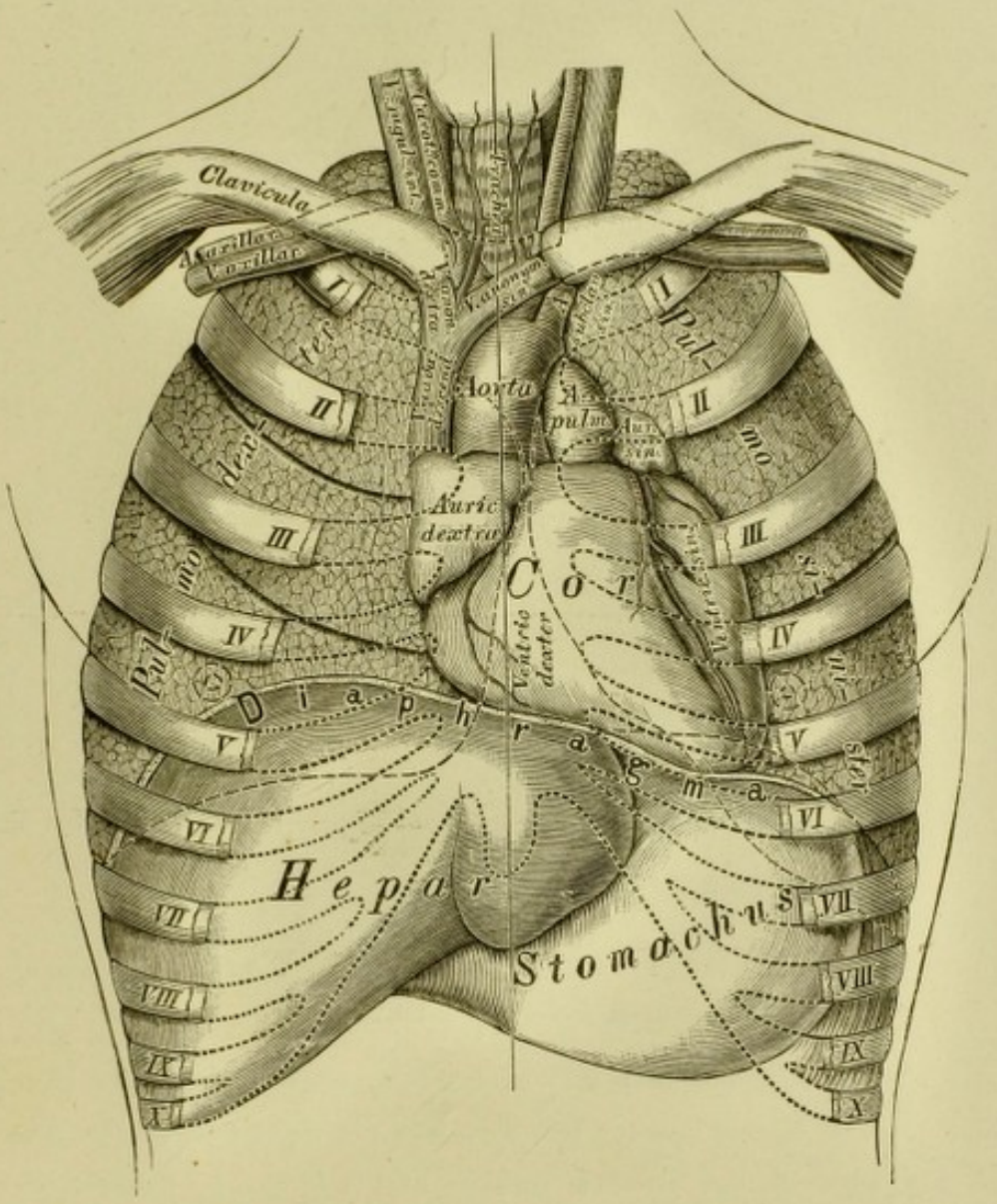
515. Medial Section through the Thorax of a Man of 21 Years.

$^1/_2$ natural size. After W. Braune.



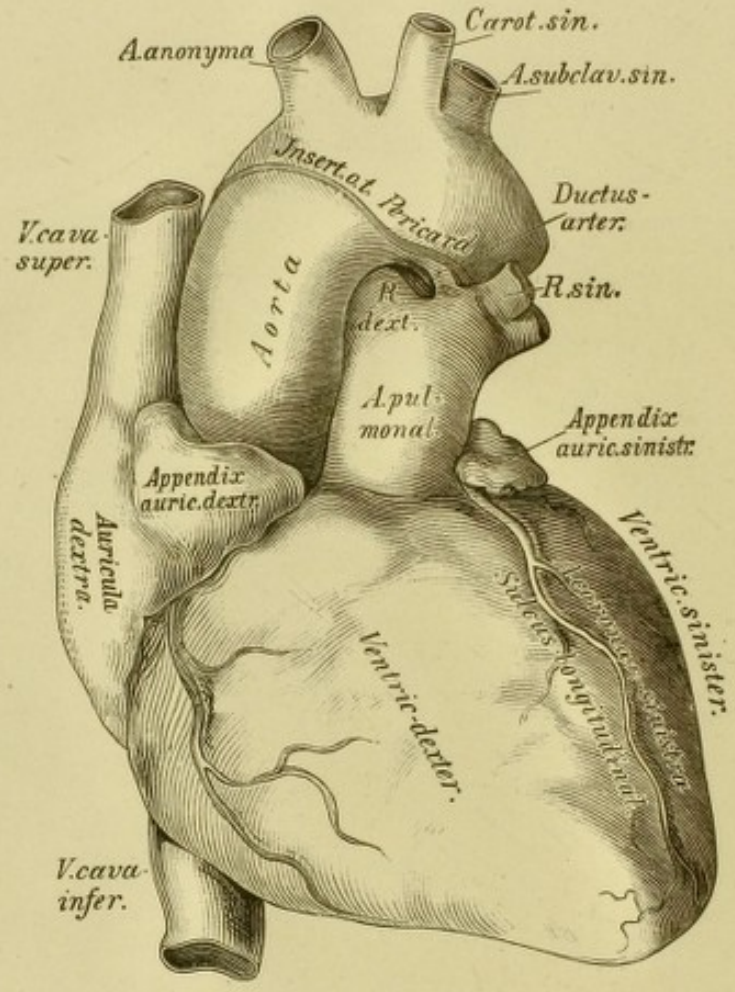
516. Topography of the Thoracic Viscera.

The heart is contained in a conical, membranous sac, the *Pericardium,* the apex of which is directed upwards and surrounds the great vessels, the base of which is attached to the central tendon of the diaphragm. The pericardium consists of an external and an internal layer; the former has the structure of fibrous, the latter of serous membranes. The serous layer invests the heart, and is then reflected on the inner surface of the pericardium; it consists, therefore, of a visceral and a parietal portion. The fibrous layer is continued above for some distance along the large blood-vessels in the form of tubular prolongations, which become gradually lost upon their external coats.



517. Topography of the Thoracic Viscera.

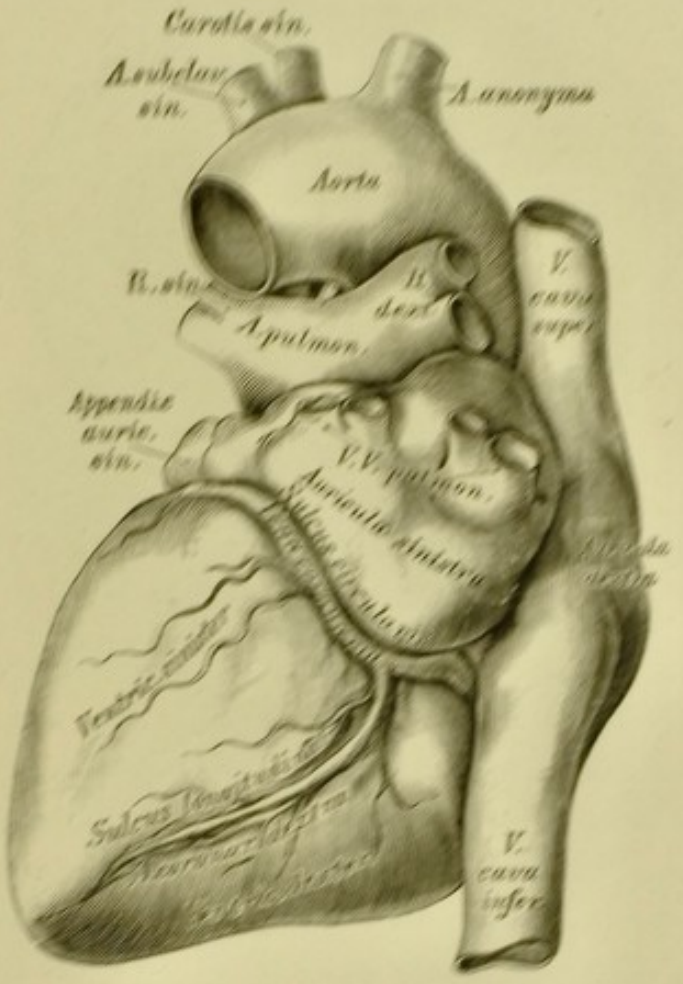
The pericardium is covered in front by the pleurae and the margins of the lungs, behind it rests upon the bronchi, oesophagus and descending aorta. After opening of the pericardium a part of the large vessels is found enclosed in its cavity. The aorta, the superior vena cava, the four pulmonary veins and the right and left divisions of the pulmonary artery, receive each an investment from the fibrous layer of the pericardium. The space between heart and pericardium contains a small quantity of *Liquor Pericardii.*



518. The Heart and Large Vessels.

View from before, $^1/_2$ natural size.

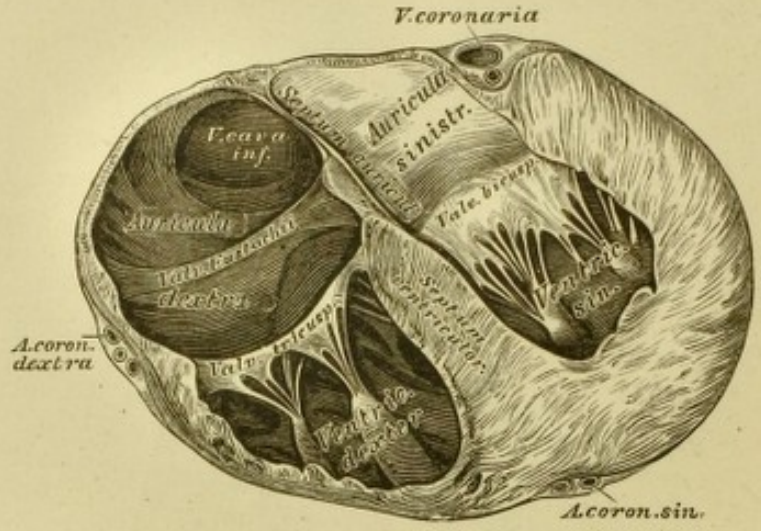
The heart, *Cor*, is a hollow, muscular organ of a conical form, which projects further into the left than into the right half of the chest, and lies between the concave surfaces of the lungs. It consists of a base, directed upwards, backwards and to the right, and of an apex, directed downwards, forwards and to the left; also of a convex anterior surface, a flattened posterior surface and two lateral borders. Two longitudinal sulci, situated one on the anterior, the other on the posterior surface, divide the heart into a right and a left half; these sulci are continuous one with the other a little to the right of the apex; the anterior is nearer to the left and the posterior nearer to the right side of the heart. Both halves are again divided by a deep transverse groove, which is plainly visible only at the posterior surface of the heart.



519. The Heart and Large Vessels.

View from behind, $^1/_2$ natural size.

Up to the fourth month of embryonic life the position of the heart is a vertical one; in the adult it is placed obliquely, the long axis of the heart forming with that of the body an angle of about 50°. The base of the heart is situated between the second and third left ribs and extends to the interspace between fourth and fifth right costal cartilages; its apex lies behind the anterior extremities of the left fifth and sixth ribs. The long axis of the heart is therefore placed obliquely from right to left from above downwards, and the base is further posterior than the apex.



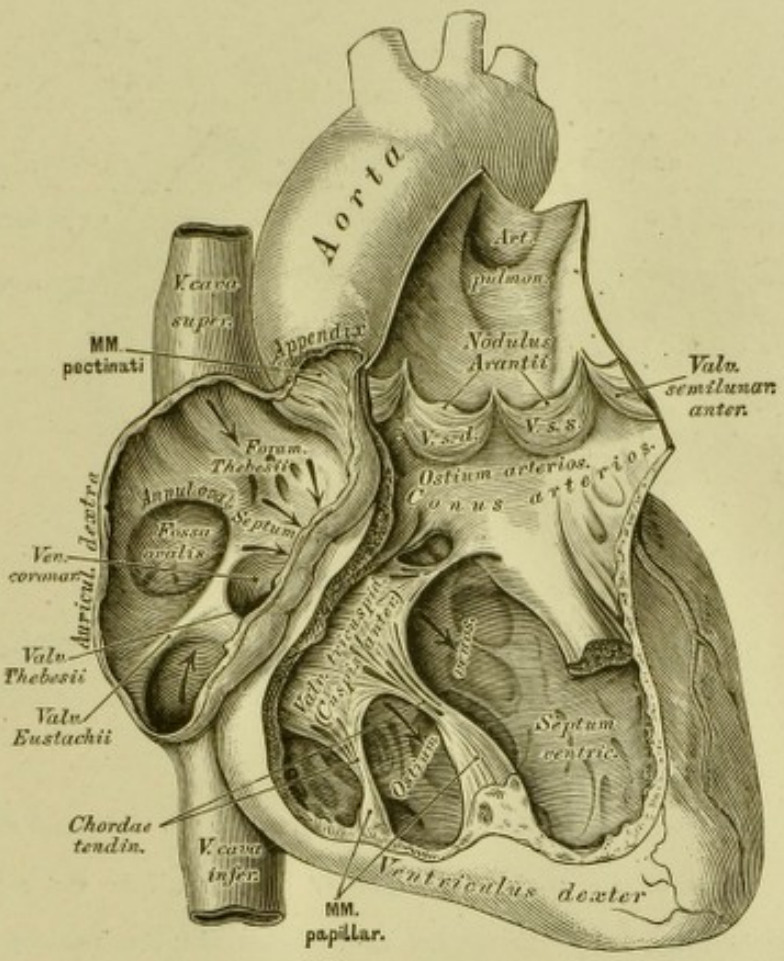
520. Horizontal Section through the Heart.

(Vertically to the long axis of the body.)

The heart is divided by a muscular septum into two halves, each of which is again subdivided into an upper cavity, the auricle*, *Auricula*, and a lower cavity, the ventricle, *Ventriculus*. The partition between the ventricles is called *Septum ventriculorum*, that between the auricles, *Septum auriculorum*. Each ventricle is triangular in form, the walls of the left considerably thicker than those of the right. The muscular columns which project from nearly the whole of the inner surfaces of the ventricles, are called *Columnae carneae;* those which run across the inner surface of the *Appendix auriculae*, and adjoining portion of the wall of the sinus, *Musculi pectinati*.

Into the right auricle the *Venae cavae* and coronary sinus open, into the left the four pulmonary veins. Each auricle communicates with the corresponding ventricle by means of the auriculo-ventricular orifice, *Ostium auriculo-ventriculare s. venosum;* the ventricles open into the arteries which arise from them, each by means of an *Ostium arteriosum*, the right into the pulmonary artery by means of the opening for the pulmonary artery, the left into the aorta, by means of the aortic opening. All openings have valves; between auricles and ventricles are the *Valvulae auriculo-ventriculares*, between ventricles and arteries the *Valvulae semicirculares*.

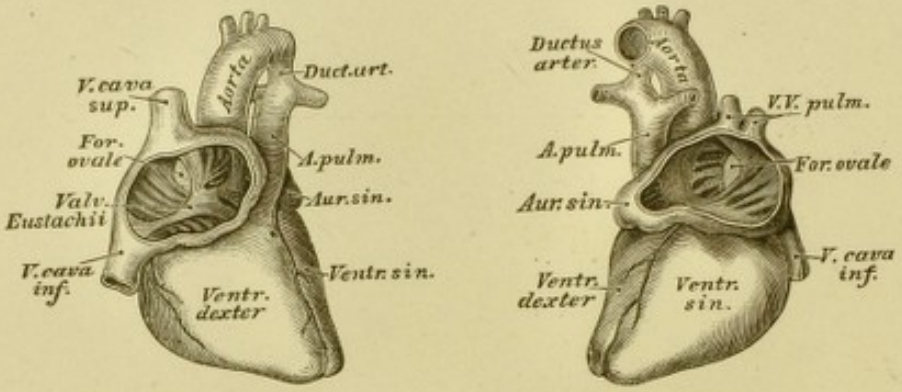
* The principal cavity or sinus of the auricle is often known as the atrium, to distinguish it from the auricular appendix, which is called auricle proper, *Auricula*.



521. The Right Heart, laid open.

The right auriculo-ventricular orifice is guarded by the tricuspid valve, *Valvula tricuspidalis;* the left by the mitral or bicuspid valve, *Valvula bicuspidalis.* One set of the *Columnae carneae* are the *Musculi papillares,* which are connected at their base with the ventricular wall, and by the other end are attached to small tendinous cords, *Chordae tendineae,* through which they are connected with the segments of the auriculo-ventricular valve.

The semilunar valves, *Valvulae semilunares,* three in number on each side, guard the orifices of the aorta and pulmonary artery; they are attached by their convex margins, to the wall of each artery, at its junction with the ventricle, the straight border being free. The free margin of each presents at its middle, a small projecting fibro-cartilaginous nodule, *Nodulus s. Corpus Arantii,* which is especially marked at the semilunar valve of the aorta. The internal surfaces of all the cavities of the heart are lined by the *Endocardium,* which is a thin, connective tissue membrane covered with endothelium.

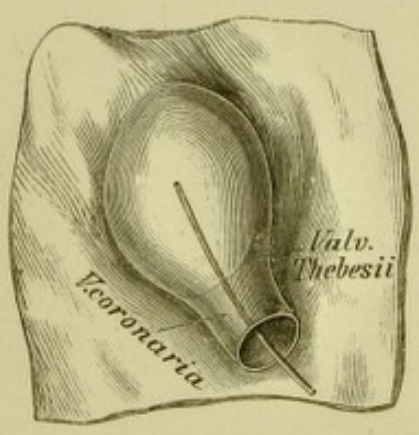


522 a. b. Heart of an Embryo of Six Months, natural size, the auricles laid open.

The right auricle, *Auricula dextra*, occupies the right and anterior portion of the base of the organ. Its right or outer wall is the smallest, the left wall is formed by the *Septum auricularum*. At the posterior half of the septum is the *Fossa ovalis*, whose floor is thin and translucent; it is bounded above and at the sides by a prominent border, deficient below, the *Annulus ovalis s. Limbus foraminis ovalis s. Isthmus Vieussenii* (see Fig. 521).

In the heart of the embryo, the *Fossa ovalis* is a foramen, *Foramen ovale;* the blood flowing from the inferior *Vena cava* into the right auricle, mostly arterial, is guided by a semilunar projection, the Eustachian valve, to the *Foramen ovale*, through which the greater part passes to the left auricle.

The inferior *Vena cava* opens at the posterior wall of the right auricle, the superior *Vena cava* at the upper wall. The right *Appendix auriculae* projects forwards and to the left side, overlapping the root of the aorta. The under part of the right auricle is occupied by the auricular-ventricular orifice, which leads into the right ventricle.

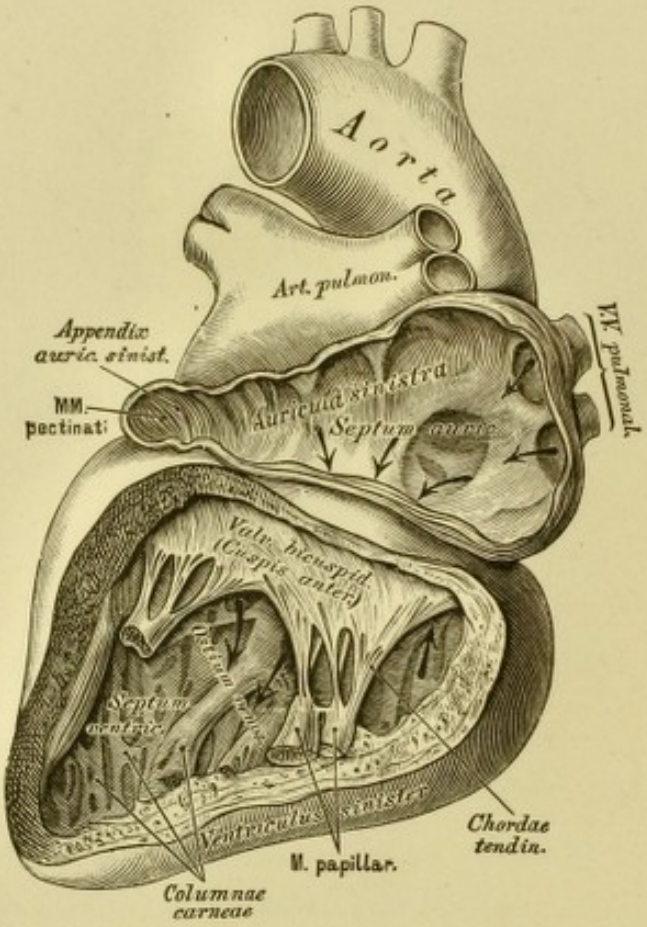


523. The Opening of the Coronary Vein into the Right Auricle.

View from behind. After a dried specimen, natural size.

In the right auricle there is also the coronary valve or *Valvula Thebesii*, a semicircular fold of the lining membrane of the auricle, protecting the orifice of the coronary sinus. The *Foramina Thebesii* are numerous minute apertures, the mouths of small veins, which open on various parts of the inner surface of the auricle.

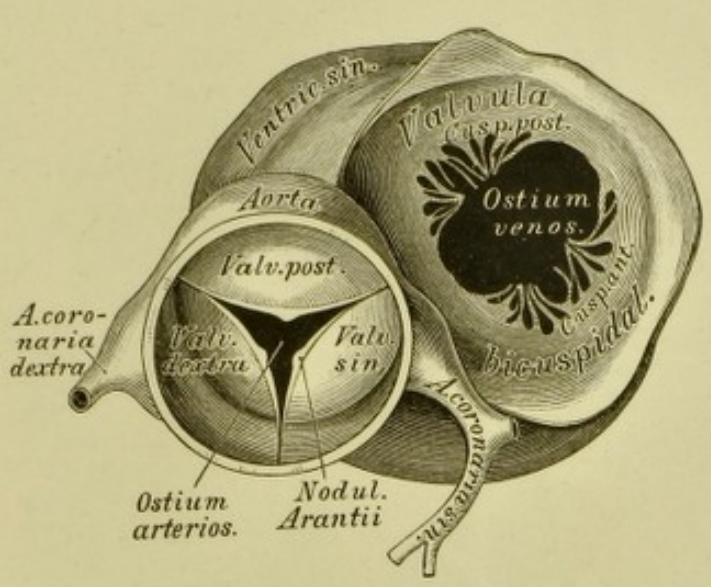
The Eustachian valve is a crescentic fold of the lining membrane, which is an important structure in the foetal heart, serving the purpose of directing the stream of blood from the inferior *Vena cava* through the *Foramen ovale* into the left auricle. Its convex margin is attached to the wall of the *Vena cava*, its free concave margin terminates in two cornua, of which the left is attached to the anterior edge of the *Annulus ovalis*. The *Tuberculum Loweri* is not visible in the hearts of adults; it is a small projection on the right wall of the auricle between the two *Venae cavae*. Both the coronary valve and the Eustachian valve may be found fenestrated.



524. The Left Heart, laid open.

The left auricle, *Auricula sinistra,* has opening into it the four pulmonary veins, two into the right and two into the left side. The direction of the *Appendix auriculae* is forwards and towards the right side, overlapping the root of the pulmonary artery.

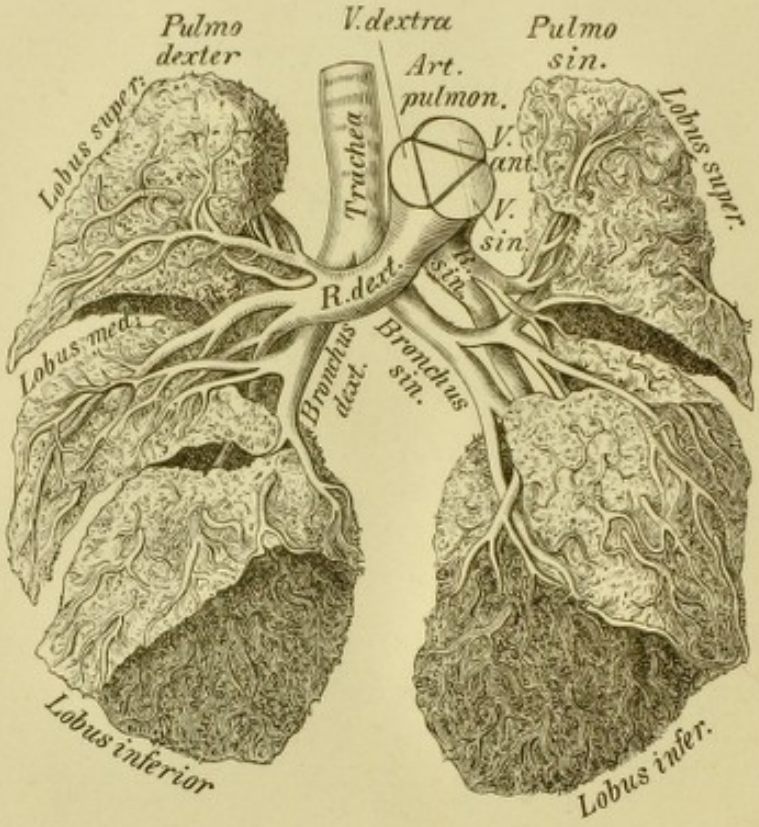
The right ventricle, *Ventriculus dexter,* is separated from the left by the *Septum ventriculorum.* The auriculo-ventricular opening is guarded by the tricuspid valve, *Valvula tricuspidalis,* which consists of three segments or flaps, an anterior, a posterior and an internal, of which the anterior is the largest. These segments are connected by their bases to the auriculo-ventricular orifice, and by their sides with one another, their free margins and ventricular surfaces giving attachment to a number of *Chordae tendineae.* The arterial opening is at the left side of the base of the ventricle, and leads into the pulmonary artery; the conical prolongation from which it is given off is called *Conus arteriosus* (see Fig. 521). The three semilunar valves at the orifice of the pulmonary artery are divided into an anterior, a right and a left; their *Noduli Arantii* are often very small.



525. The Left *Ostium auriculo-ventriculare s. venosum* and *arteriosum,* from above. After a dried specimen, natural size.

The wall of the left ventricle, *Ventriculus sinister,* is, in the adult, considerably thicker than that of the right. Its auriculo-ventricular opening is guarded by the bicuspid or mitral valve, *Valvula bicuspidalis s. mitralis,* which consists of an anterior and a posterior segment. Of the semilunar valves surrounding the orifice of the aorta, one is placed to the right, one to the left and one posteriorly; they are stronger and thicker than those of the pulmonary artery, and the *Noduli Arantii* are larger and more prominent.

During the diastole the auricles and ventricles of the heart are filled with blood, which, during the systole is again driven out. The systole of both auricles is, as well as that of the ventricles, synchronous, and the latter follows the former after a very short interval. During the diastole the right heart is filled by the venous blood from the *Venae cavae* and coronary veins, and during the systole it drives the blood into the pulmonary artery. The left heart is filled during the diastole with the arterial blood from the four pulmonary veins, and during the systole drives the blood into the aorta.



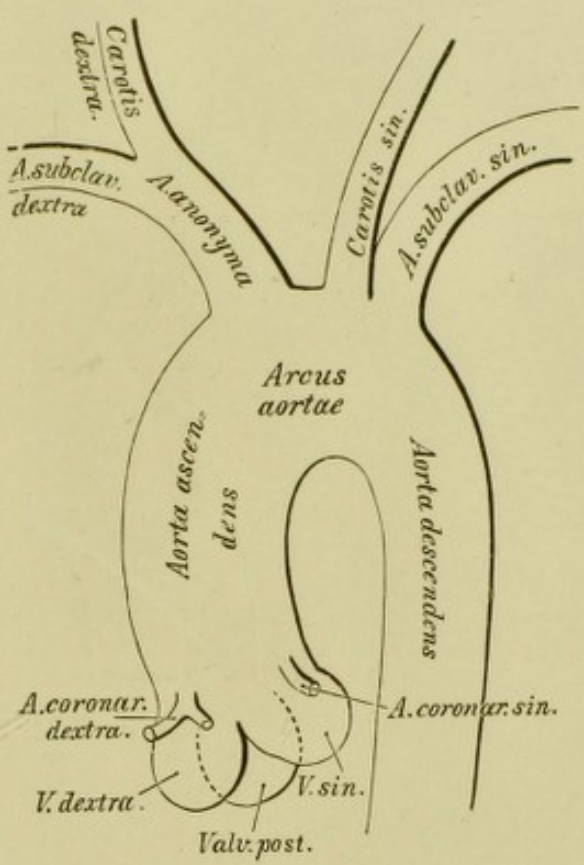
526. Pulmonary Artery and Air Passages of a Child.

$^1/_2$ natural size, after a specimen of Hyrtl.

The pulmonary artery, *Arteria pulmonalis*, arises from the right ventricle; at the concavity of the aortic arch it divides into a right and a left branch. The right, longer branch passes behind the ascending aorta and superior *Vena cava* to the root of the right lung. The left, smaller branch passes in front of the descending aorta and left bronchus to the root of the left lung; it is connected with the concave portion of the aortic arch by means of a short, fibrous cord, which corresponds to the obsolete *Ductus arteriosus Botalli* of the embryo.

In the root of the lung, the right and left pulmonary arteries, both lie in front of the bronchus and behind the veins. On the right side the bronchus is highest and the veins lowest, while on the left side the bronchus sinks to a level between the artery and veins.

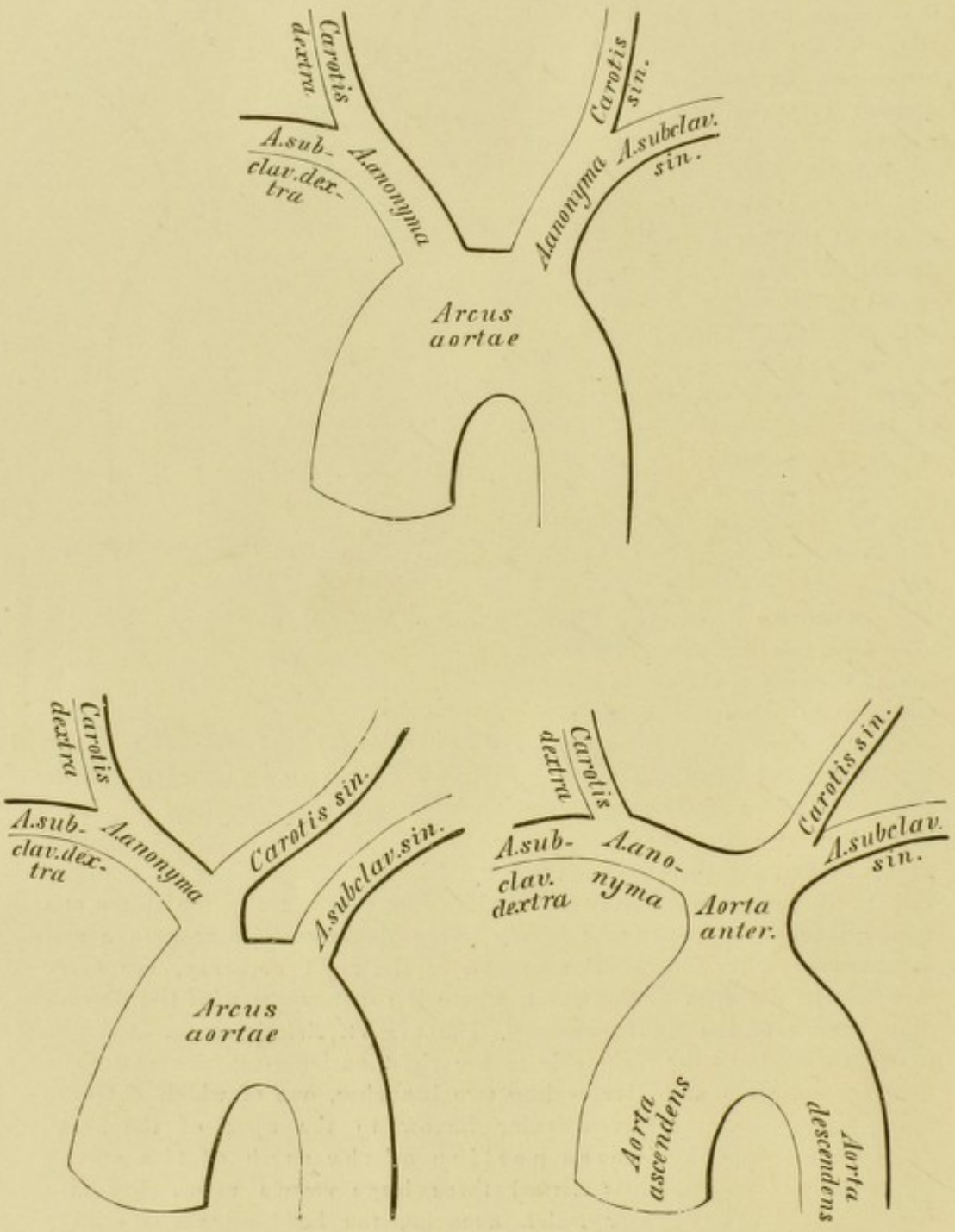
The aorta, the main trunk of the arterial system, arises from the upper part of the left ventricle of the heart, with an enlargement, the *Bulbus Aortae*. It is divided into the arch of the aorta, thoracic aorta and abdominal aorta. The arch of the aorta extends from the origin of the vessel to the lower border of the body of the fourth dorsal vertebra; it at first ascends obliquely upwards and to the right side as ascending aorta, then passes transversely from right to left, and from before backwards as transverse aorta, and then descends upon the left side of the body of the fourth dorsal vertebra, being there called descending aorta.



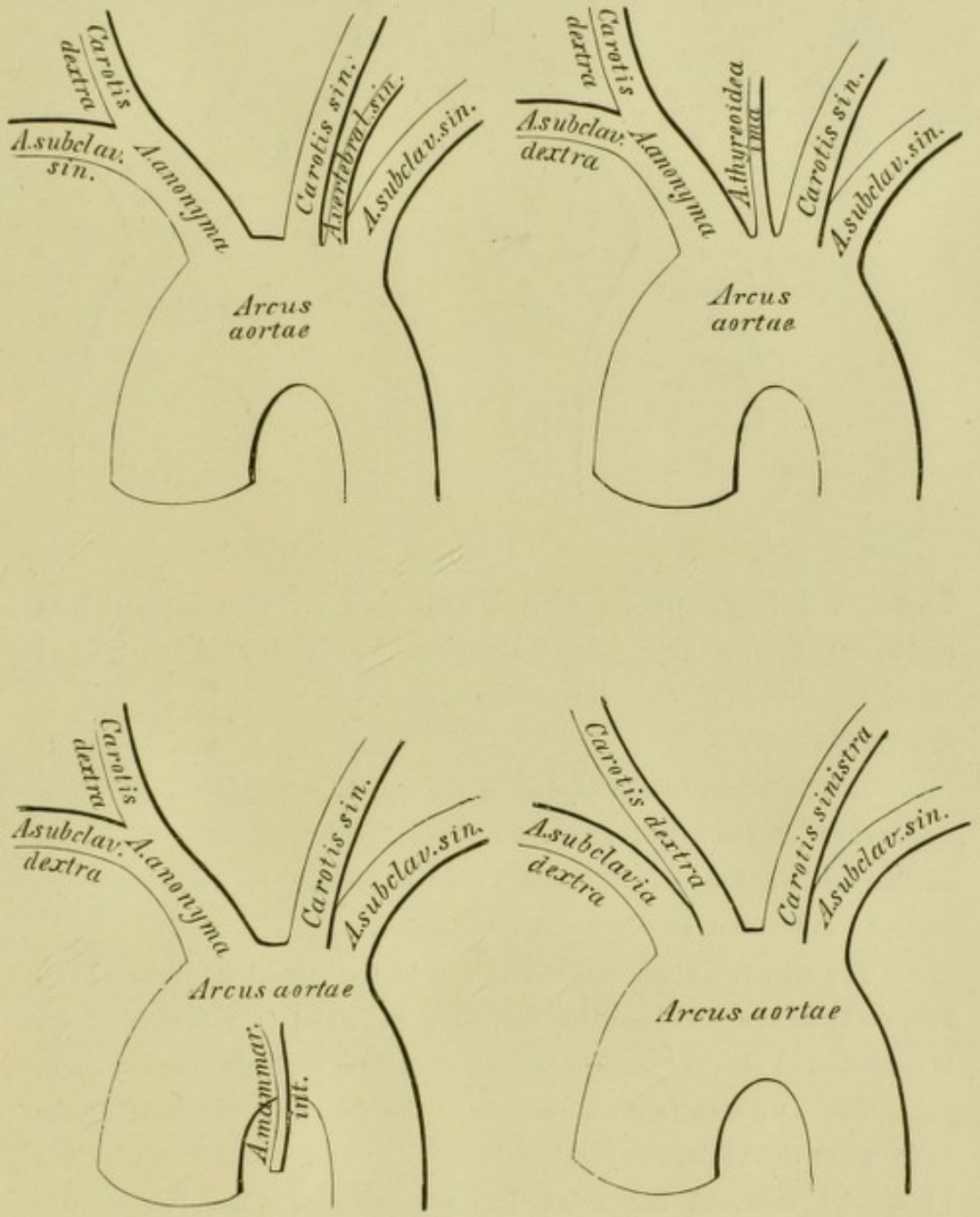
527. Diagram of the Primary Branches of the Arch of the Aorta.

The two coronary arteries arise from the ascending portion of the arch of the aorta, in the upper parts of two of the sinuses of Valsalva, on a level with the margins of the semilunar valves. The left, *Arteria coronaria sinistra*, is usually larger than the right; it passes behind and then to the left side of the pulmonary artery and divides into two branches; of these one passes transversely outwards in the left auriculo-ventricular groove and anastomoses with the superior branch of the right coronary, the other descends to the apex of the heart, where it anastomoses with the descending branch of the right coronary. The right, *Arteria coronaria dextra*, passes forwards to the right side in the right auriculo-ventricular groove, curves backwards and divides into two branches, one of which descends along the posterior interventricular furrow to the apex of the heart.

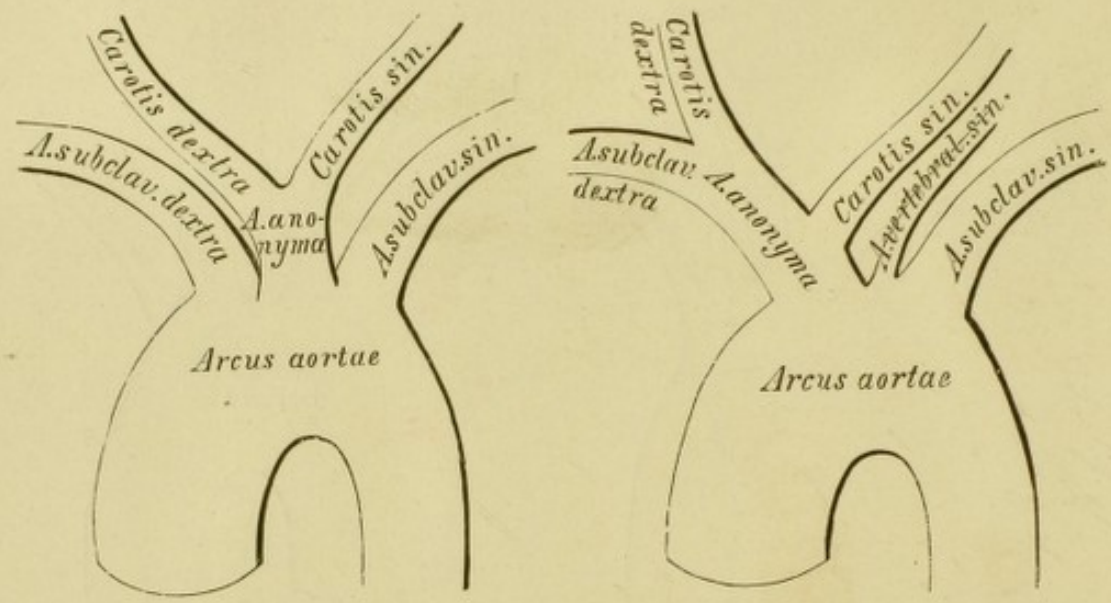
From the transverse portion of the arch of the aorta (often simply called *Arcus Aortae*) three large vessels arise; they are: the innominate artery, *Art. anonyma*, the left common carotid, *Carotis sinistra*, and the left subclavian, *Art. subclavia sinistra*. The innominate artery passes obliquely upwards and to the right in front of the trachea, and divides behind the right sterno-clavicular articulation into the right subclavian and right common carotid arteries. The left carotid and left subclavian arteries are therefore longer and placed more deeply in the thorax, than the right.



528 a. b. c. Diagram of the Varieties of the Branches arising from the Transverse Arch by Diminution.



529 a. b. c. d. Diagram of the Varieties of the Branches arising from the Transverse Arch by Augmentation.



530 a.b. Diagram of the Varieties of the Branches arising from the Transverse Arch by Abnormal Ramification.

The variations in the origins of the vessels arising from the transverse arch of the aorta can take place in three different ways: the number of branches either diminishing, or increasing, or there being the normal number but an abnormal ramification.

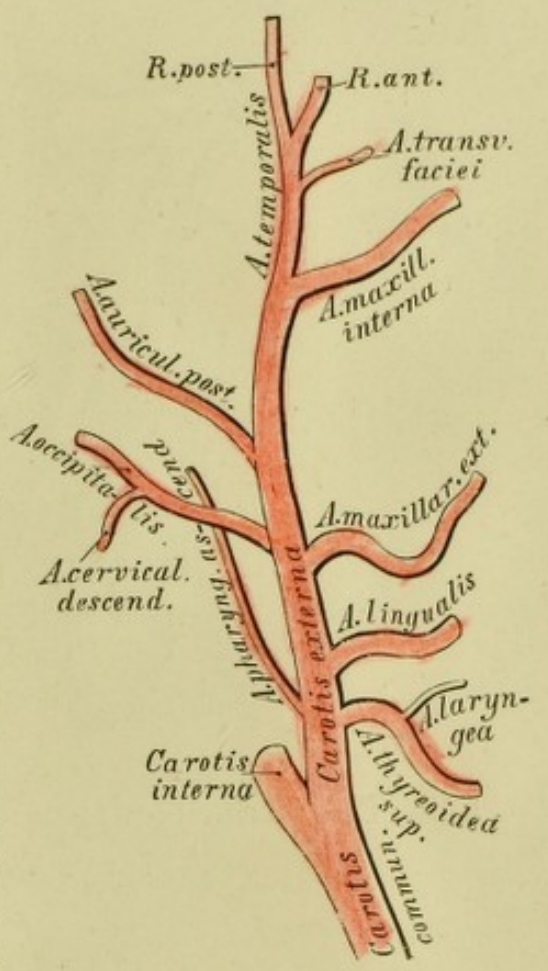
The diminution can take place in the following ways: a) two innominate arteries; b) the left carotid is a branch of the innominate; c) all the branches are united to form a single anterior aorta.

The augmentation consists in the following varieties: a) the left vertebral artery arises between carotid and left subclavian; b) an *Art. thyreoidea ima* arises between innominate and left carotid; c) an internal mammary artery or *Art. thymica* arises from the anterior wall of the transverse arch; d) the innominate is not present and all branches arise separately.

The abnormal ramification may take place in two ways: a) both carotids unite to form one innominate; b) the left carotid arises from the innominate, and the left vertebral artery arises alone.

The commom carotid, *Carotis communis,* ascends to the upper margin of the thyroid cartilage without giving off any branches, and there divides into the external and internal, *Carotis externa* and *interna.*

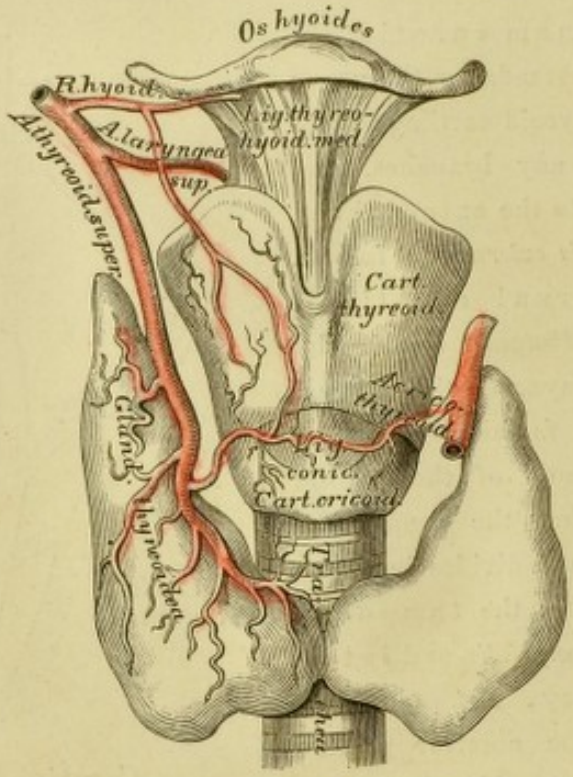
The external carotid is covered by the *Platysma myoides,* by the superficial layer of the cervical fascia and the facial vein, passes into the substance of the parotid gland and behind the condyle of the lower jaw, and divides into two terminal branches: the temporal, *Art. temporalis superficialis,* and internal maxillary, *Art. maxillaris interna.* From the anterior portion of the external carotid arise:



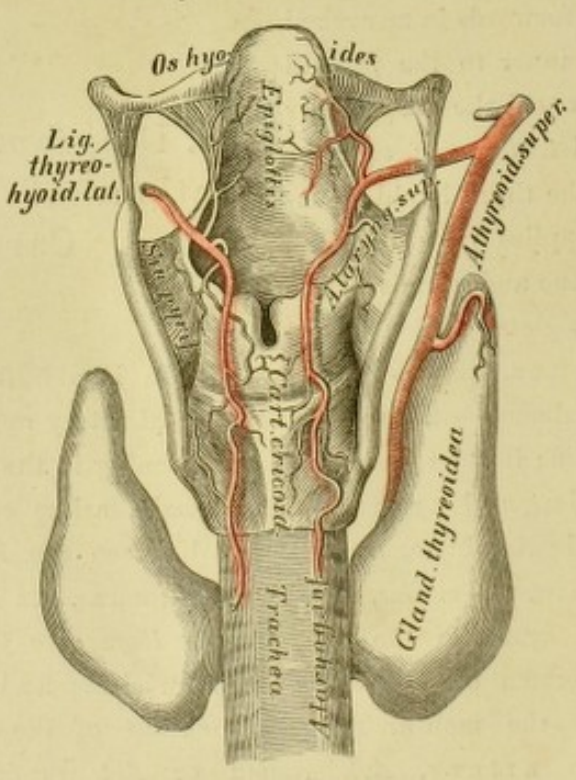
531. Diagram of the Ramifications of the External Carotid.

a) The superior thyroid, *Art. thyreoidea superior,* which curves downwards and forwards in an arched and tortuous manner to the thyroid gland. It gives off the superior laryngeal, *Art. laryngea superior,* which pierces the thyro-hyoid membrane and supplies the muscles, mucous membrane and glands of the larynx and epiglottis; also muscular branches. (See Fig. 532, 533. In Fig. 533 — the original was a dried specimen — the superior laryngeal artery appears as if pushed out of its position; it must be imagined as running in the *Sinus pyriformis.*)

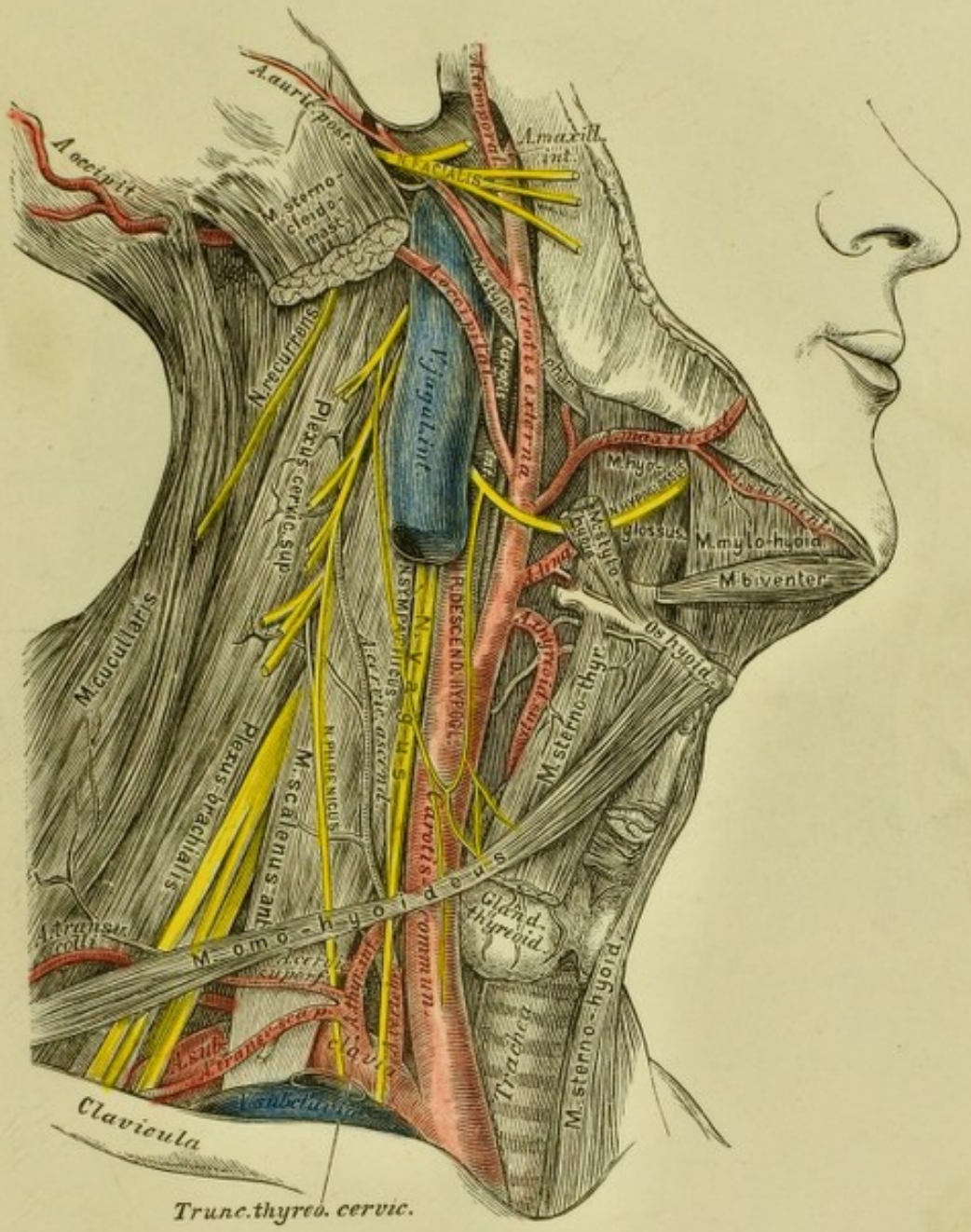
b) The lingual artery, *Art. lingualis,* arises opposite the great cornu of the hyoid bone, and passing between the *M. hyo-glossus* and *M. constrictor pharyngis medius,* reaches the tongue. Its branches are the hyoid, *Ramus hyoideus;* the *Art. dorsalis linguae* to the mucous membrane of the dorsum of the tongue; the sublingual, *Art. sublingualis,* to the floor of the mouth. The continuation of the lingual artery is called ranine artery, *Art. ranina* or *Art. profunda linguae* (see Fig. 541). It communicates with the artery of the other side only by means of capillaries.



532. The Ramification of the Superior Thyroid Artery. View from before.

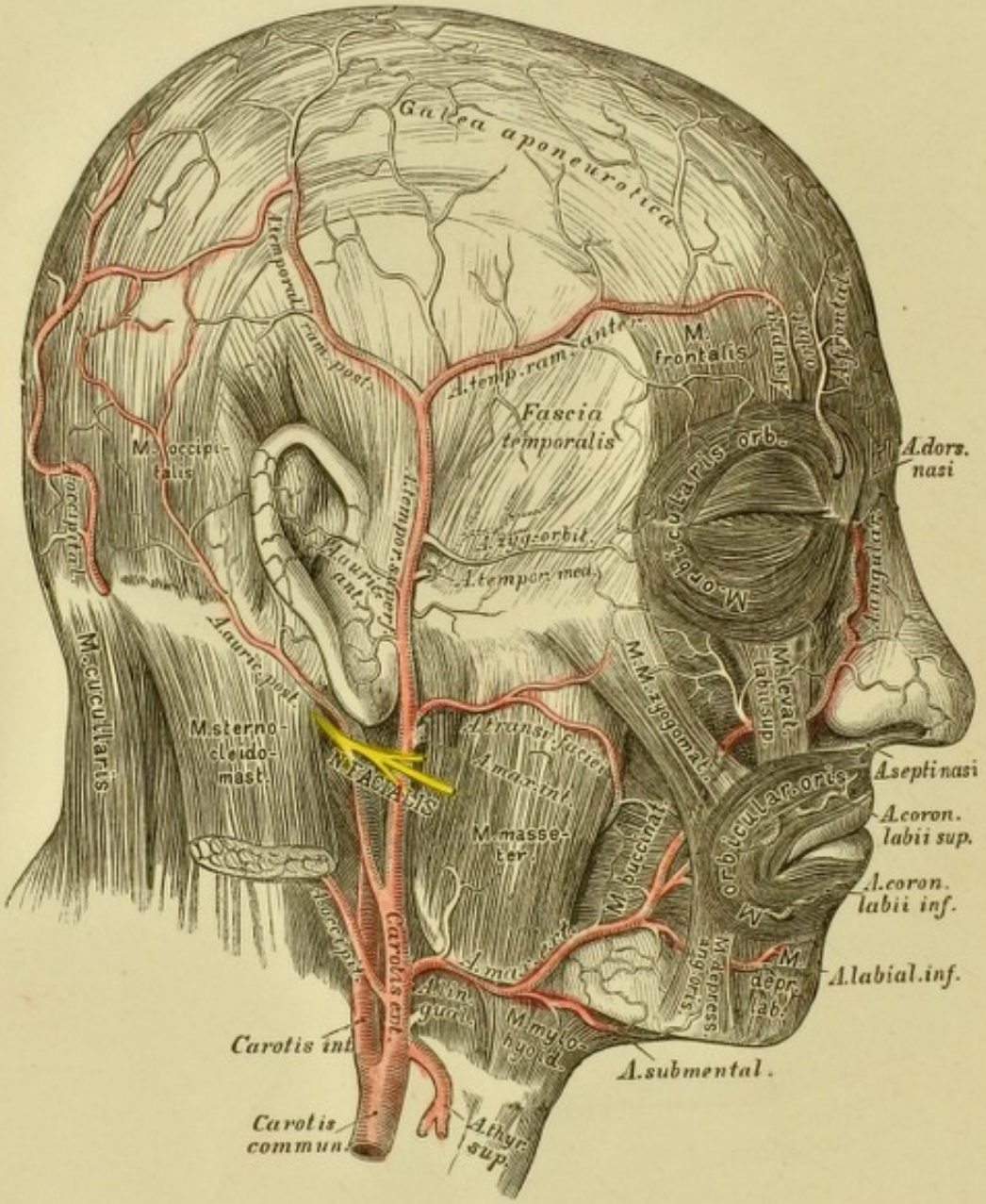


533. The Ramification of the Superior Thyroid Artery. View from behind.



534. Topographical Anatomy of the Neck.

c) The facial or external maxillary artery, *Art. maxillaris externa*, passes forwards to the face, ascends at the angle of the mouth to the side of the nose and terminates as angular artery, *Art. angularis*, which anastomoses with the ophthalmic artery from the internal carotid. Its branches are: the submental, *Art. submentalis;* the ascending palatine, *Art. palatina ascendens s. pharyngo-palatina*, which lies at the side of the pharynx and supplies the *MM. stylo-glossus* and *stylo-pharyngeus*, the soft palate and the mucous membrane of the pharynx; the tonsillar artery, *Art. tonsillaris*, to the side of the pharynx and the tonsil; the submaxillary; muscular branches to the internal pterygoid, masseter and buccinator muscles; the inferior labial; the superior and inferior coronary, *Art. coronaria labii superioris et inferioris*, which run along the edges of the lips and anastomose with the corresponding arteries of the opposite side. From the upper arch arises the *Art. septi mobilis nasi.*



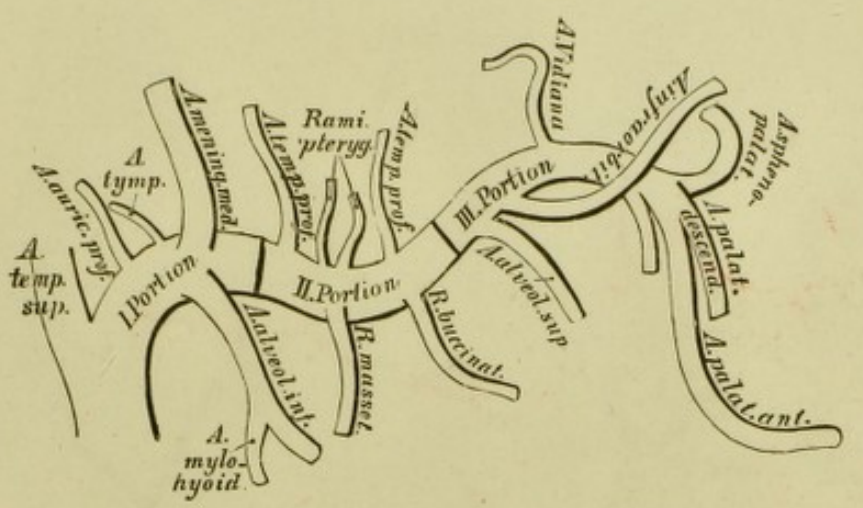
535. The Arteries of the Face and Pericranium.

From the inner side of the external carotid arises:

d) The ascending pharyngeal artery, *Art. pharyngea ascendens,* which ascends at the side of the pharynx, and, dividing into two branches, supplies the posterior wall of the pharynx (see Fig. 542).

From the posterior portion of the external carotid arise:

e) The occipital artery, *Art. occipitalis.* At its origin it is covered by the posterior belly of the digastric muscle, then passes beneath the *M. sterno-cleido-mastoideus* to the occiput, where it divides into two terminal branches and supplies the soft parts up to the vertex. It gives off the mastoid artery, *Art. mastoidea,* which passes through the mastoid foramen to the dura mater, and the *Art. cervicalis descendens* to the muscles at the back of the neck.



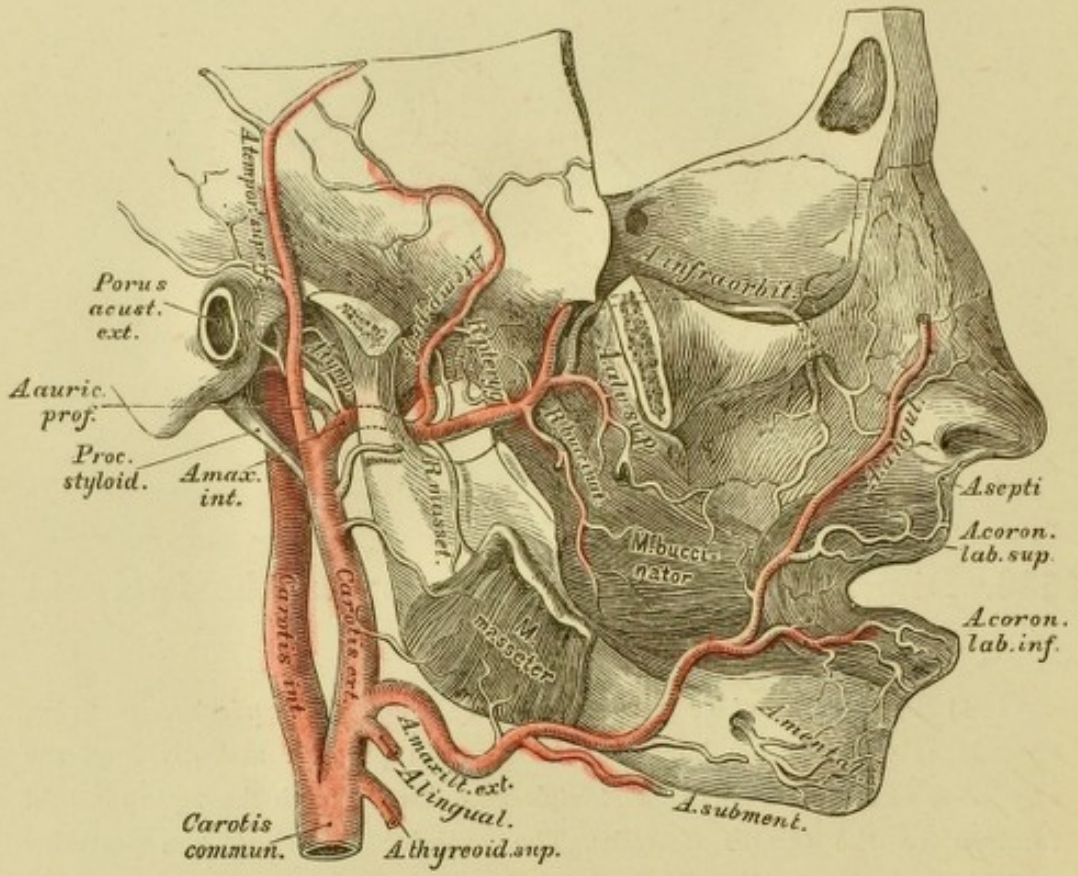
536. Diagram of the Ramification of the Internal Maxillary Artery.

f) The posterior auricular artery, *Art. auricularis posterior*, ascends at the anterior border of the mastoid process, and gives off the stylo-mastoid branch, *Art. stylo-mastoidea*, through the stylo-mastoid foramen to the *Canalis Fallopiae*. The anterior branch of the posterior auricular artery supplies the auricle, the posterior the soft parts behind the ear.

The terminal branches of the external carotid are:

1. The superficial temporal artery, *Arteria temporalis superficialis*, which is divided upon the temporal fascia into an anterior and a-posterior branch. The former supplies the integument of the temporal and frontal regions, the latter passes to the vertex. The superficial temporal artery gives off the following branches: the transverse facial, *Art. transversa faciei*, which passes transversely up to the region of the infraorbital foramen; the middle temporal, *Art. temporalis media*, which, perforating the temporal fascia, supplies the temporal muscle; the anterior auricular, *Art. auriculares anteriores* (2—3 inferior and 1 superior), to the external auditory meatus and to the anterior surface of the pinna; the orbital, or *Art. zygomatico-orbitalis*, which passes obliquely forwards to the margin of the orbit.

2. The internal maxillary artery, *Art. maxillaris interna*, which supplies all the cavities of the head with branches, can be divided into three portions, in the first part of its course it lies behind the condyle of the lower jaw, in the second part it runs obliquely forwards and upwards upon the outer surface of the external pterygoid muscle, in the third part it enters the spheno-maxillary fossa.



537. Course and Ramification of the Internal Maxillary Artery. View from outside.

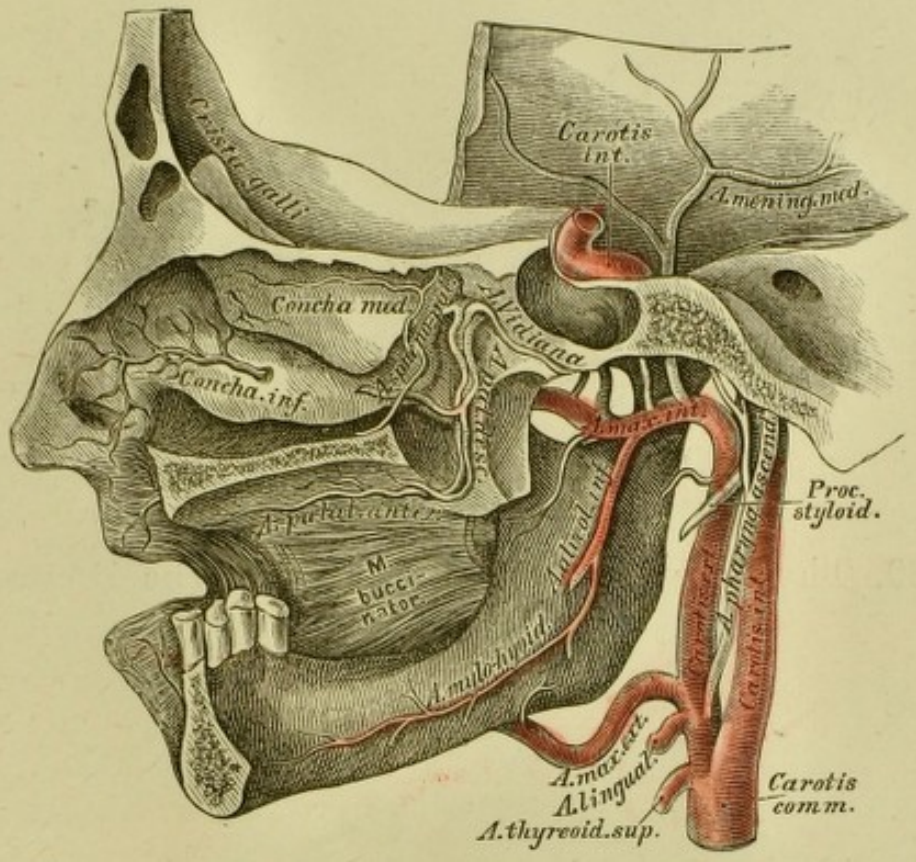
The branches arising from the first or maxillary portion of the internal maxillary artery are:

a) The deep auricular, *Art. auricularis profunda*, to the external auditory meatus;

b) The tympanic, *Art. tympanica*, through the Glaserian fissure to the tympanum;

c) The inferior dental, *Art. alveolaris inferior*, to the posterior opening of the dental canal. While it runs through this canal it gives off the dental twigs, *Ramuli dentales*, to the roots of the teeth, escapes by the mental foramen, where it is called mental artery, and anastomoses with the inferior labial, inferior coronary and submental branches. Before it enters the dental canal, it gives off the mylo-hyoid artery, for the mylo-hyoid muscle (see Fig. 538 and 539).

d) The middle meningeal, *Art. meningea media*, which passes directly upwards under cover of the external pterygoid muscle and enters the skull by the *Foramen spinosum*; within the cranium it divides into an anterior and a posterior branch, which supply the dura mater and diploë of the vault of the cranium (see Fig. 540). It sends the *Art. petrosa* to the tympanic cavity.



538. Course and Ramification of the Internal Maxillary Artery. View from inside.

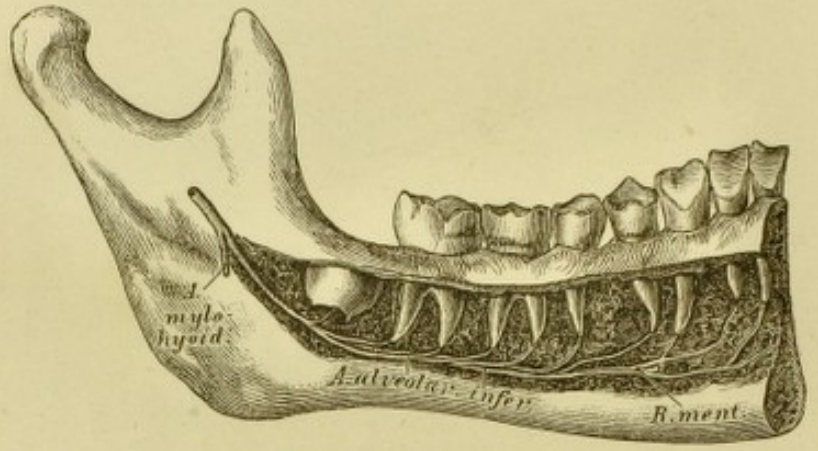
The branches of the second or pterygoid portion of the internal maxillary artery are the following:

a) The masseteric, *Ramus massetericus*, for the *M. masseter*, which passes through the sigmoid notch of the lower jaw;

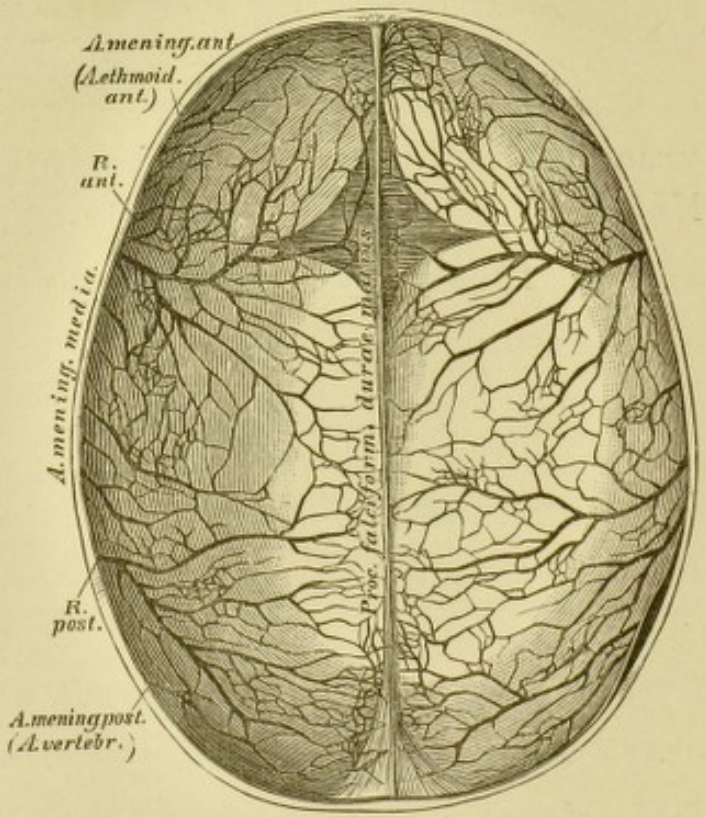
b) The buccal, *Ramus buccinatorius*, for the *M. buccinator*, whose twigs anastomose with those of the infraorbital, transverse facial and facial arteries;

c) The pterygoid, *Rami pterygoidei*, for both *MM. pterygoidei;*

d) The deep temporal, *Art. temporales profundae*, which are two in number, an anterior and a posterior, for the temporal muscle. The anterior *Art. temporalis profunda*, sends a branch through the *Canalis zygomaticus temporalis* into the orbit, where it anastomoses with the lachrymal artery (see Fig. 543).

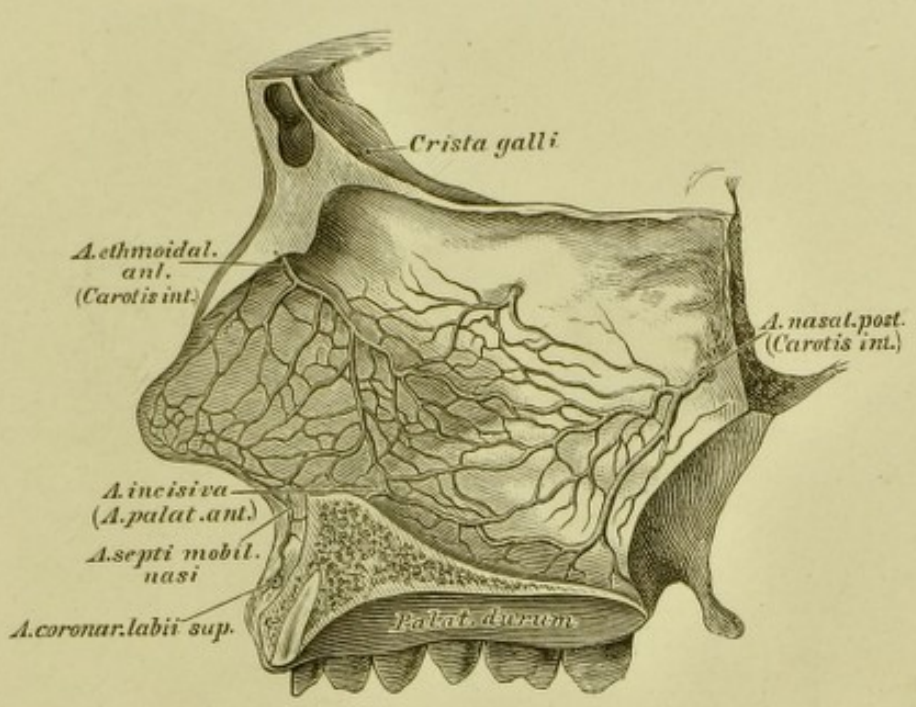


539. The Inferior Dental Artery in the Dental Canal.



540. The Arteries of the Dura Mater.

Injected roof of the skull of a child. $^2/_3$ natural size.



541. The Arteries of the *Septum narium.*

(Natural size.)

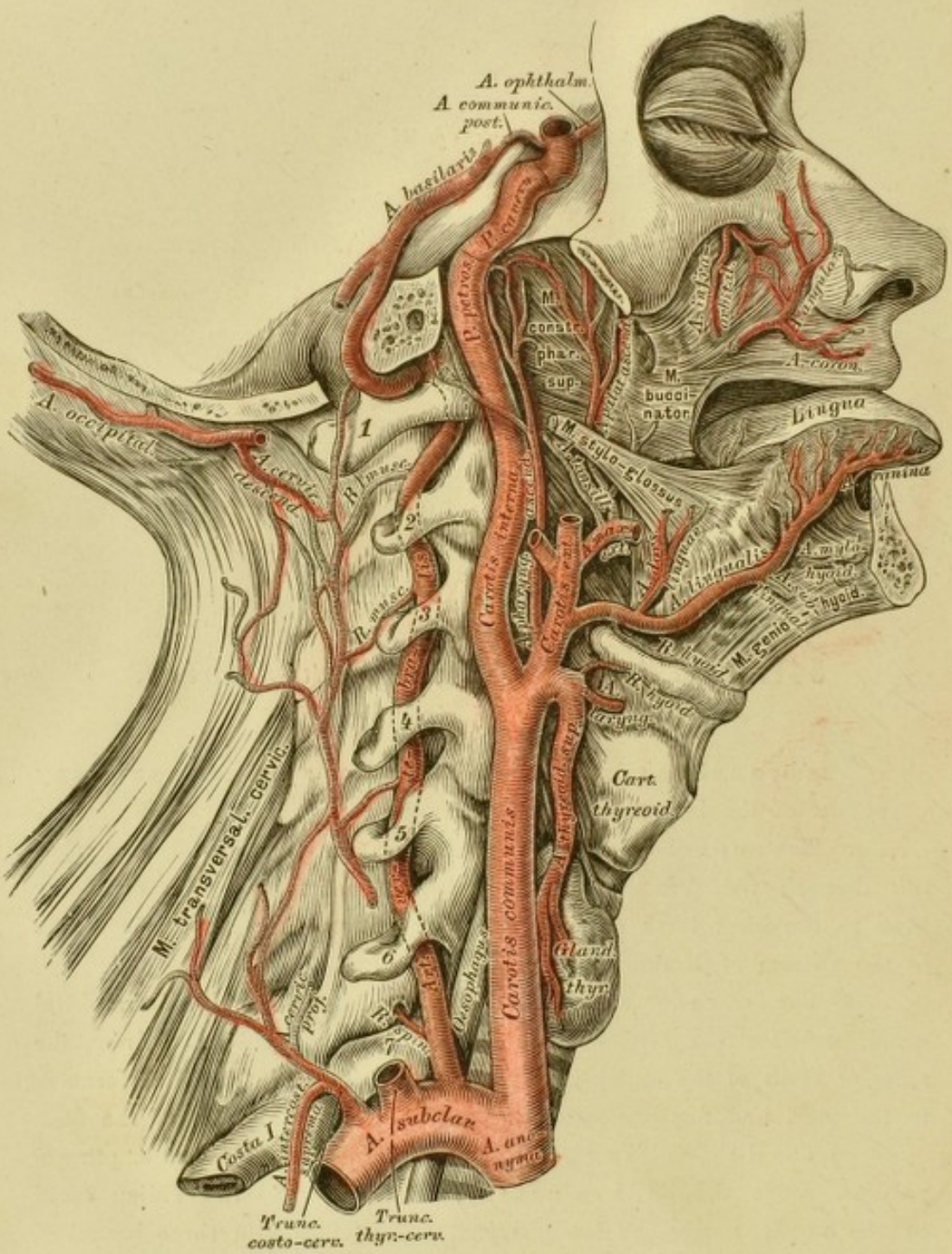
The branches arising from the third or spheno-maxillary portion of the internal maxillary artery are:

a) The superior alveolar, *Art. alveolaris superior.* Its branches run through the foramina of the tuberosity of the superior maxillary bone to the back teeth of the upper jaw and to the mucous membrane of the antrum of Highmore.

b) The infra-orbital, *Art. infraorbitalis,* runs along the infraorbital canal, supplies the *Periorbita,* the *MM. rectus* and *obliquus inferior,* the anterior teeth of the upper jaw, passes through the infraorbital foramen to the face, and finally anastomoses with the other arteries of the face.

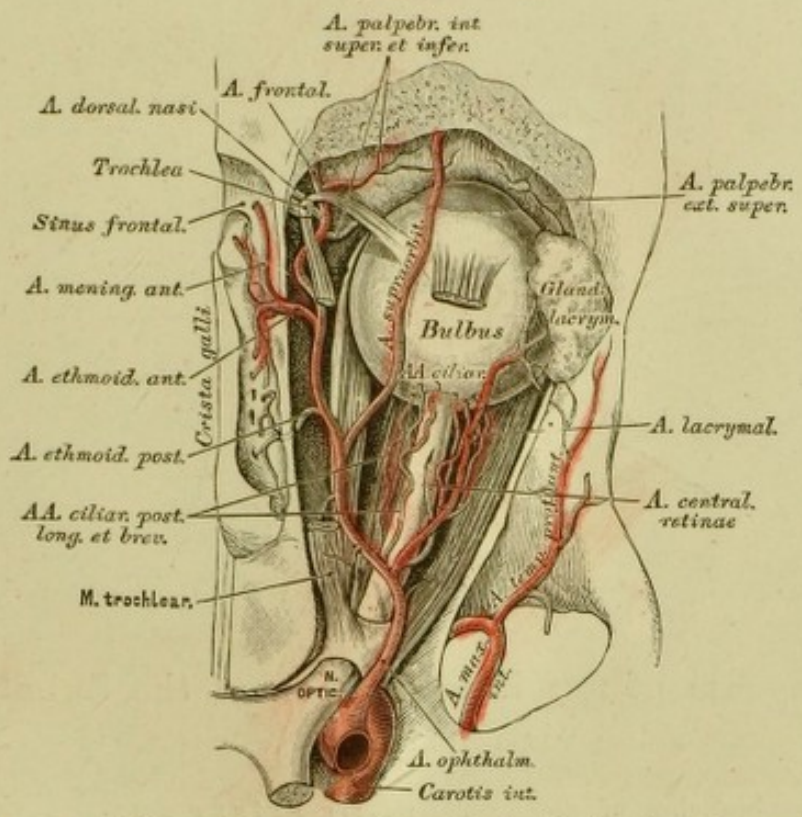
c) The descending palatine, *Art. palatina descendens s. pterygo-palatina,* sends the Vidian artery, *Art. Vidiana,* in the Vidian canal to the upper portion of the pharynx, and divides into three branches, which pass through the descending palatine canals to the soft palate and the tonsils. Its largest branch, the anterior palatine, passes along the hard palate to the gums of the incisor teeth and gives off the *Art. incisiva* to the nasal cavity.

d) The spheno-palatine, *Art. spheno-palatina,* passes through the spheno-palatine foramen into the nasal cavity and supplies the posterior portions of the mucous membrane and the *Septum narium,* and finally anastomoses with the anterior palatine and the *Art. septi mobilis nasi.*



542. Course and Ramification of the Internal Carotid and the Vertebral Artery.

The internal carotid artery, *Carotis interna,* which lies at first to the outer side of the external carotid, is separated from the latter by the *MM. stylo-glossus* and *stylo-pharyngeus.* It is remarkable for the number of curvatures that it presents; in its cervical portion it occasionally presents one or two flexures near the base of the skull, whilst through the rest of its extent it describes a double curvature which resembles the italic s placed horizontally. During its course in the carotid canal and cavernous sinus, it sends small branches to the mucous membrane of the tympanic cavity (*Ramulus carotico-tympanicus*), to the Gasserian ganglion, to the dura mater and to the *Tentorium cerebelli.*



543. Ramification of the Ophthalmic Artery in the Orbit. Natural size.

After the internal carotid has emerged from the cavernous sinus, it gives off:

1. The ophthalmic artery, *Art. ophthalmica*, which passes through the optic foramen into the orbit and divides below the trochlea into two terminal branches, the nasal, *Art. dorsalis nasi*, and the frontal, *Art. frontalis*. Its branches are:

a) The small *Arteria centralis retinae*, which pierces the sheath and substance of the optic nerve, and runs forwards within it to the retina;

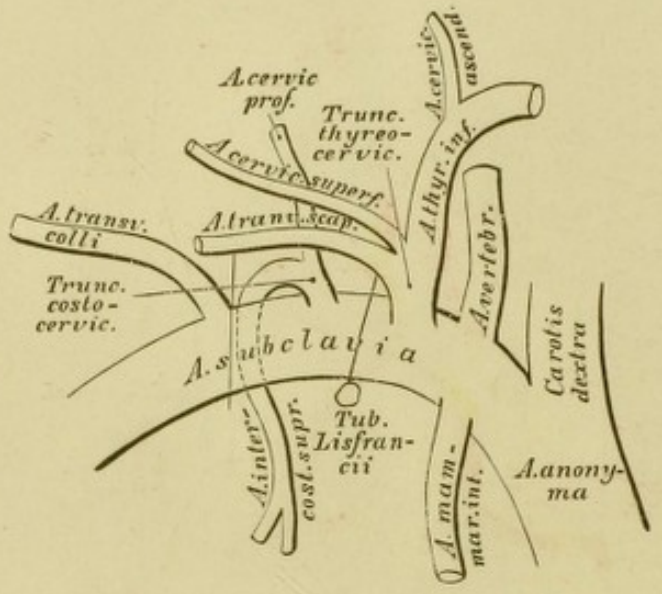
b) The lachrymal artery, *Art. lacrymalis*, which passes forwards along the upper border of the external rectus muscle to the lachrymal gland and gives off 1 or 2 posterior ciliary arteries, sends malar branches into the *Canalis zygomaticus facialis* and *temporalis*, and divides at the external angle of the eye into the *Art. palpebralis externa superior et inferior;*

c) Muscular branches for the muscles of the eye-ball;

d) 2 long and 3 or 4 short posterior ciliary arteries, *Arteriae ciliares posticae longae* and *breves*, the former to the iris and ciliary muscle, the latter to the choroid;

e) The supraorbital, *Art. supraorbitalis*, through the supraorbital foramen to the forehead;

f) The anterior and posterior ethmoidal, *Art. ethmoidalis anterior et posterior*, the former to the cranium where it gives off a meningeal branch, the *Art. meningea anterior*, and a nasal branch, which passes through the anterior foramen in the cribriform plate of the ethmoid to the nasal cavity; the latter through the posterior ethmoidal foramen to the posterior ethmoidal cells.



544. Diagram of the Ramification of the Subclavian Artery.

Further branches of the ophthalmic artery are:

g) The palpebral, *Art. palpebralis interna superior et inferior,* which supply the lachrymal sac, caruncle and conjunctiva, and pass into the eyelids;

h) The frontal, *Art. frontalis,* passes around the *Margo infraorbitalis* to the forehead;

i) The nasal, *Art. dorsalis nasi,* perforates the *M. orbicularis* and finally unites with the angular artery, the termination of the facial.

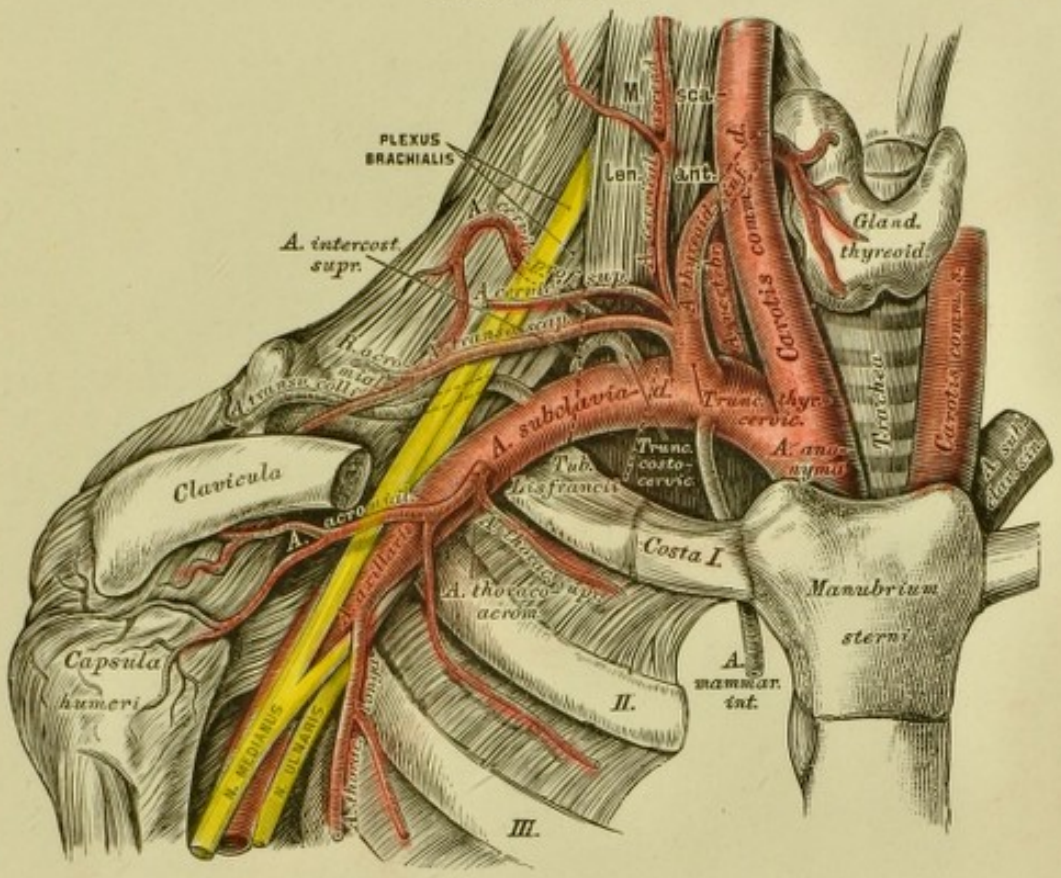
Other branches of the internal carotid are:

2. The posterior communicating, *Art. communicans posterior,* which, passing backwards, anastomoses with the posterior cerebral, and helps to form the circle of Willis, *Circulus arteriosus Willisii.*

3. The choroid, *Art. choroidea* to the *Plexus choroideus lateralis.*

4. The anterior cerebral or *Art. corporis callosi,* passes forwards, is connected by means of the anterior communicating artery with the corresponding artery of the other side, and ascends to the *Corpus callosum,* to supply the hemispheres of the brain.

5. The middle cerebral or *Art. fossae Sylvii* divides in the fossa of Sylvius into a number of branches for the anterior and inferior cerebral lobes.

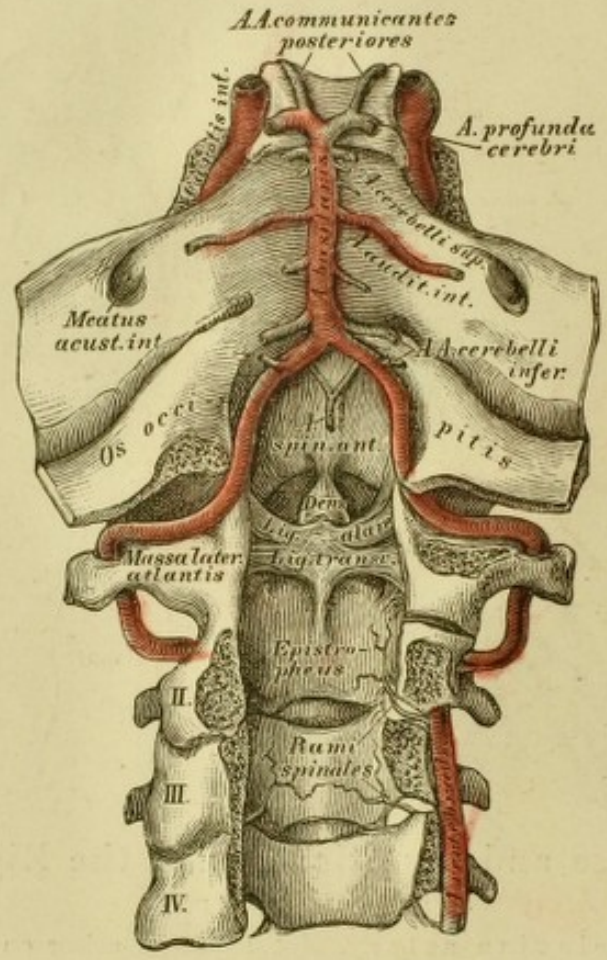


545. Course and Ramification of the Right Subclavian Artery.

The subclavian artery, *Art. subclavia,* arises on the right side from the innominate artery, on the left from the arch of the aorta, passes a short way up into the neck, arches outwards over the pleura and lung, and rests between the anterior and middle scaleni muscles on the first rib. At the outer border of the first rib it assumes the name of axillary artery. Its five branches are the following:

1. The vertebral artery, *Art. vertebralis,* enters the foramen in the transverse process of the sixth cervical vertebra, and ascends through the foramina in the transverse processes of all the vertebrae above this. Above the upper border of the axis it inclines outwards and upwards to the foramen in the transverse process of the atlas, through which it passes; then it winds backwards and finally enters the skull through the *Foramen magnum.* At the lower border of the *Pons Varolii* it unites with the vessel of the opposite side to form the single basilar artery. — Up to its entrance into the cranium it gives off muscular branches, spinal branches and the posterior meningeal artery. After its entrance it gives off: the anterior and posterior spinal, the two anterior of which unite to form a common trunk; then the posterior inferior cerebellar to the posterior portion of the cerebellum; finally the anterior inferior cerebellar to the anterior portion of the inferior cerebellar region.

The basilar artery, *Art. basilaris,* formed by the junction of the two vertebral arteries, extends from the posterior to the anterior border of the *Pons Varolii,* where it divides into two branches, the right and left posterior cerebral or *Art. profunda cerebri dextra et sinistra.*

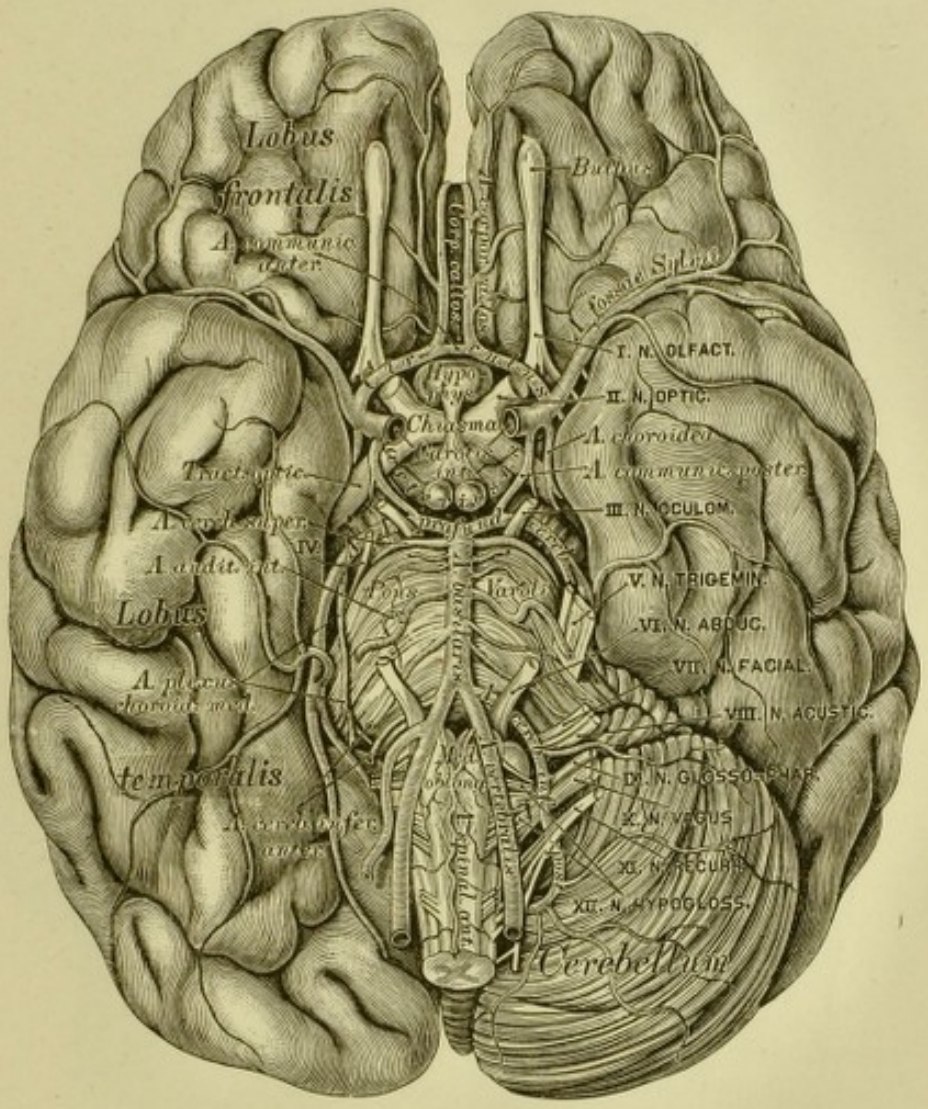


546. Course of the Vertebral Arteries.

View from behind, the vertebral canal being laid open.

The branches arising from the basilar artery on each side are: the internal auditory, *Art. auditiva interna,* passing through the internal auditory meatus to the labyrinth, and the superior cerebellar, *Art. cerebelli superior,* to the upper surface of the cerebellum. The posterior cerebral (*Arteriae profundae cerebri*), unite with the posterior communicating arteries from the internal carotid, pass backwards and upwards and supply the posterior lobes of the cerebrum. By the anastomosis which exists between the branches of the internal carotid and vertebral arteries at the base of the brain, the circle of Willis, *Circulus arteriosus Willisii,* is formed. The parts of the brain included within this circle are: the *Chiasma, Lamina cinerea, Infundibulum, Tuber cinereum, Corpora albicantia* and posterior perforated space.

2. The internal mammary artery, *Art. mammaria interna,* arises from the subclavian opposite the thyroid axis, and descends behind the clavicle to the inner surface of the anterior wall of the chest. Its branches are: mediastinal, thymic, anterior bronchial, pericardiaco-phrenic to the diaphragm, the anterior intercostal, two for each intercostal space, an upper, larger, and a lower, smaller, perforating branches, *Rami perforantes,* to the skin and muscles of the thorax, and in the female the external mammary artery to the mamma. Between the sixth costal cartilage and xiphoid appendix, the internal mammary artery divides into the musculo-phrenic and superior epigastric, which latter anastomoses with the inferior epigastric and crural arteries (see Fig. 548).

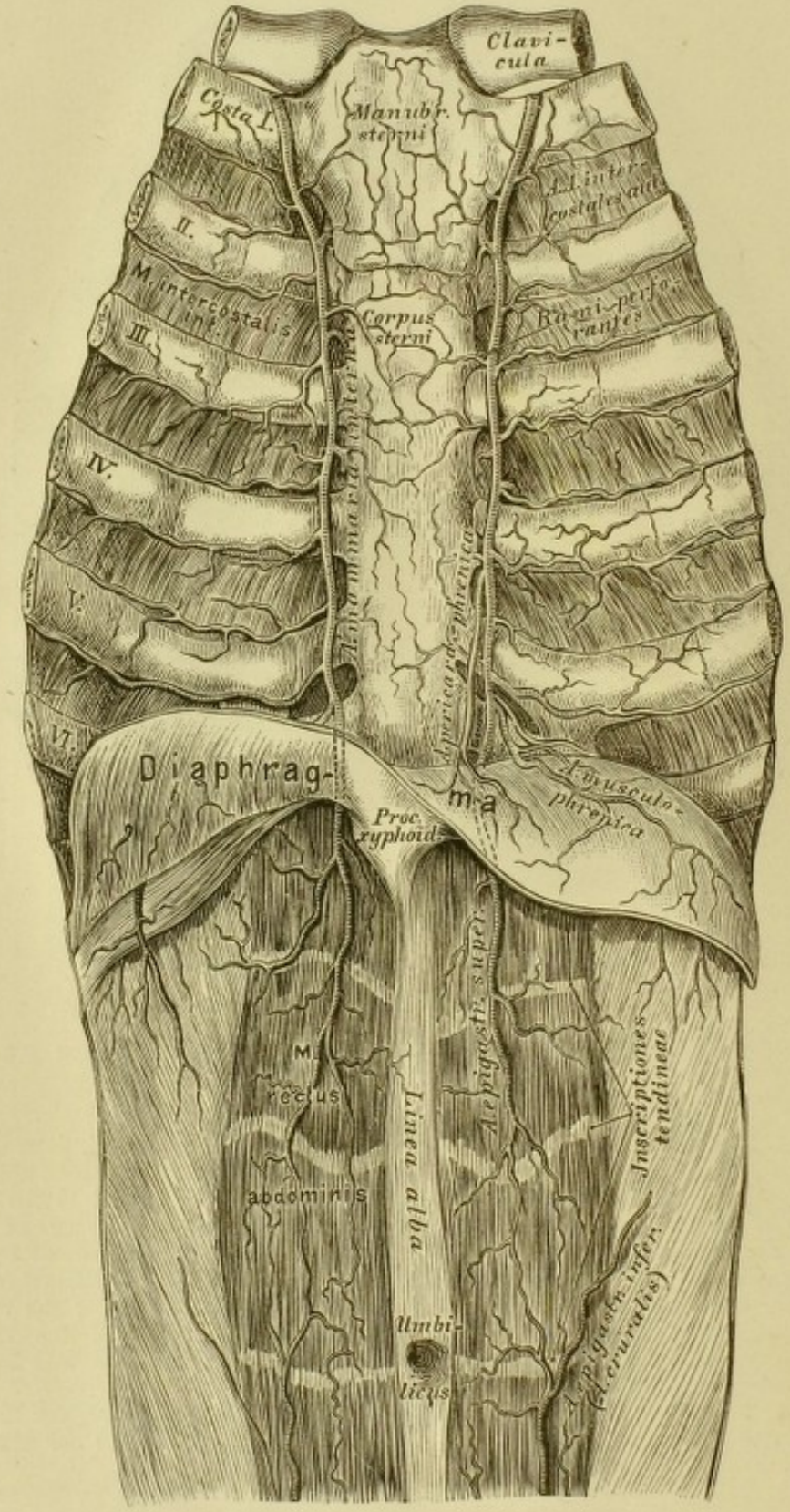


547. The Basilary Artery and its Branches at the Base of the Brain.

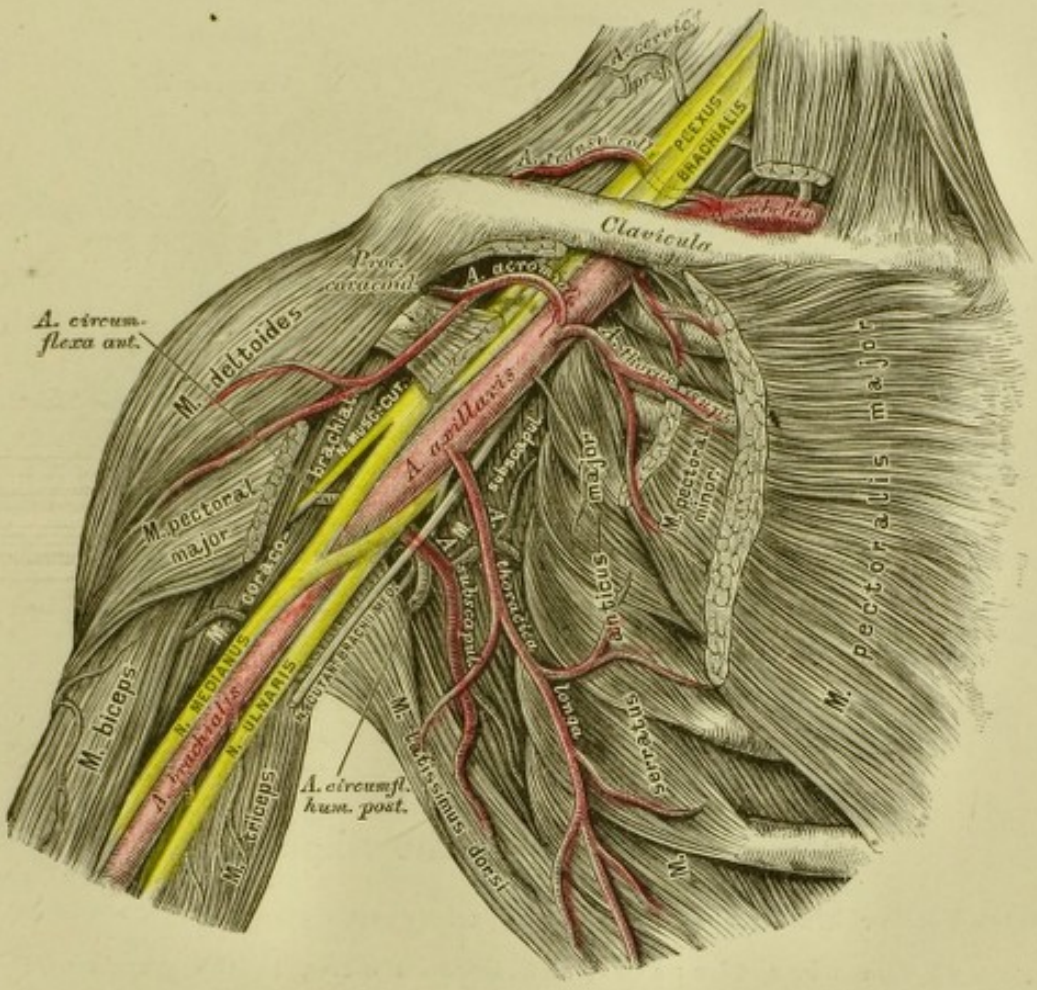
3. The thyroid axis, *Truncus thyreo-cervicalis;* this trunk soon divides into three branches: a) the inferior thyroid, which passes upwards, and after a short course bends inwards and downwards, and is distributed to the under surface of the thyroid gland; its branches are the inferior laryngeal to the larynx, tracheal to the trachea, oesophageal to the oesophagus and ascending cervical; b) the superficial cervical, which, in the supraclavicular fossa passes to the *M. trapezius, MM. spleniis* and *rhomboideis;* c) the transverse scapular, or suprascapular, which passes behind the clavicle through the scapular notch to the supra- and infraspinous fossae, and supplies the muscles in those regions (see Fig. 550).

4. The superior intercostal, *Art. intercostalis suprema,* for the first and second intercostal space, which, with the deep cervical for the deep cervical muscles, forms the *Truncus costo-cervicalis.*

5. The transversalis colli artery, arises between or beyond the scaleni. It pierces the brachial plexus, passes to the upper border of the scapula, where it gives off the *Ramus supraspinatus* for the *MM. trapezius, deltoides, levator scapulae* and to the acromion, and then courses along the inner border of the scapula as *Art. dorsalis scapulae* (see Fig. 550).



548. Course and Ramification of the Internal Mammary Artery.



549. Course and Ramification of the Right Axillary Artery.

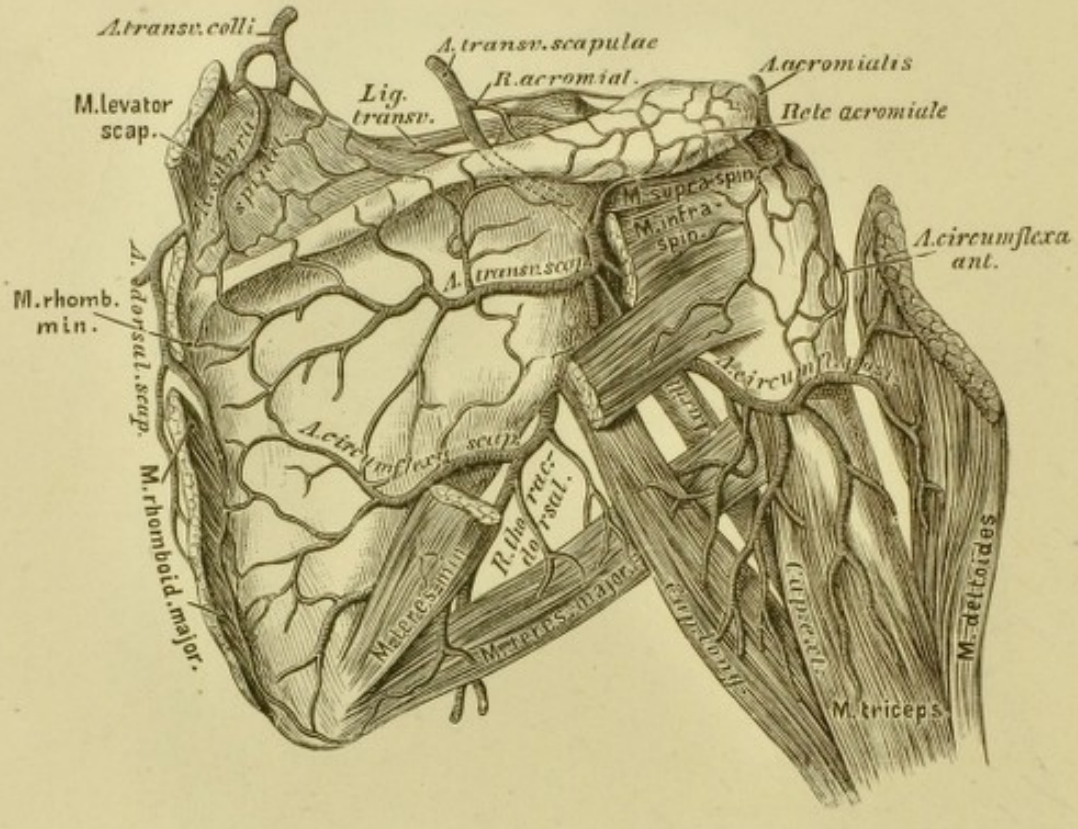
The axillary artery, *Art. axillaris*, the continuation of the subclavian, commences at the lower border of the first rib, and terminates at the lower border of the tendons of the latissimus dorsi and teres major muscles, where it takes the name of the brachial; the two roots of the median nerve surround the artery.

Its branches are:

a) The superior thoracic, *Art. thoracica suprema*, which passes between the *M. pectoralis major* and *minor* to the side of the chest.

b) The acromial thoracic, *Art. acromialis s. thoraco-acromialis*, passes in front of the acromial process outwards and upwards to the acromion, supplies the capsule of the shoulder joint, and sends acromial branches to the shoulder, which, by anastomosing with the acromial branch of the transverse scapular artery, form the *Rete acromiale* (see Fig. 550).

c) The long thoracic, *Art. thoracica longa*, passes downwards upon the *M. serratus magnus* and supplies it and the outer portion of the mammary gland.



350. The Arteries of the Shoulder.

Further branches of the axillary artery are:

d) The alar thoracic, *Art. thoracica alaris*, to the glands and areolar tissue of the axilla; not constant.

e) The subscapular, *Art. subscapularis*, which distributes two or three upper, smaller, and one lower, larger branch, to the muscles in its neighbourhood. The lower gives off the *Ramus thoracico-dorsalis*, which runs parallel to the outer border of the scapula and passes to the lower dentations of the *M. serratus magnus* and to the costal origins of the *M. latissimus dorsi* and the *Art. circumflexa scapulae*, which passes between the *M. subscapularis* and *teres major* to the posterior surface of the scapula; it supplies the muscles in the infraspinous fossa.

f) The anterior circumflex, *Art. circumflexa humeri anterior*, passes in front of the surgical neck of the humerus.

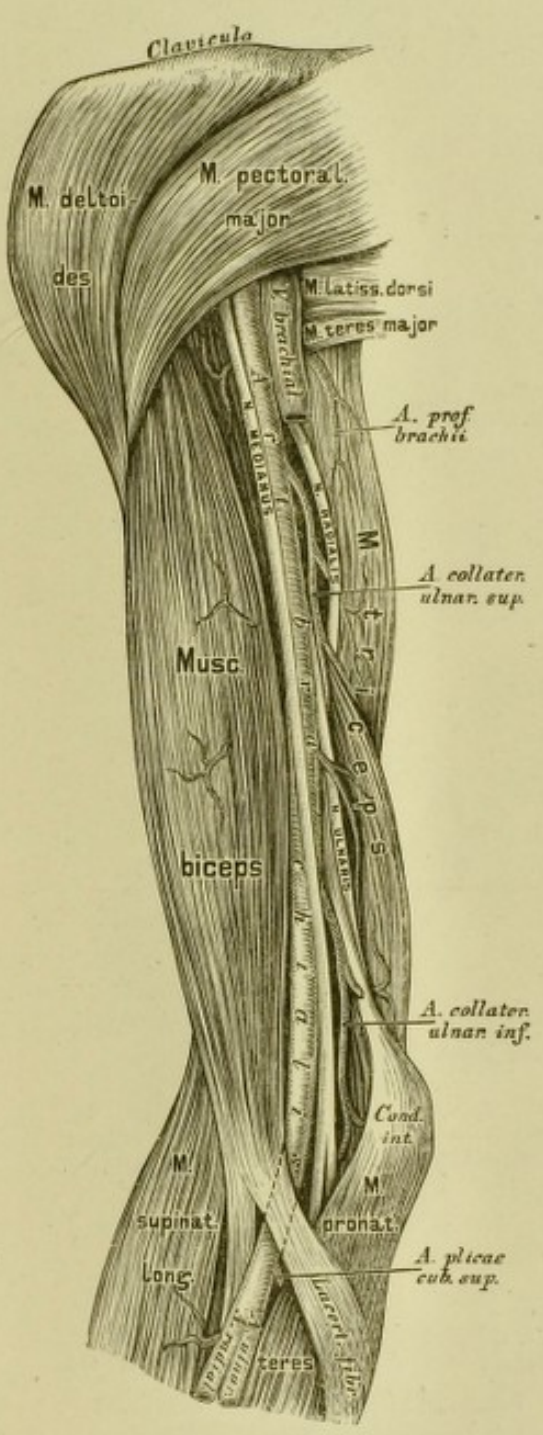
g) The posterior circumflex, *Art. circumflexa humeri posterior*, much the larger, passes behind the surgical neck close to the bone. Both supply the soft parts at the shoulder joint and anastomose with each other.

The brachial artery. *Art. brachialis,* extends from the lower border of the teres major muscle to about half an inch below the bend of the elbow, where it divides into the radial and ulnar. It lies in the *Sulcus bicipitalis internus,* the median nerve at its outer, the ulnar nerve at its inner side in the upper third of the humerus; further down the two *Venae brachiales* are in close contact with it. At the bend of the elbow it passes below the *Lacertus fibrosus* of the tendon of the *M. biceps.* Besides its muscular branches which are given off from it at different parts of its course, its branches are:

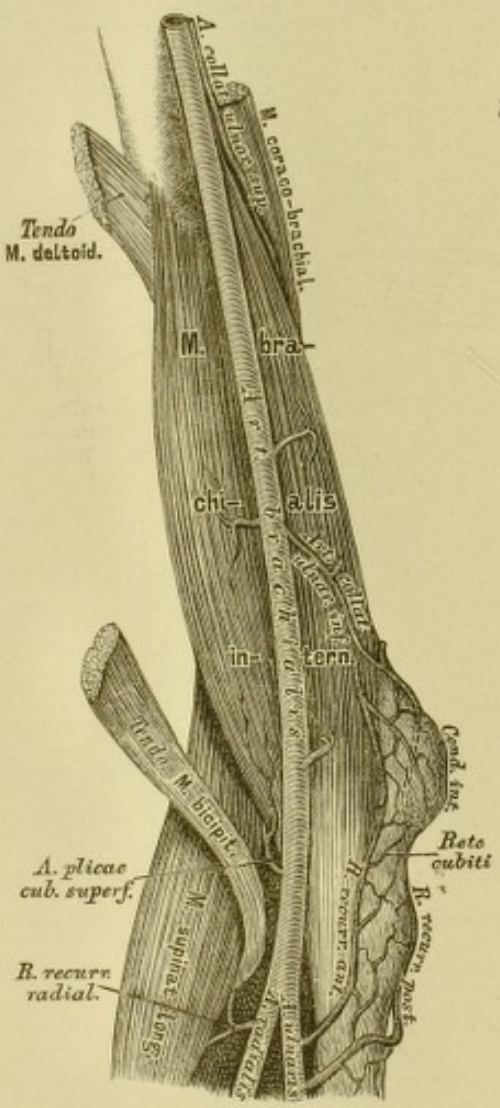
a) The profunda or superior profunda, *Art. profunda brachii,* passes between the internal and long heads of the triceps, in connection with the musculo-spiral (radial) nerve, to the outer side of the upper arm, supplies the *M. triceps,* then the humerus by means of a nutrient artery, pierces the external intermuscular septum, and descends to the elbow where it is called *Art. collateralis radialis.* One terminal branch anastomoses with the recurrent branch of the radial, the other with the *Art. anastomotica magna.*

b) The inferior profunda, also called *Art. collateralis ulnaris superior,* arises about the middle of the arm and descends in company with the ulnar nerve; it supplies the *M. brachialis anticus* and *M. triceps* and anastomoses with the posterior recurrent branch of the ulnar.

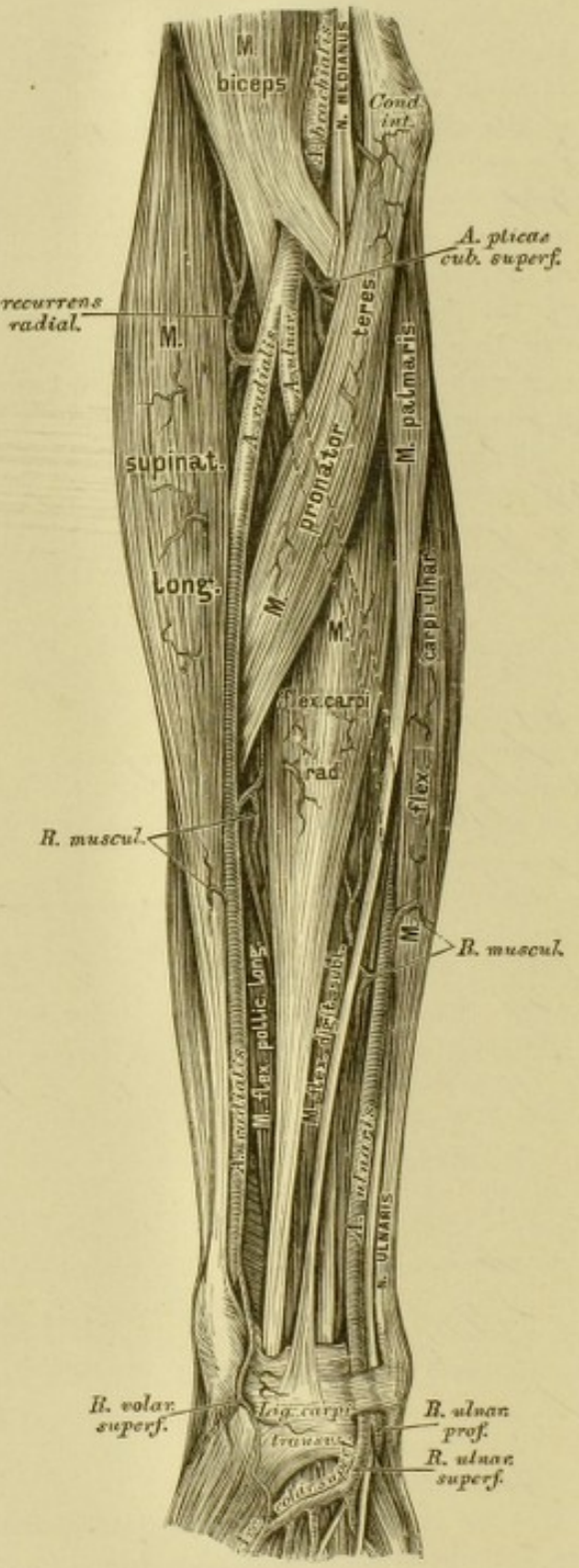
c) The *Anastomotica magna* or *Art. collateralis ulnaris inferior,* passes towards the internal condyle, supplies the superficial muscles arising from it, and anastomoses with the anterior recurrent branch of the ulnar, and, after passing behind the humerus, with the superior profunda artery.



551. Course and Ramification of the Brachial Artery.



552. The Anastomoses of the *Arteria anastomotica magna.*



553. Course and Ramification of the Arteries of the Forearm.

At the bend of the elbow the brachial artery lies upon the *M. brachialis anticus s. internus*, to the inner side of the tendon of the *M. biceps*, and to the outer side of the *M. pronator radii teres*. Here it gives off the *Art. plicae cubiti superficialis* and divides below the bend of the elbow into the radial and ulnar arteries.

a) The radial artery, *Art. radialis*, passes along the radial side of the forearm to the wrist; in the upper half of the forearm it lies between *M. supinator longus* and *M. pronator radii teres*, in the lower half between *M. supinator longus* and *M. flexor carpi radialis*. At the wrist it passes between the styloid process of the radius and the scaphoid to the back of the hand, where it is covered by the tendons of the *M. extensor ossis metacarpi pollicis* and *M. extensor primi internodii pollicis;* it then passes into the palm of the hand between the bases of the metacarpal bones of the thumb and index finger, and arches across the palm to the base of the metacarpal bone of the little finger, where it inosculates with the deep branch of the ulnar artery, forming the deep palmar arch, *Arcus volaris profundus*. Its branches are:

The radial recurrent, which anastomoses with the anterior terminal branch of the superior profunda artery;

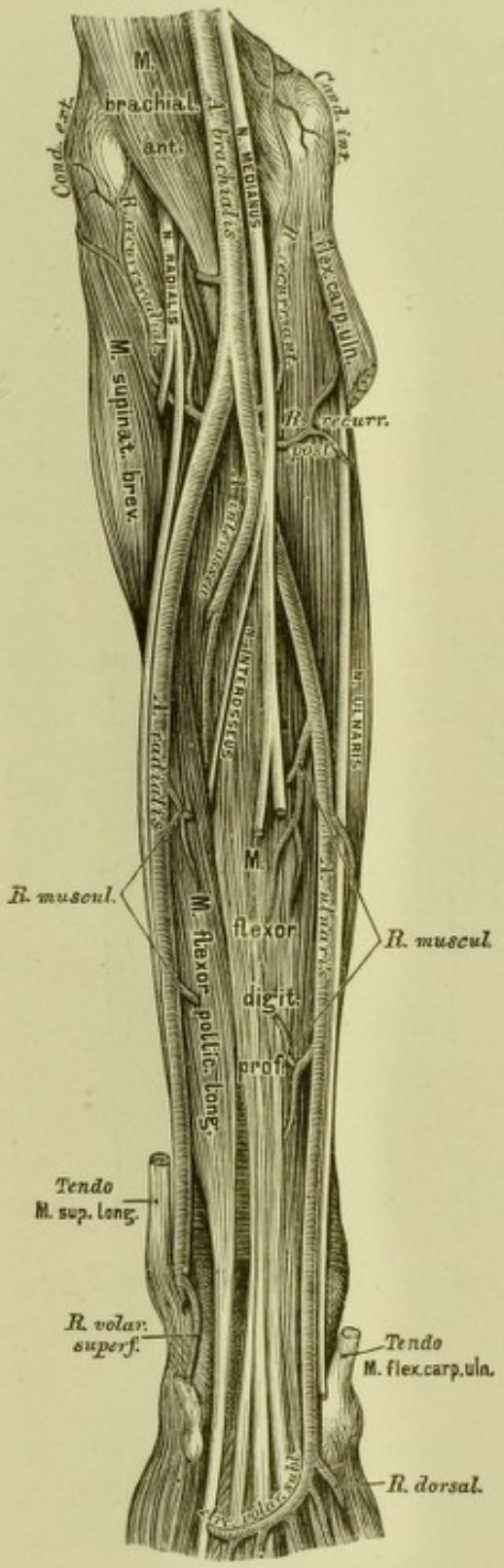
The muscular branches to the neighbouring muscles;

The *superficialis volae*, to the muscles of the ball of the thumb; it usually helps to form the superficial palmar arch.

At the back of the hand the radial artery gives off (see Fig. 559):

The posterior or dorso-carpal branch, *Ramus carpi dorsalis*, which, with the branches of the external interosseous artery helps to form the *Rete carpi dorsale* (posterior carpal arch);

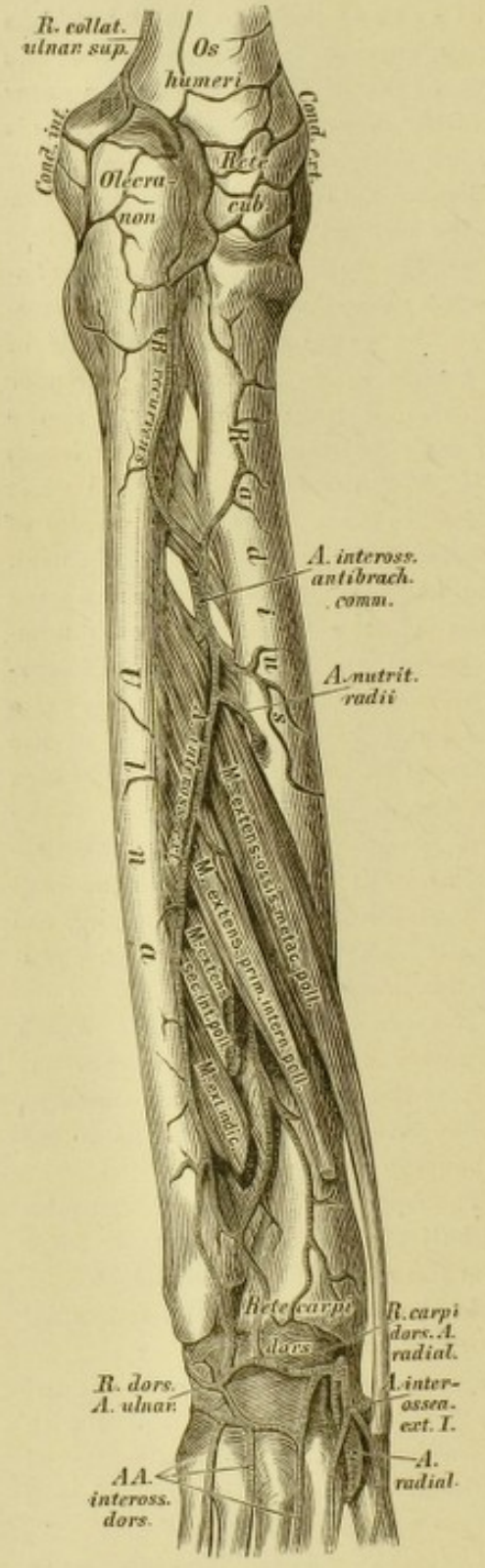
The first dorsal interosseous artery, *Art. interossea dorsalis prima*, which supplies both sides of the thumb and the radial side of the index finger.



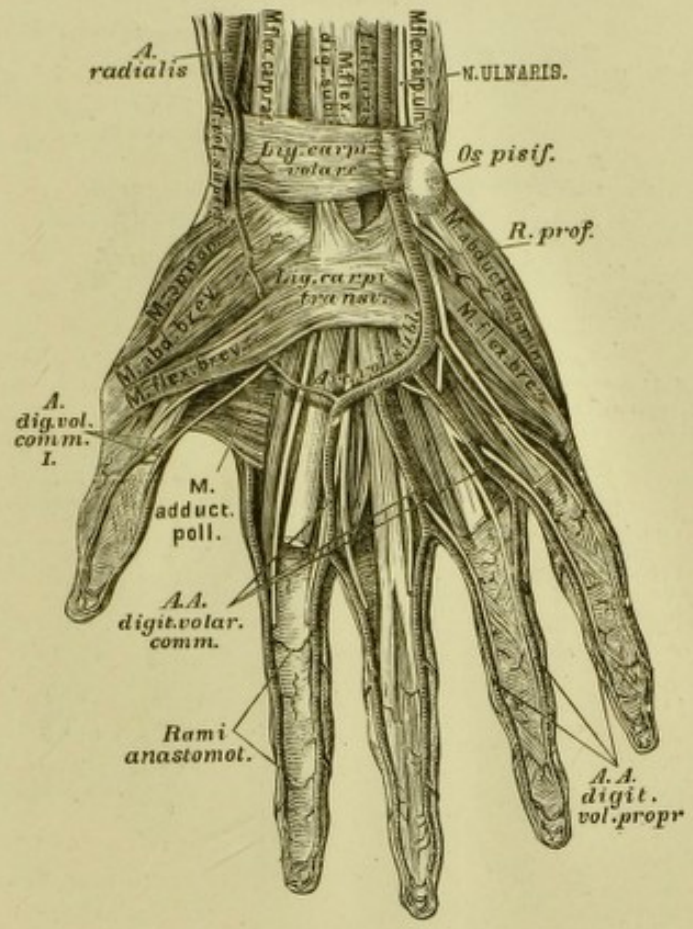
554. Course and Ramification of the Arteries of the Forearm.

Having returned to the palm of the hand, the radial artery gives off the *Art. digitalis volaris communis*, from which the *Art. volaris indicis radialis* arises, and which finally divides into two *Arteriae volares pollicis*.

555. Course of the Internal Interosseous Artery.



556. Course of the External Interosseous Artery.



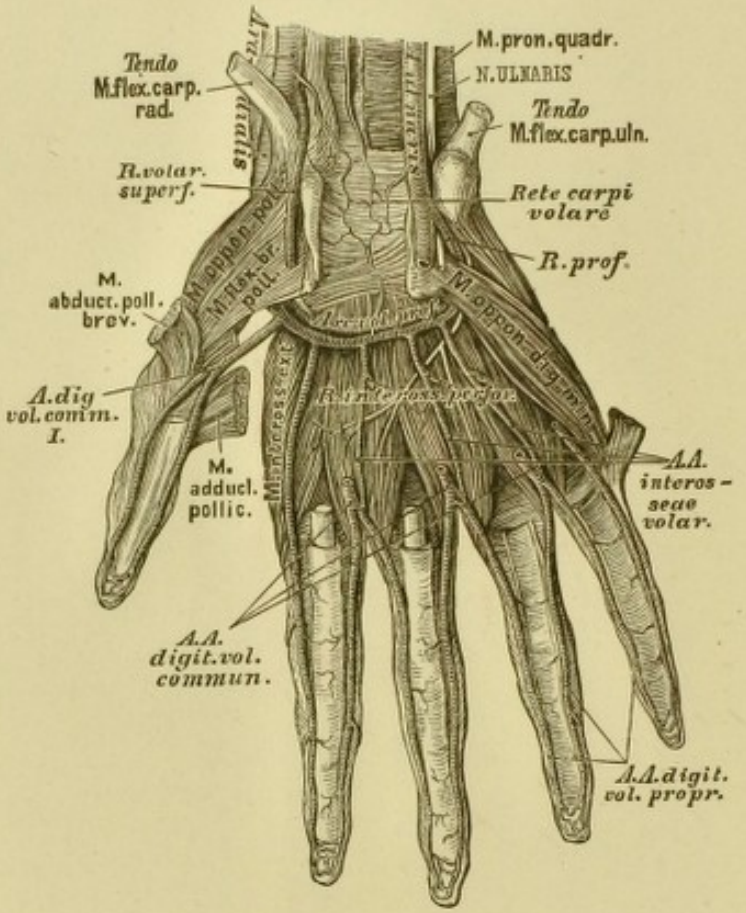
557. The Superficial Palmar Arch.

b) The ulnar artery, *Art. ulnaris,* runs along the ulnar border of the forearm, upon and to the side of the *M. flexor profundus digitorum,* between which and the *M. flexor carpi ulnaris* it passes to the wrist. It crosses the annular ligament on the radial side of the pisiform bone and passes into the palm of the hand where it divides into a superficial and a deep branch. The superficial branch forms, usually with the superficialis volae of the radial artery, the superficial palmar arch, *Arcus volaris sublimis,* the deep branch forms with the termination of the radial artery the deep palmar arch, *Arcus volaris profundus.* The branches of the ulnar artery are:

1. The anterior ulnar recurrent, which passes back to the internal condyle of the humerus and anastomoses with *Art. anastomotica magna;*

2. The posterior ulnar recurrent, the larger, which anastomoses behind the internal condyle of the humerus with the inferior profunda artery;

3. Several muscular branches for the neighbouring muscles, one of which supplies the ulna by means of a nutrient artery.

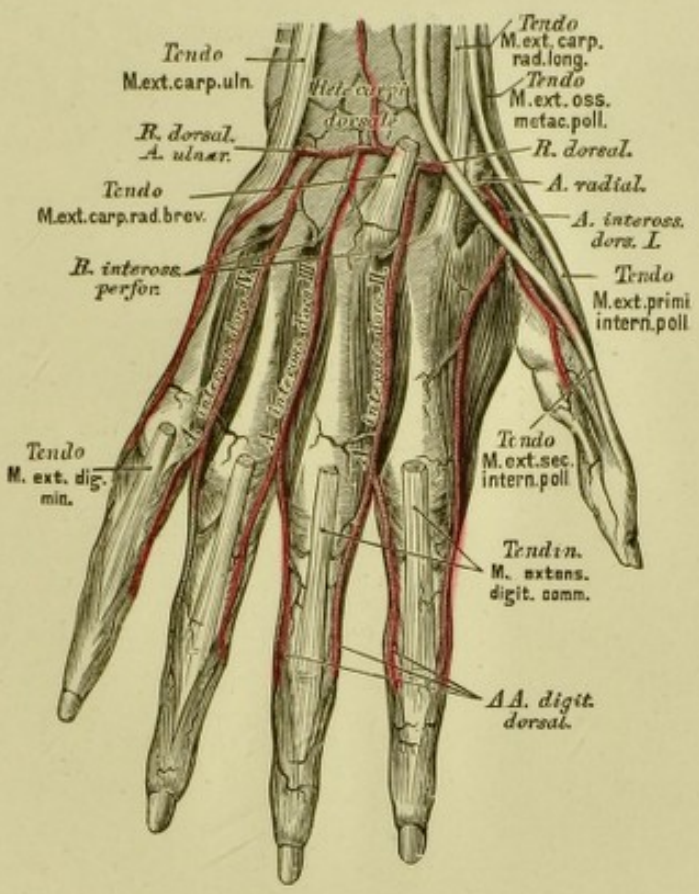


558. The Deep Palmar Arch.

Further branches of the ulnar artery (see Fig. 555 and 556) are:

4. The common interosseous artery, *Art. interossea antibrachii communis,* which, soon after its origin, divides into the posterior or external and anterior or internal branch. The posterior interosseous artery passes through the interosseous membrane, sends the interosseous recurrent branch to the posterior region of the elbow, lies upon the *MM. extensor ossis metacarpi* and *extensor secundi internodii pollicis,* gives off a number of muscular branches and finally anastomoses with the posterior carpal branch of the radial artery so as to form the posterior carpal arch, *Rete carpi dorsale.* The anterior interosseous artery passes down the forearm on the anterior surface of the interosseous membrane to the *M. pronator quadratus,* behind which it passes, gives off a branch to the *Rete carpi volare,* and, piercing the interosseous membrane as *Art. perforans inferior,* descends to the back of the wrist, where it joins the posterior carpal arch.

5. The last branch of the ulnar artery before it divides, is the posterior carpal, for the posterior carpal arch.



559. The Arteries at the Back of the Hand.

The superficial palmar arch, *Arcus volaris sublimis* (see Fig. 557) has its convexity directed towards the fingers; it is the continuation of the ulnar artery, and is sometimes completed by inosculating with the superficialis volae branch of the radial. From its convexity three digital branches, *Arteriae digitales volares communes*, are given off, each of which divides into two, the *Arteriae digitales volares propriae*, to supply the contiguous surfaces of the second, third, fourth and fifth fingers, down to the tip; a fourth branch supplies the ulnar side of the little finger.

The deep palmar arch, *Arcus volaris profundus* (see Fig. 558), the smaller and less convex, is formed principally by the radial artery. It gives off three palmar interosseous branches, *Arteriae interosseae volares*, which lie in front of the interosseous spaces of the four fingers, send off perforating branches, *Rami interossei perforantes*, to the dorsum of the hand and inosculate with the digital branches from the superficial arch.

From the posterior carpal arch, *Rete carpi dorsale*, only three interosseous arteries, *Arteriae interosseae dorsales*, are given off, the first arising directly from the radial artery; this latter divides into three branches, the others only into two; these are called dorsal digital arteries, *Arteriae digitales dorsales*, and pass down as far as the second phalanges.

560. Segment of the Thoracic Aorta with Injected *Vasa vasorum.*

View from behind. Natural size.

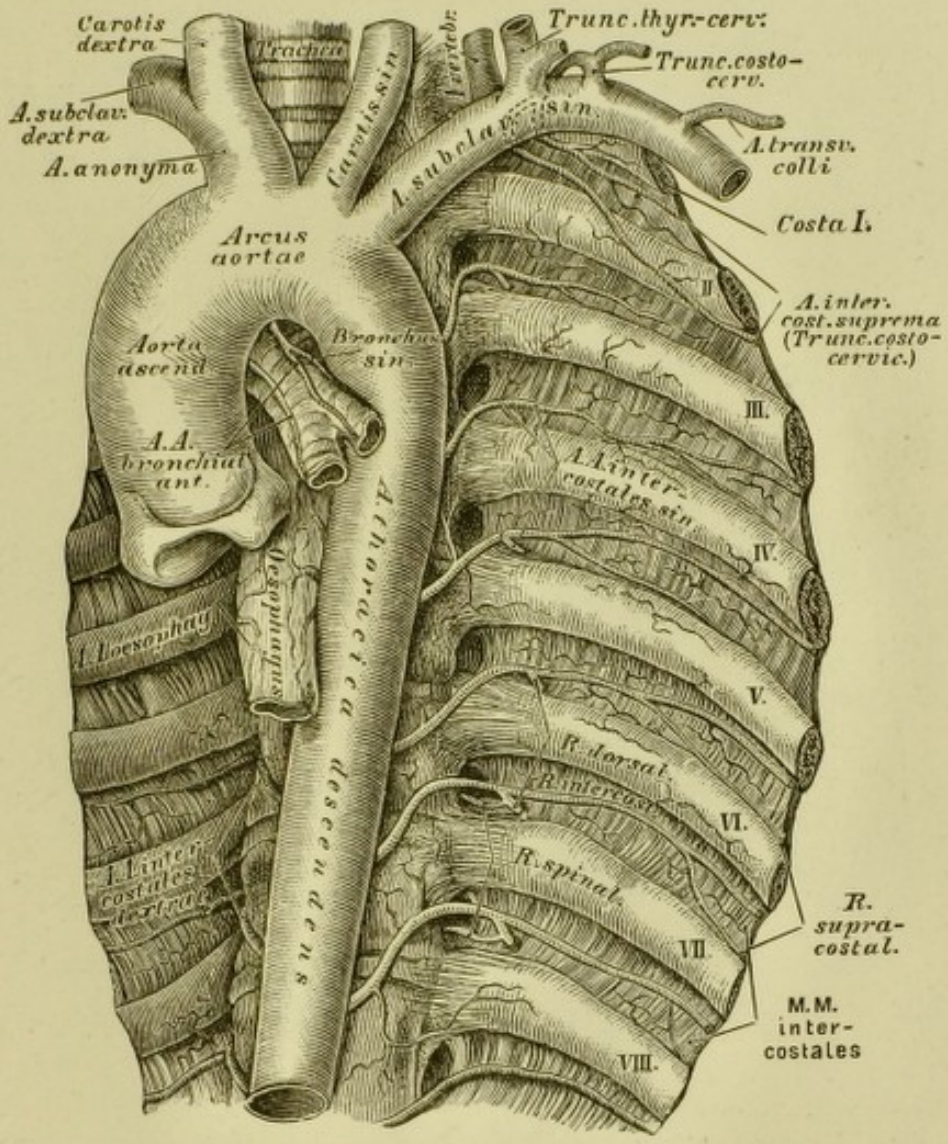
The descending thoracic aorta, *Aorta thoracica descendens,* gives off numerous, but mostly small branches. These are:

a) The posterior bronchial, *Arteriae bronchiales posteriores,* to the posterior wall of the bronchial tubes, the right frequently arises from the third or fourth right intercostal artery. The anterior bronchial, *Arteriae bronchiales anteriores,* arise from the internal mammary artery.

b) The oesophageal, *Arteriae oesophageae,* 2—4 in number.

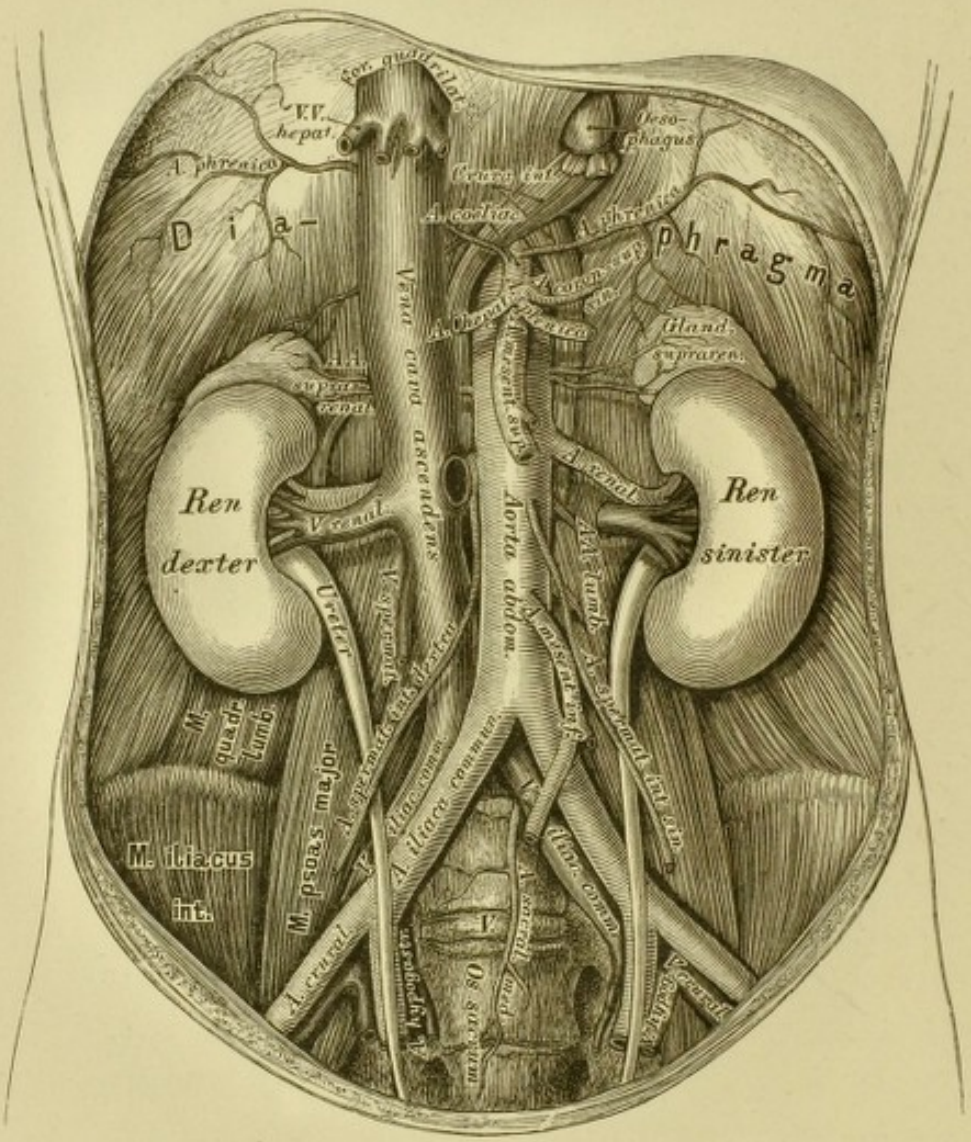
c) The mediastinal, *Arteriae mediastinicae,* to the structures in the posterior mediastinum. These, as well as the previous, supply also the posterior wall of the pericardium by means of the posterior pericardiac arteries.

d) The intercostal, *Arteriae intercostales,* for the nine inferior intercostal spaces and for the lower border of the twelfth rib, the two upper intercostal spaces being supplied by the superior intercostal branch of the subclavian artery. The left are shorter than the right. Each of these arteries divides into a posterior or dorsal and an anterior or intercostal branch. The dorsal branches pass each between the transverse processes of two vertebrae to the muscles of the back, and also supply the spinal cord and its membranes with branches, which enter through the intervertebral foramina. Each intercostal branch passes forwards to the sternum in the *Sulcus costae* of the rib above it, sends the supracostal branch to the upper border of the rib below and finally unites with the anterior intercostal branch of the internal mammary artery. The intercostal branches supply the intercostal muscles, the *M. pectoralis major, M. serratus magnus* and the costal origins of the abdominal muscles, in the female also the mammary gland.



561. Course and Ramification of the Descending Thoracic Aorta.

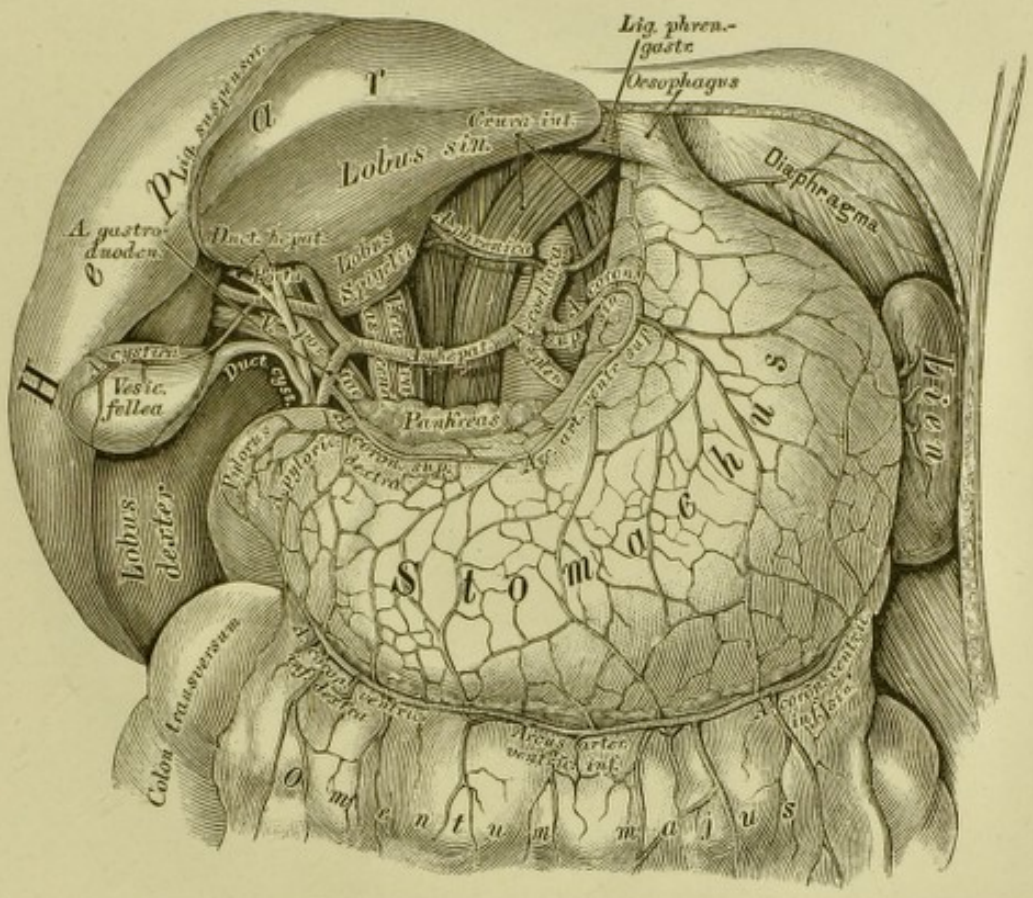
The origins from the posterior part of the aorta of each two of the intercostal arteries, are nearer to each other, the lower these arteries are placed. Several intercostal arteries may arise from a common trunk, which descends in front of the heads of the ribs. The artery which runs at the lower border of the twelfth rib, should, according to Haller, be more correctly called the first lumbar, *Art. lumbalis prima.* The upper intercostal arteries frequently arise lower than the position of the intercostal spaces to which they belong.



562. Course and Ramification of the Abdominal Aorta.

The abdominal aorta, *Aorta abdominalis,* gives off a large number of branches. From its anterior aspect three single arteries arise, the others arise from its lateral aspect. The single arteries are:

1. The coeliac artery or axis, *Art. coeliaca;* it is a short thick trunk, which arises from the aorta opposite the margin of the diaphragm; it passes above the upper border of the pancreas, a little to the left, and immediately gives off two phrenic arteries. These ramify in the suprarenal capsules, and in the lumbar and costal portions of the diaphragm, and anastomose with each other, as well as with the intercostal arteries (from the thoracic aorta) and the musculo-phrenic (from the internal mammary).



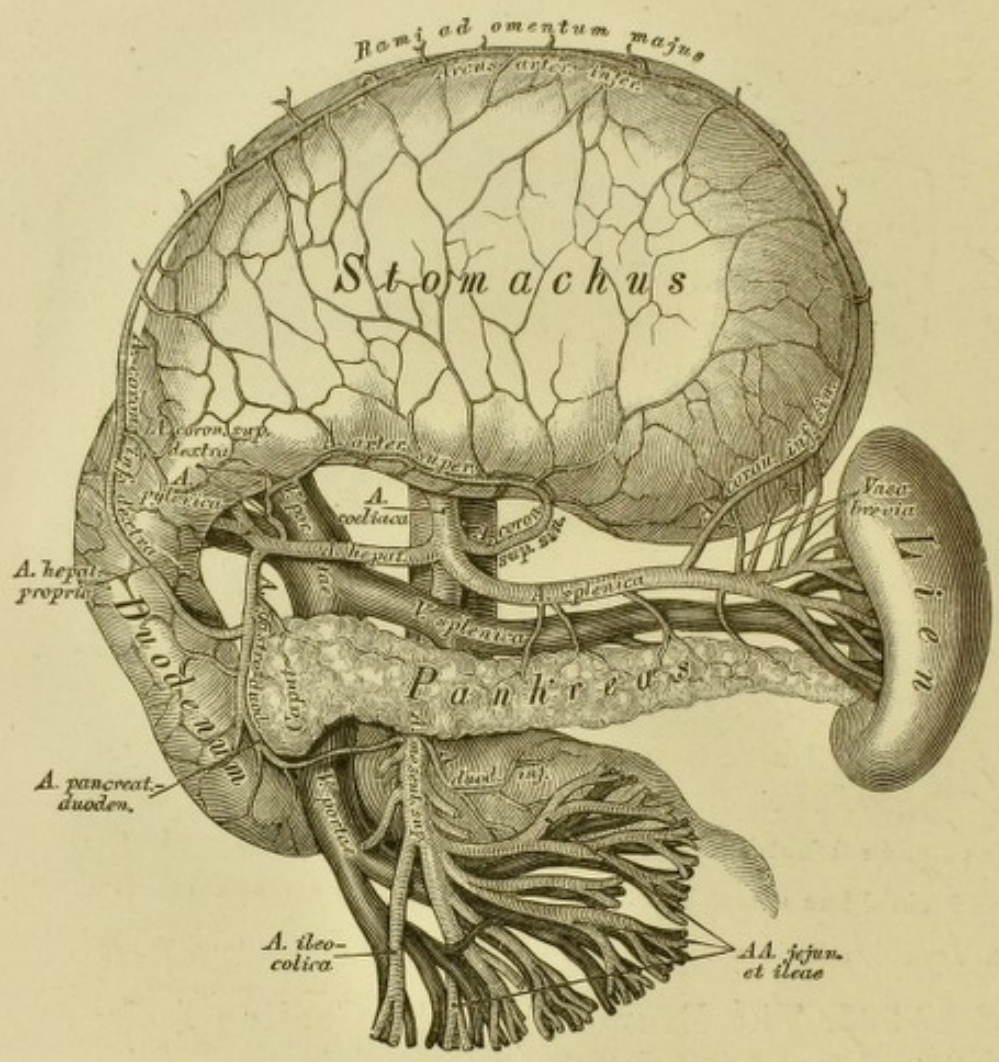
563. The Branches of the Coeliac Axis.

View after removal of the Lesser Omentum.

To the right of the cardia, the coeliac axis divides into three branches:

a) The gastric, *Art. coronaria ventriculi superior sinistra,* which runs in the lesser curvature of the stomach from left to right; its branches anastomose at the anterior and posterior surfaces of the stomach with the *Art. coronaria superior dextra,* the *Art. coronariae inferiores* and the *Vasa brevia.*

b) The hepatic, *Art. hepatica,* which runs in the *Lig. hepato-duodenale,* sends off the *Art. coronaria superior dextra* to the lesser curvature of the stomach (a branch of this is the pyloric artery) and then divides into an ascending and a descending branch. — The ascending branch is the *Art. hepatica propria,* which, dividing into two branches, enters the porta of the liver; its right branch gives off the cystic artery, supplying the gall-bladder, and passes into the right lobe of the liver; the left branch passes to the left lobe.



564. The Branches of the Coeliac Artery.

The stomach being turned upwards.

The descending ramus of the hepatic artery is called the gastro-duodenal artery; behind the pylorus this artery divides again into two branches:

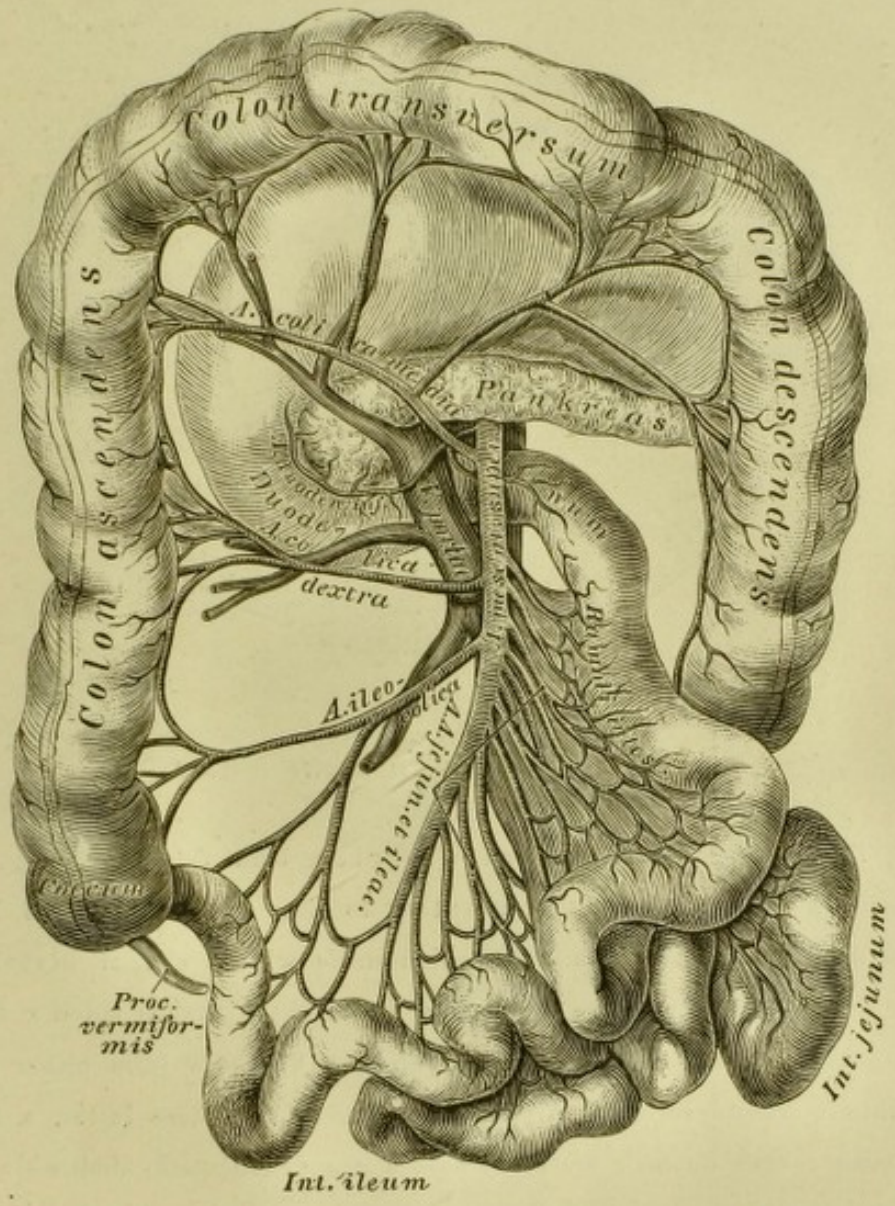
Art. pancreatico-duodenalis for the head of the pancreas and the duodenum;

Art. gastro-epiploica dextra (Art. coronaria ventriculi inferior dextra) running from right to left along the greater curvature of the stomach. Its branches pass to the stomach and great omentum, and it anastomoses with the *Art. gastro-epiploica sinistra.*

c) The splenic, *Art. splenica,* passes to the left to the spleen and gives off:

The *Art. gastro-epiploica sinistra (coronaria ventriculi inferior sinistra)* and 4—6 *Vasa brevia* to the fundus of the stomach.

By the anastomosis of these branches two arches are formed: the *Arcus arteriosus ventriculi superior,* at the lesser curvature of the stomach, and the *Arcus arteriosus ventriculi inferior* at the great curvature.



565. The Ramification of the Superior Mesenteric Artery.

2. The superior mesenteric artery, *Art. mesenterica (mesaraica) superior*, arises immediately below the coeliac axis, passes behind the head of the pancreas to the root of the mesentery and supplies the greatest part of the intestines by means of about twenty branches. It forms:

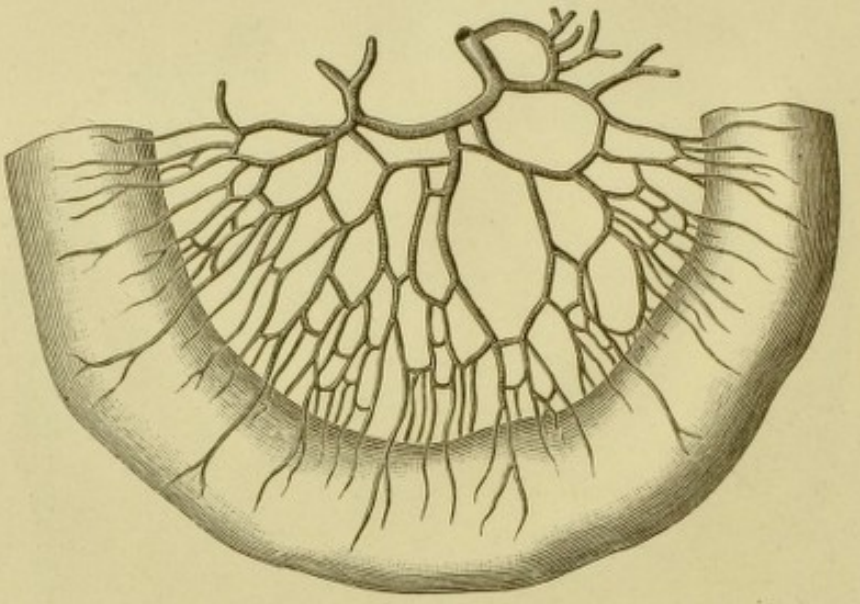
a) The inferior pancreatico-duodenal artery, *Art. duodenalis inferior*, for the descending portion of the duodenum and the head of the pancreas;

b) The intestinal branches, *Arteriae jejunales et ileae*, for the small intestine;

c) The ileo-colic for the termination of the small and commencement of the large intestine;

d) The *Art. colica dextra* for the ascending colon;

e) The *Art. colica media* for the transverse colon.

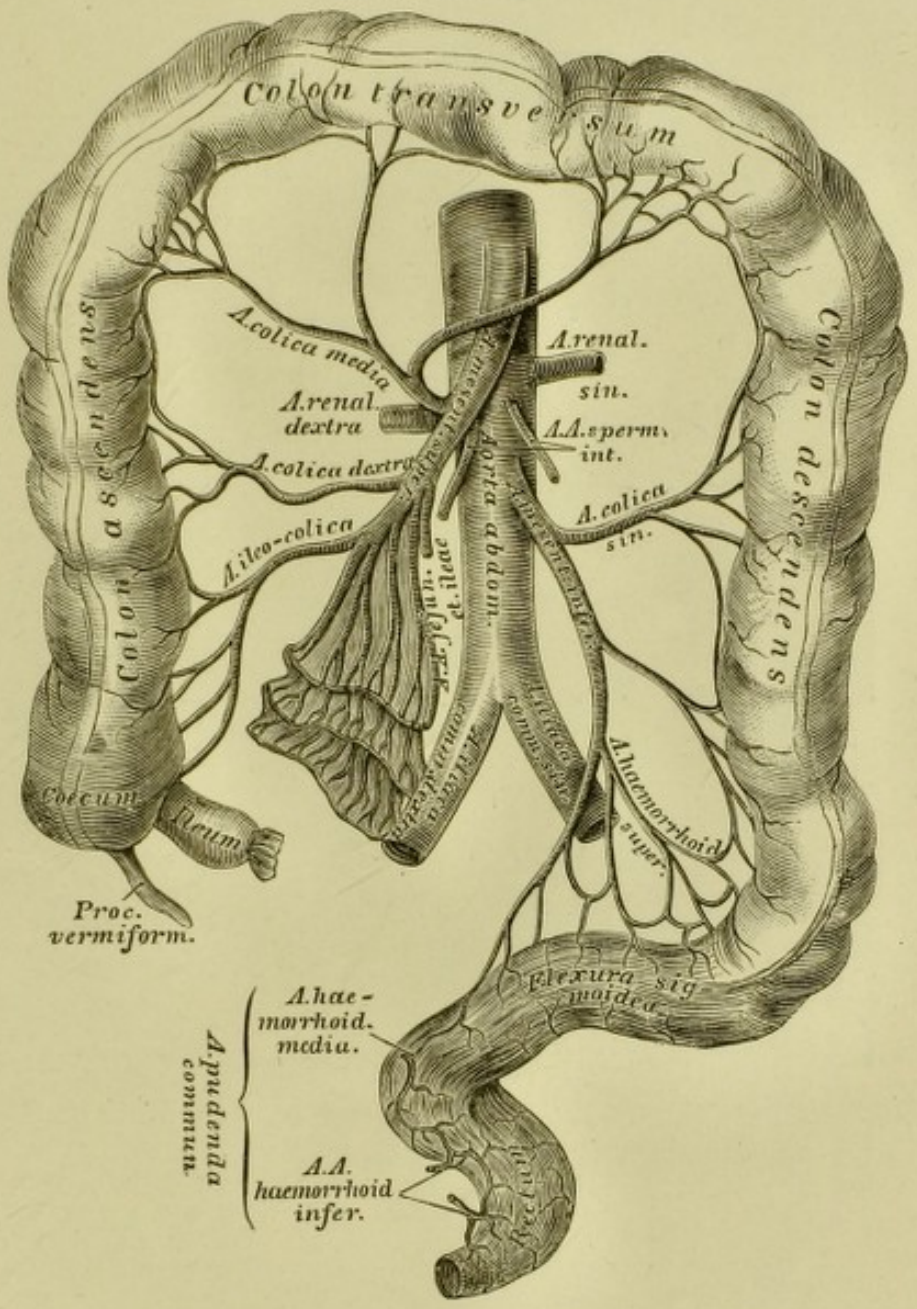


566. The *Vasa intestini tenuis.*

The 16—18 intestinal arteries, *Vasa intestini tenuis,* pass between the two layers of the mesentery to the jejunum and ilium. Each vessel divides into two branches, which unite with a similar branch on each side, forming a series of arches. From these arches smaller branches arise, which again unite with similar branches from either side, and thus a second series of arches is formed; from these latter, a third and even fourth or fifth series of arches are constituted, diminishing in size the nearer they approach the intestine.

From the terminal arches, numerous small vessels, the *Ramuli intestinales* arise, which encircle the intestine, upon which they are distributed, ramifying thickly between its coats. The *Art. ileo-colica, colica dextra* and *colica media* also form a number of arches with each other, especially at the angles between the ascending and transverse colon, and two or three between the transverse and descending colon.

3. The inferior mesenteric artery, *Art. mesenterica inferior,* divides soon after its origin into two branches: the *Colica sinistra* to the descending colon, and the superior haemorrhoidal artery to the sigmoid flexure and rectum. These branches too, anastomose with each other, forming arterial arches.



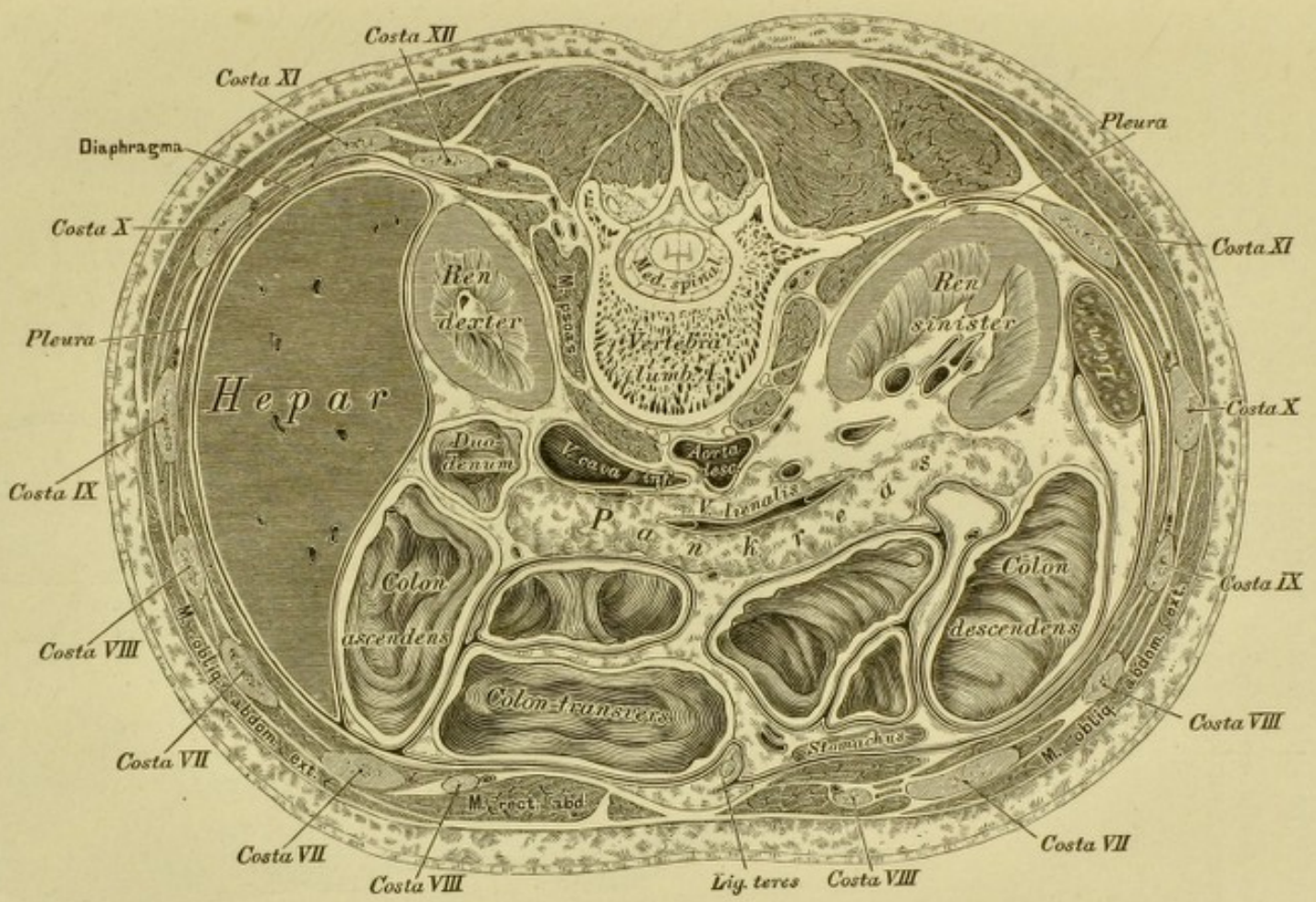
567. The Ramification of the Inferior Mesenteric Artery.

The other branches of the abdominal aorta, one on each side, are:

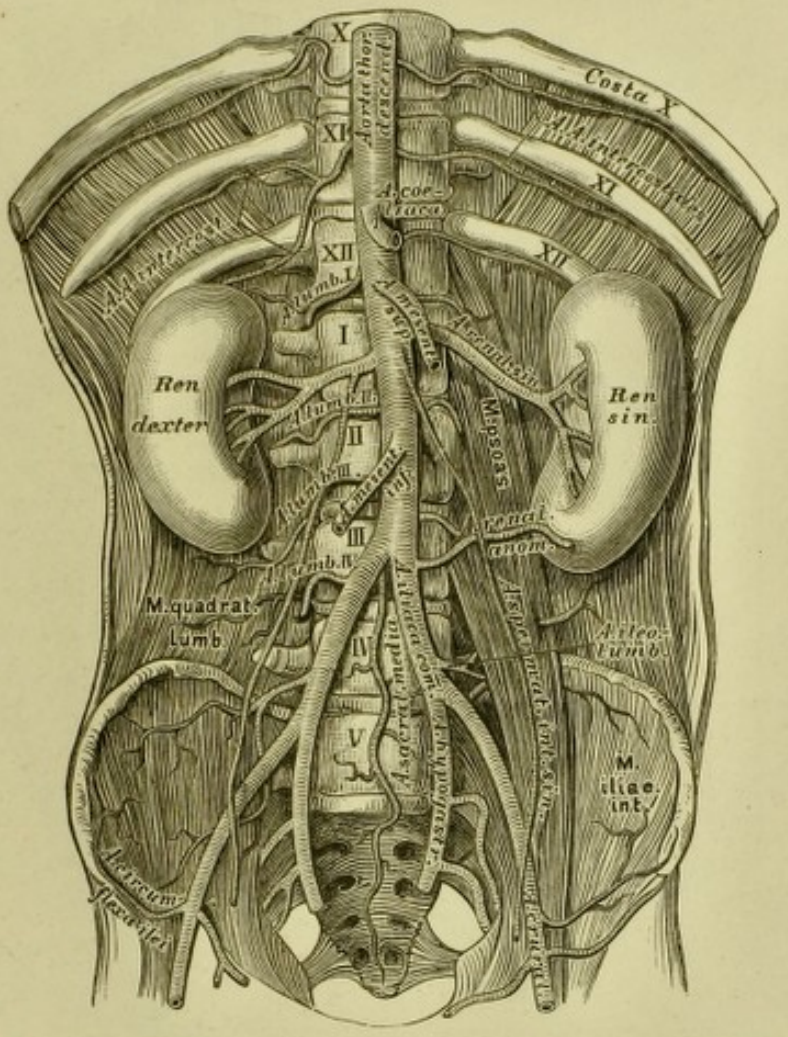
1. The suprarenal arteries, *Arteriae suprarenales.*

2. The renal arteries, *Arteriae renales,* which arise below the superior mesenteric artery, give off capsular branches to the connective tissue and fat around the kidney, also smaller branches to the pelvis of the kidney and the ureter, and then enter the substance of the kidney.

3. The internal spermatic arteries, *Arteriae spermaticae internae;* the one on the left side arises from the aorta below the renal artery, while the right usually arises from the right renal artery. In the male they are directed outwards, to the internal abdominal ring, and accompany the other constituents of the spermatic cord along the spermatic canal to the testis; in the female they pass to the ovaries and along the Fallopian tubes to the uterus, and anastomose with a branch of the uterine arteries (see Fig. 575).



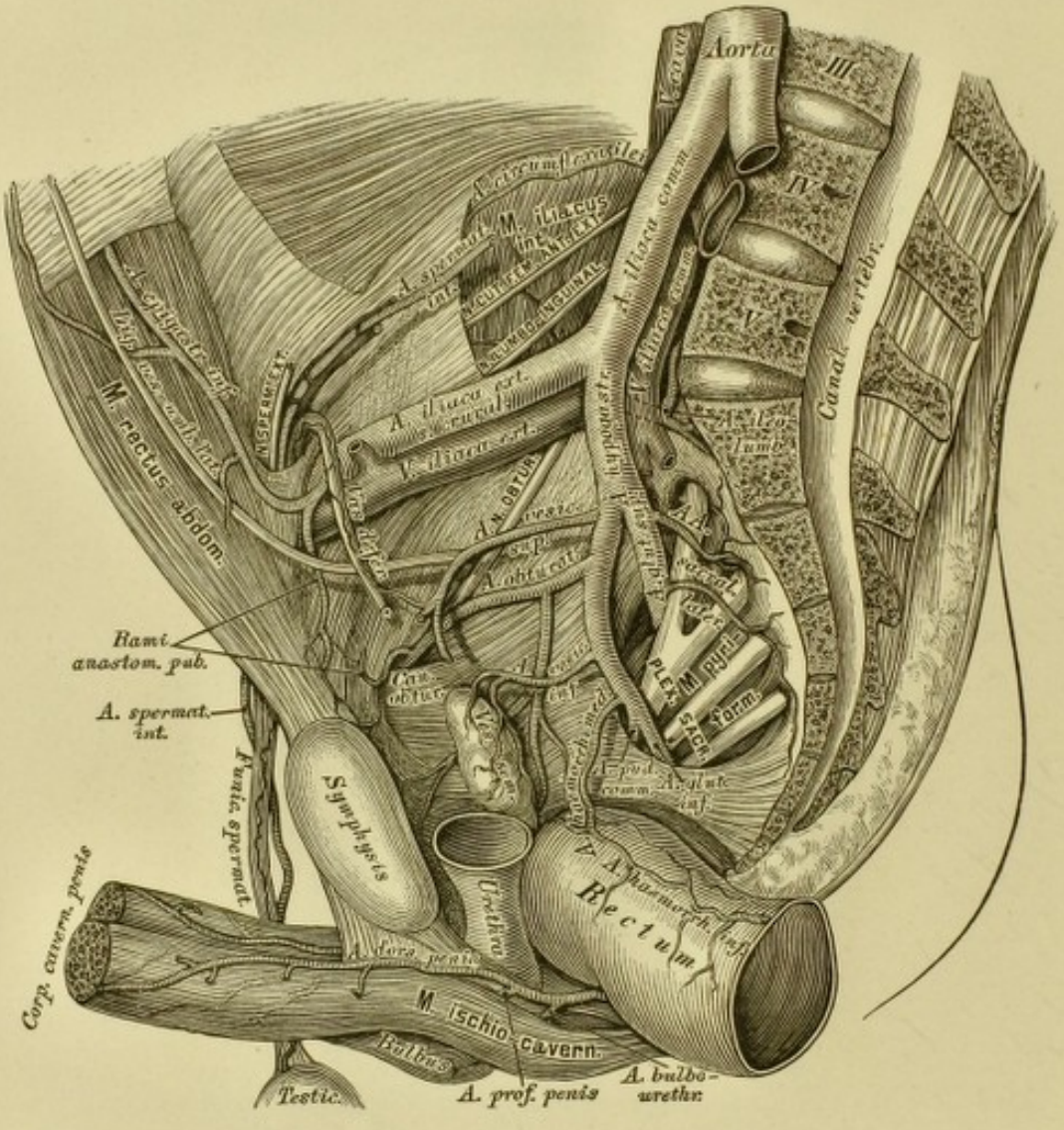
568. Horizontal Section through the Abdomen, opposite the First Lumbar Vertebra.
After W. Braune. $^1/_2$ natural size.



569. Course and Ramification of the Abdominal Aorta. Specimen from a child. Natural size.

4. The lumbar arteries, *Arteriae lumbales,* are five in number on each side and arise from the back part of the aorta; they pass outwards behind the psoas muscle. Each artery divides into a posterior or dorsal branch, which, with its spinal branch is distributed to the spinal cord and its membranes, and an anterior branch for the broad abdominal muscles. If the artery which runs along the lower border of the twelfth rib is counted as an intercostal artery, there are only four lumbar arteries.

In front of the fourth lumbar vertebra the abdominal aorta divides into the two common iliac arteries, *Arteriae iliacae communes.* These pass downwards towards the sacro-iliac symphisis and divide opposite the promontory into the external iliac or crural and the internal iliac or hypogastric arteries. Between both common iliac arteries the *Art. sacralis media,* which passes down to the coccyx, arises; it gives off lateral branches, and partly supplies the *M. psoas magnus,* the *M. iliacus internus* and the rectum.



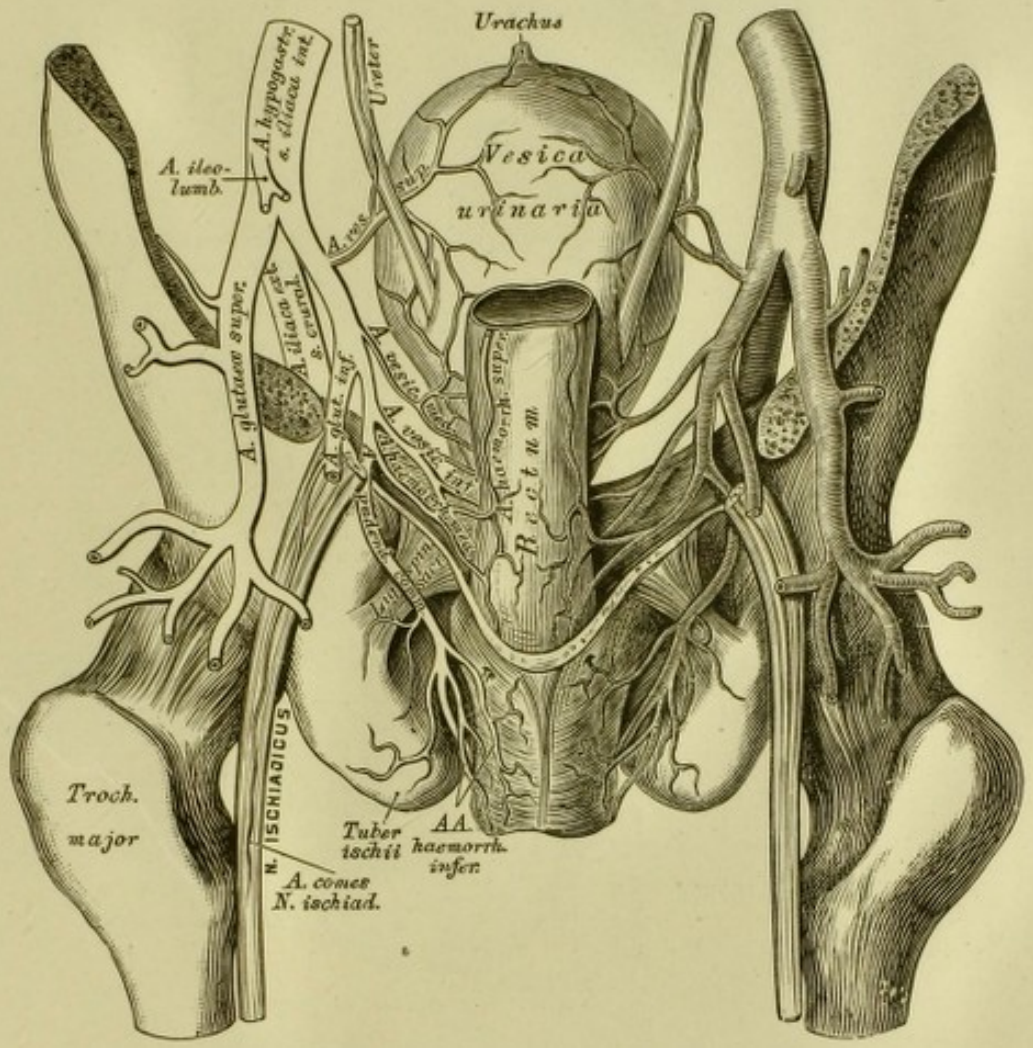
570. Course and Ramification of the Arteries of the Pelvis.

The internal iliac artery, *Art. iliaca interna s. hypogastrica*, extends from the bifurcation of the common iliac artery downwards towards the great sacro-sciatic foramen, where it divides into two large trunks, an anterior and a posterior, which supply the pelvic viscera, gluteal region and the external genital organs.

The posterior branches of the internal iliac artery are:

a) The ileo-lumbar, *Art. ileo-lumbalis*, which ascends beneath the psoas muscle, and gives off the iliac branch for the *M. iliacus*, and the lumbar branch for the *MM. psoas* and *quadratus lumborum*.

b) The lateral sacral, *Arteriae sacrales laterales*, a superior larger and an inferior smaller for the *MM. pyriformis, levator ani* and *coccygeus*. Some of its branches pass through the anterior sacral foramina to the termination of the spinal cord, others through the posterior sacral foramina to the long muscles of the back.

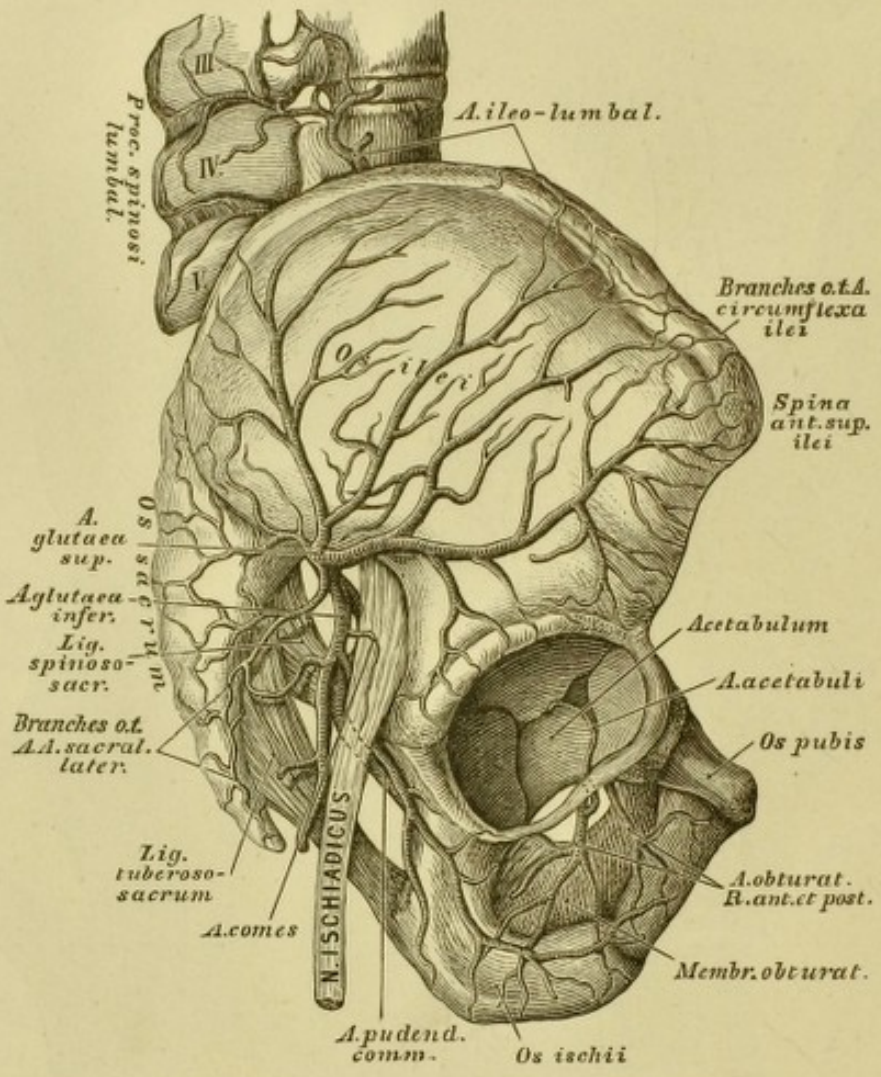


571. Course and Ramification of the Arteries of the Pelvis. View from behind, after removal of the posterior pelvic wall.

c) The superior gluteal artery, *Art. glutaea superior*, the largest branch of the internal iliac artery, passes above the upper border of the pyriformis muscle through the great sacro-sciatic notch, to the gluteal muscles; one of its branches passes forwards between *M. glutaeus maximus* and *medius*, the other, larger, passes between *M. glutaeus medius* and *minimus*. Both divide into a number of branches.

The anterior branches of the internal iliac artery are:

a) The obturator, *Art. obturatoria;* it passes through the obturator canal in company with the obturator nerve and divides at the upper border of the *M. obturatorius* into an anterior or internal and a posterior or external branch. The internal ramifies in the *MM. adductor femoris longus et brevis, pectineus* and *gracilis;* the external sends the *Art. acetabuli* to the *Lig. teres* of the hip-joint and finally distributes branches to the external rotator muscles.



572. The Arteries at the Hip.

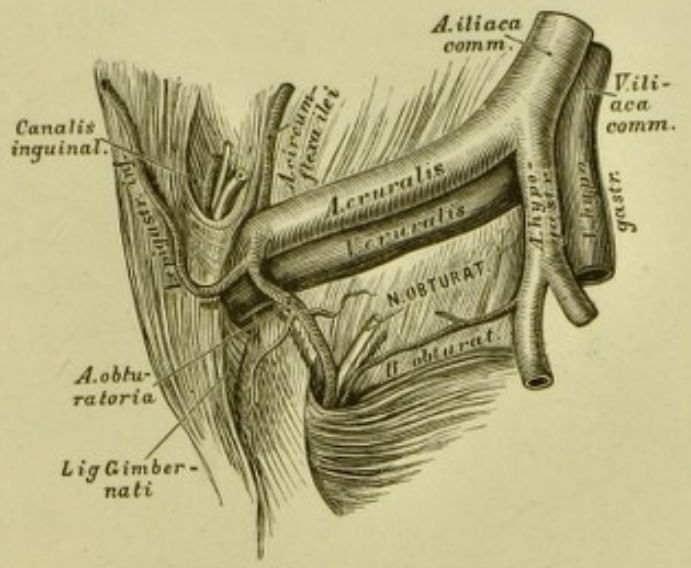
Specimen from a child.

Within the pelvis the obturator artery supplies the *MM. iliacus, obturator internus* and *levator ani* and sends the *Ramus anastomoticus* to the *Symphisis pubis* (see Fig. 570).

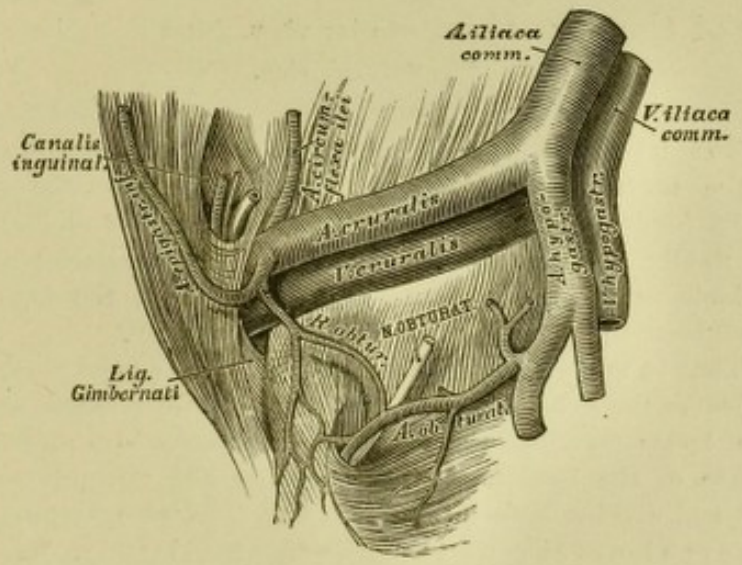
The two most important anomalies in the origin and communication of the obturator and inferior epigastric arteries are shown in Fig. 573 and 574.

b) The sciatic artery, *Art. ischiadica s. glutaea inferior,* leaves the pelvis below the *M. pyriformis* in company with the sciatic nerve; it supplies the external rotators of the thigh and the flexors of the leg which arise from the *Tuber ischii.* A small branch, the *Art. comes N. ischiadici,* accompanies the sciatic nerve.

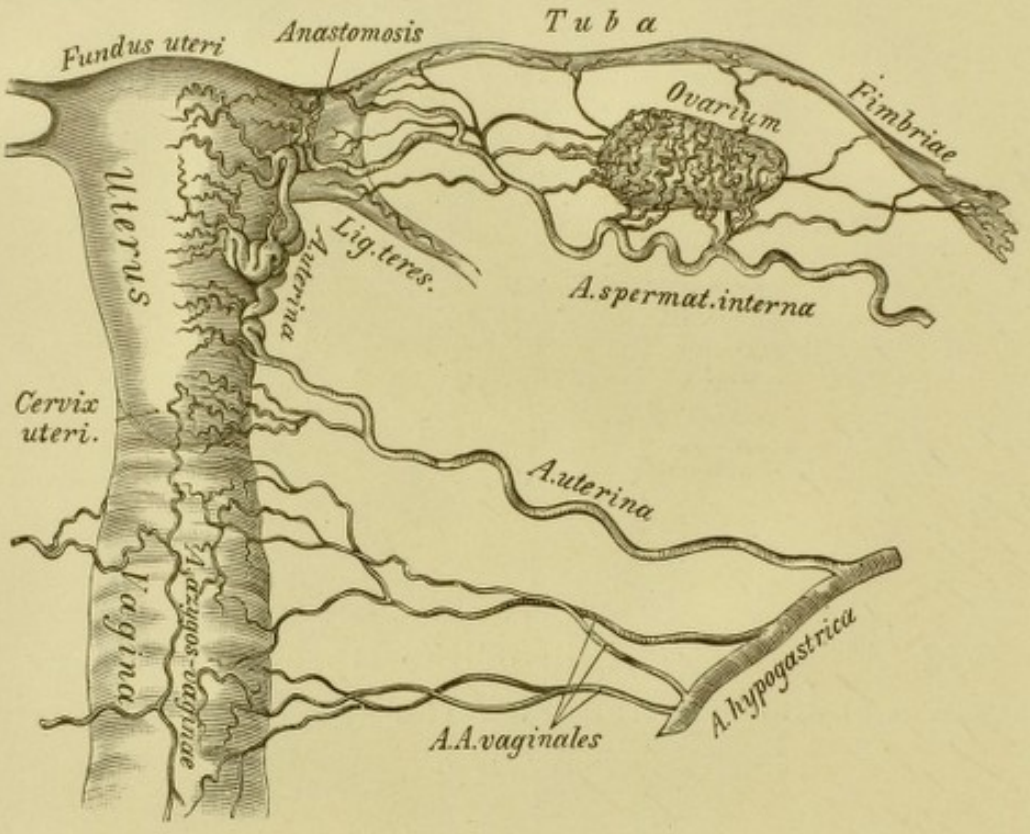
c) The vesical arteries, *Arteriae vesicales,* a superior and an inferior, very often also a middle. The superior supplies the posterior wall and fundus of the bladder; the inferior the base of the bladder, the *Vesiculae seminales,* the prostate gland and, in the female, the vagina (see Fig. 575). In the male it also sends off the artery of the *Vas deferens,* which passes down as far as the epididymis.



573. Abnormal Origin of the Obturator Artery from a common trunk with the Inferior Epigastric Artery.



574. Abnormal Branch of Communication between the Obturator Artery and the Inferior Epigastric Artery.



575. The Arteries of the Internal Generative Organs of the Female. Posterior view. After a specimen of Hyrtl. $^2/_3$ natural size.

d) The uterine artery, *Art. uterina,* passes downwards to the neck of the uterus, ascends in a tortuous course on the side of the organ to its fundus, supplies branches to the vagina and *Portio vaginalis uteri* and finally anastomoses with the ovarian (spermatic) artery. One branch, which runs in the round ligament, reaches the inguinal canal and communicates with the inferior epigastric artery.

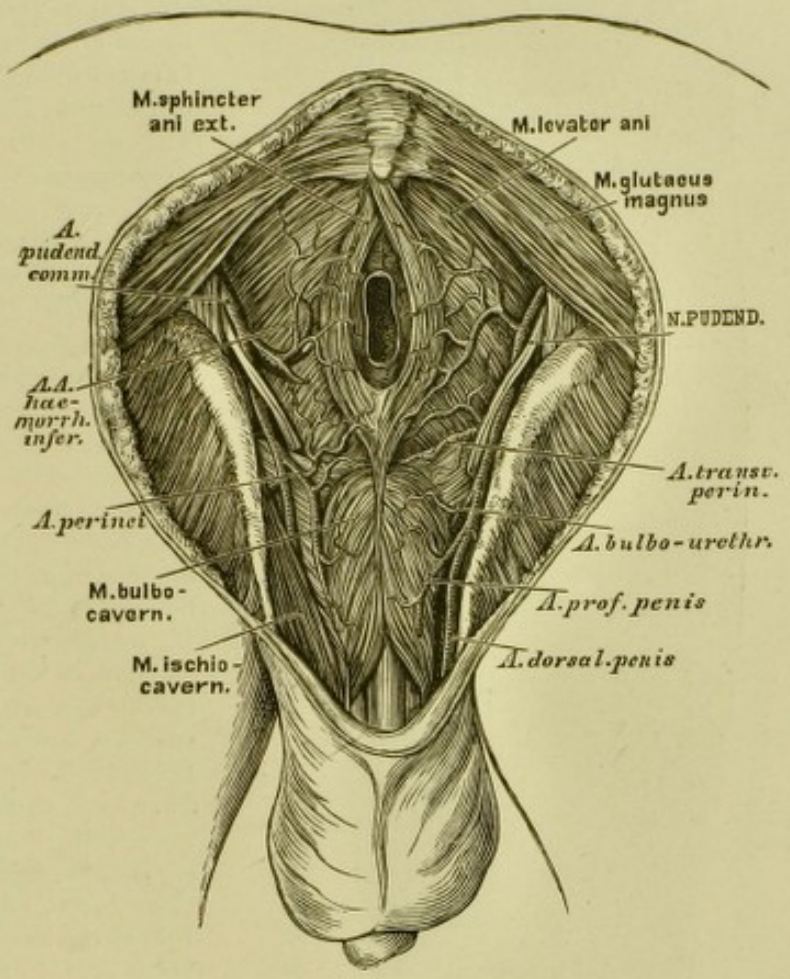
e) The internal or common pudic artery, *Art. pudenda communis,* leaves the pelvis by the great sacro-sciatic foramen and reenters it by the lesser sacro-sciatic foramen. It passes downwards on the inner surface of the ischium, curves forwards and upwards towards the pubic arch and divides here into the artery of the *Corpus cavernosum* and the dorsal artery of the penis or clitoris.

The branches of the internal pudic are:

1. The middle haemorrhoidal, while still within the pelvis;

2. The inferior haemorrhoidal, two or three in number, pass through the ischio-rectal space to the *M. levator ani* and the anus;

3. The perineal or superficial perineal, which passes forwards through the *M. transversus perinei* and gives off the posterior scrotal arteries in the male, the posterior labial in the female.



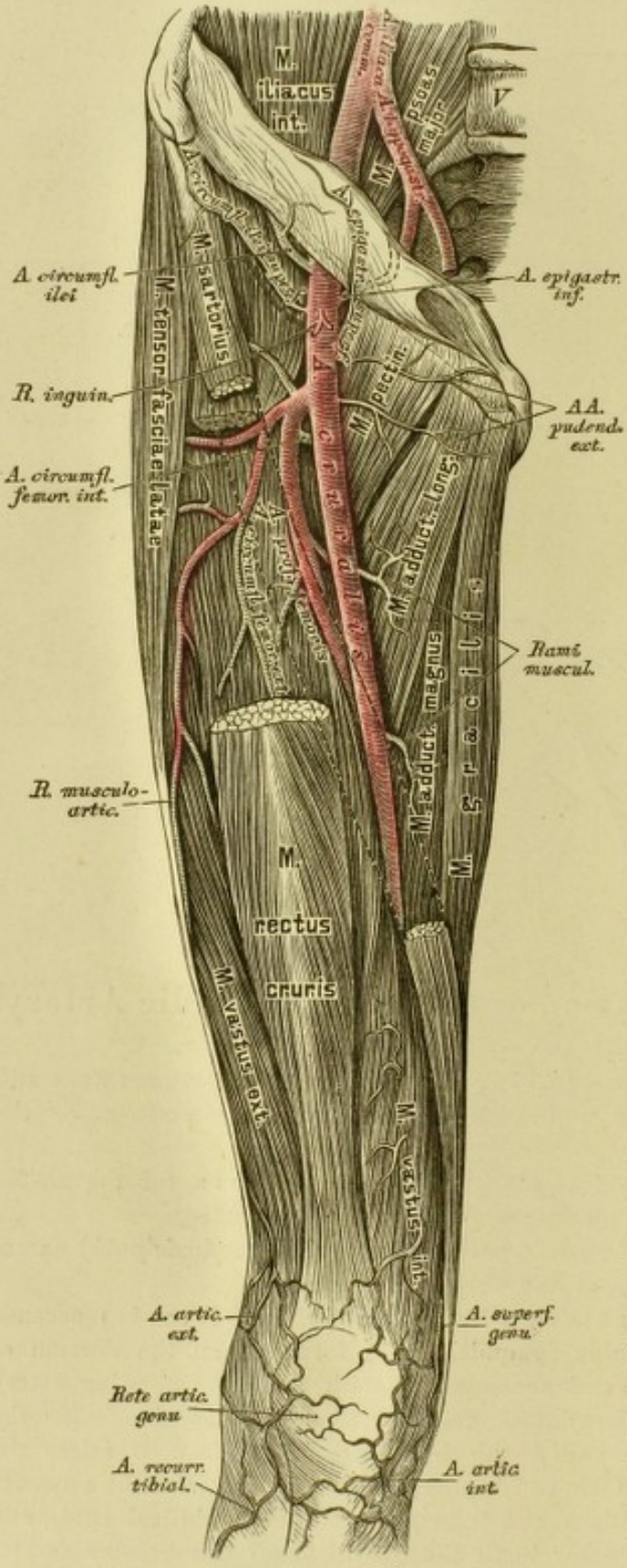
576. The Ramification of the Internal Pudic Artery.

4. The transverse perineal, for the region between anus and *Bulbus urethrae,* is either a branch of the superficial perineal or the internal pudic;

5. The artery of the bulb of the urethra for the *Bulbus urethrae* and Cowper's glands;

6. The artery of the *Corpus cavernosum (Art. profunda penis)* passes to the anterior extremity of the *Corpus cavernosum.*

7. The dorsal artery of the penis (or clitoris) ascends between the crus and pubic symphisis, runs forwards on the dorsum of the penis to the glans, and accompanies with the corresponding artery of the opposite side the dorsal vein of the penis. In the foetus the internal iliac artery is called the hypogastric; from it arises the umbilical artery, which, converging towards its fellow of the opposite side, passes to the umbilicus and from there to the umbilical cord, and ramifies in the placenta. After birth the umbilical arteries become impervious and form the *Ligamenta vesico-umbilicalia lateralia.* The obliteration continues up to the origin of the superior vesical artery.



577. Course and Ramification of the Crural Artery.

The crural artery, *Art. cruralis,* has received the names of external iliac, femoral and popliteal in different parts of its course. The external iliac artery passes obliquely downwards and outwards along the inner border of the *M. psoas,* from the bifurcation of the common iliac artery to Poupart's ligament, where it enters the thigh, and becomes the femoral artery. The femoral artery commences immediately behind Poupart's ligament, and passing down the fore part and inner side of the thigh, terminates at the opening in the *M. adductor magnus* at the junction of the middle with the lower third of the thigh, where it becomes the popliteal. The popliteal artery, commencing at the opening in the *M. adductor magnus,* passes obliquely downwards and outwards behind the knee-joint to the lower border of the *M. popliteus,* and there divides into the anterior and posterior tibial arteries.

The branches of the external iliac are:

a) The inferior epigastric, *Art. epigastrica inferior.* It at first descends to reach Poupart's ligament, and then ascends obliquely inwards to the outer margin of the *M. rectus abdominis,* and anastomoses above the umbilicus with the superior epigastric artery from the internal mammary (see Fig. 548 and 570). From it arise the pubic, *Ramus anastomoticus pubicus*; the external spermatic to the spermatic cord and sheaths of the scrotum; and numerous muscular branches.

b) The circumflex iliac artery, *Art. circumflexa ilei* (see Fig. 569) runs obliquely upwards and outwards along the crest of the ilium. It supplies the muscles which arise from the crest of the ilium.

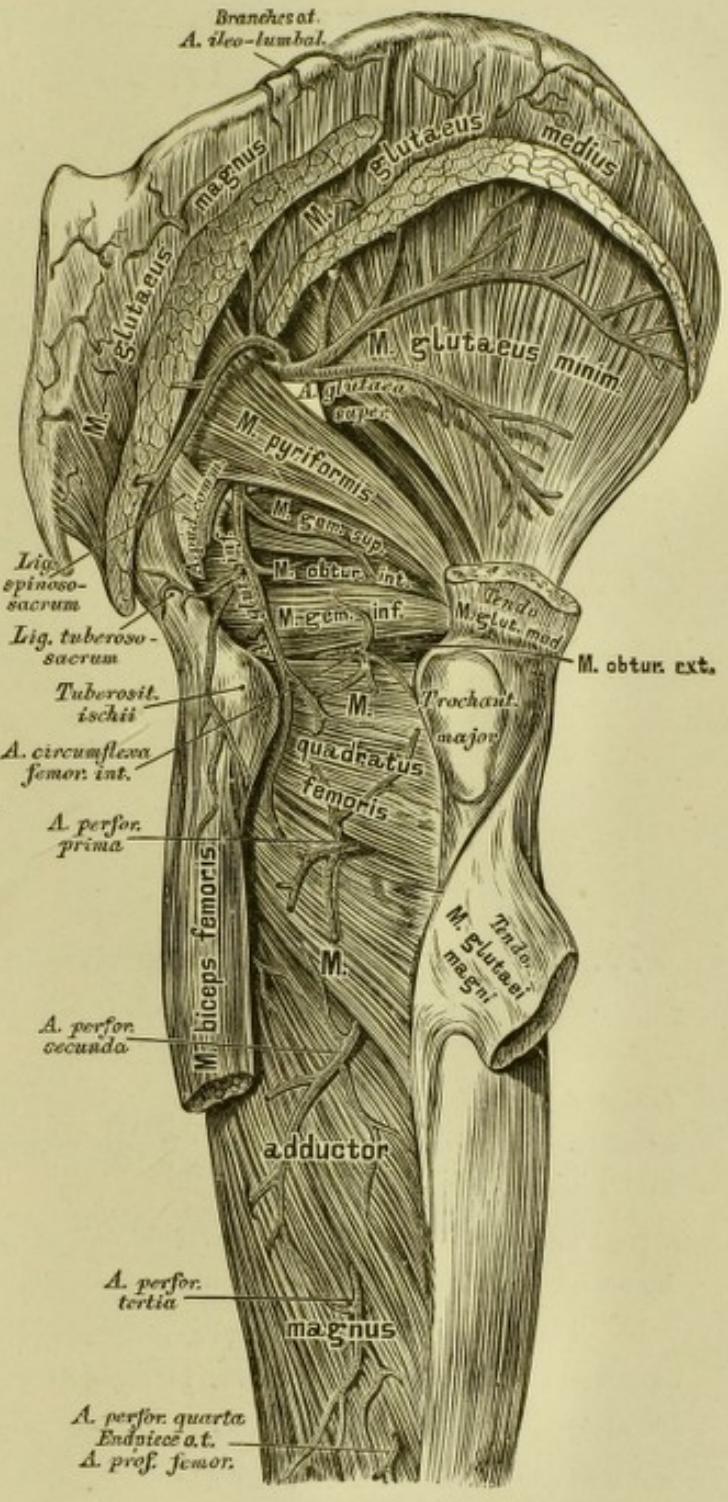
The femoral artery gives off the following branches:

1. Inguinal, *Ramuli inguinales.*

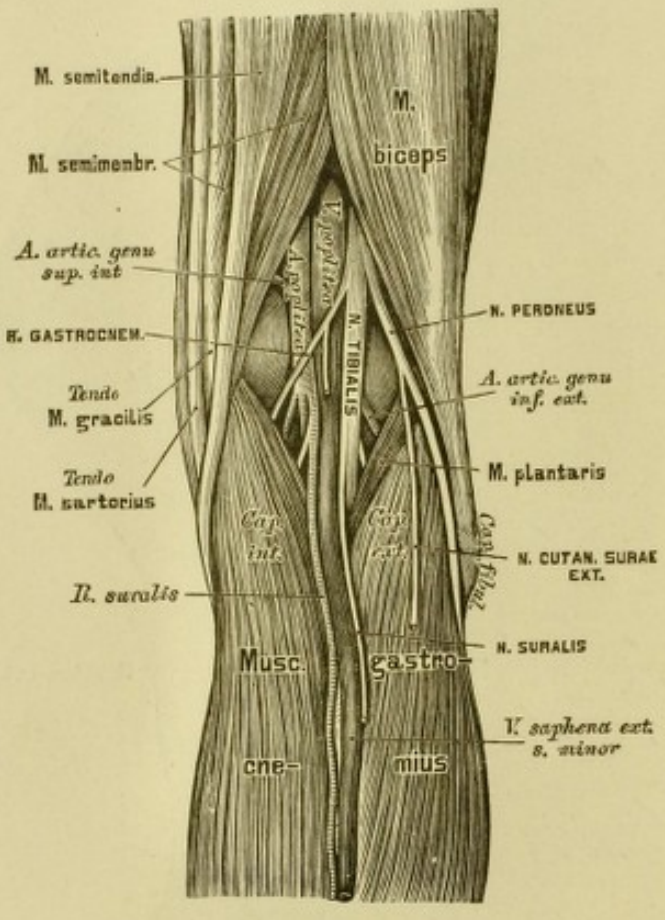
2. Superficial epigastric, *Art. epigastrica superficialis,* frequently also a superficial circumflex iliac, *Art. circumflexa ilei superficialis,* both for the integument.

3. External pudic, *Arteriae pudendae externae,* a superficial and a deep, pass transversely inwards; the deep gives off the anterior scrotal or labial arteries.

4. Deep femoral, *Arteria profunda femoris,* nearly equal in size to the superficial femoral, supplies all the muscles of the thigh. It arises 1—1½ inches below Poupart's ligament, passes inwards and backwards between the *MM. adductor longus* and *brevis,* and finally perforates the *M. adductor magnus.* It gives off two circumflex arteries: the internal, *Art. circumflexa femoris interna,* and the external, *Art. circumflexa femoris externa.* The internal winds backwards around the lesser trochanter and after having supplied the muscles at the inner side of the thigh, divides into an ascending and a descending branch.



578. The Arteries at the Outer Side of the Hip and Posterior Side of the Thigh.



579. Topographical Anatomy of the Popliteal Space.

The external circumflex artery passes outwards, behind the *M. rectus femoris*, supplies the muscles in front and on the outer side of the thigh, sends the *Ramus musculo-articularis* down to the knee and finally perforates the *M. vastus externus*. The perforating arteries of the *profunda femoris, Arteriae perforantes* (see Fig. 578), pass through the tendons of the adductors to the posterior side of the thigh; they are three in number, the termination of the *profunda femoris* being the fourth.

5. Muscular branches, *Rami musculares*, for the muscles of the thigh.

6. *Art. superficialis genu (anastomotica magna)* passes to the internal condyle of the femur and anastomoses with the superior internal articular branch of the popliteal artery.

The popliteal artery gives off muscular and articular branches. The latter, which form the *Rete articulare genu*, are the following:

The superior articular, *Arteriae articulares genu superiores*, a larger external and a smaller internal;

The inferior articular, *Arteriae articulares genu inferiores*, also an external and an internal;

The middle or azygos articular, *Art. articulationis genu media*, for the internal ligaments of the knee-joint. The two superior and two inferior lie close to the bone, the middle pierces the popliteal ligament and the posterior capsular wall, and passes into the cavity of the knee-joint.

580. Course of the Anterior Tibial Artery.

The popliteal artery divides into the anterior and posterior tibial arteries:

1. The anterior tibial, *Art. tibialis antica*, passes through the upper interosseous space to the anterior surface of the interosseous membrane and lies at first between the *M. tibialis anticus* and *M. extensor longus digitorum*, further down between *M. tibialis anticus* and *M. extensor pollicis longus*. At the ankle-joint it lies upon the capsule and, under the name of dorsal artery of the foot, *Art. dorsalis pedis*, passes to the dorsum of the foot. Its branches are:

a) The recurrent tibial, *Arteriae recurrentes tibiales*, to the *Rete articulare genu*;

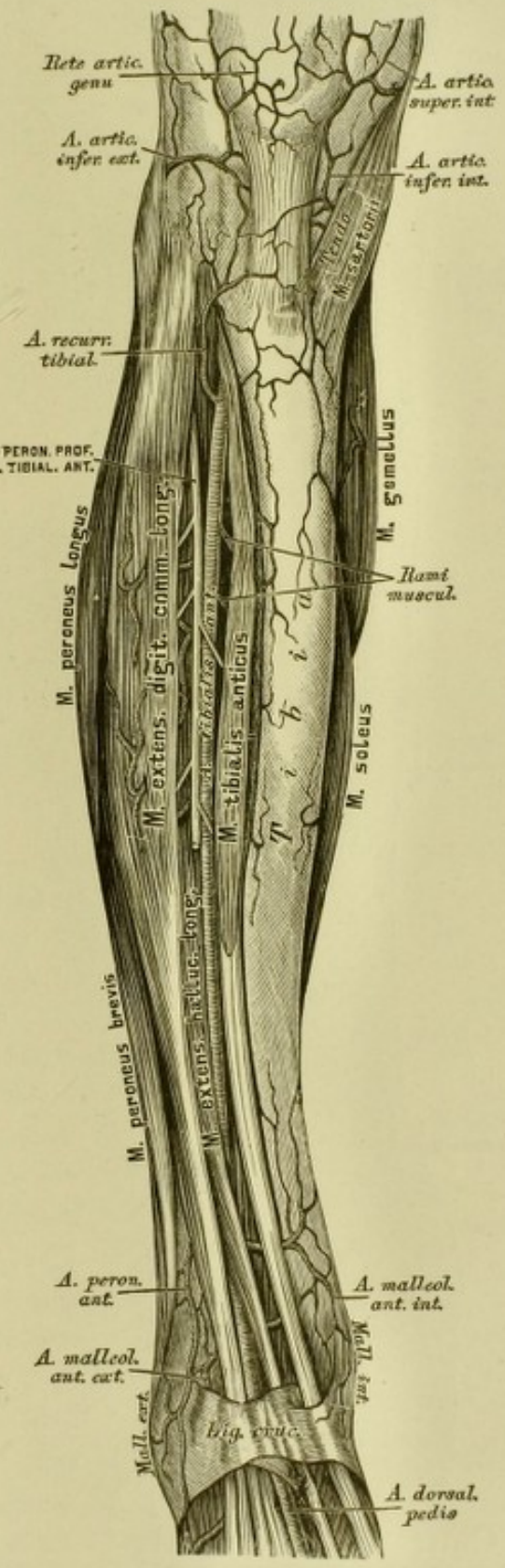
b) Muscular branches, *Rami musculares*, 10—20 in number, for the muscles at the front of the leg;

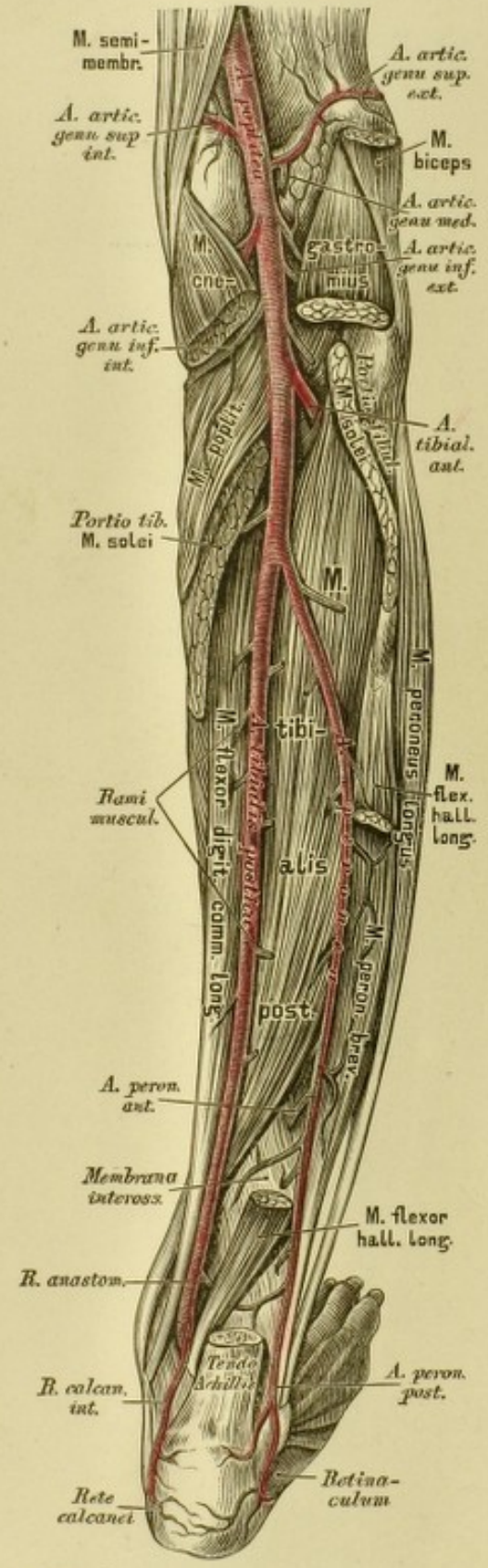
c) Two anterior malleolar, *Arteriae malleolares anteriores*, an external and an internal, which help to form the *Rete malleolare*.

From the *Art. dorsalis pedis* arise (see Fig. 581):

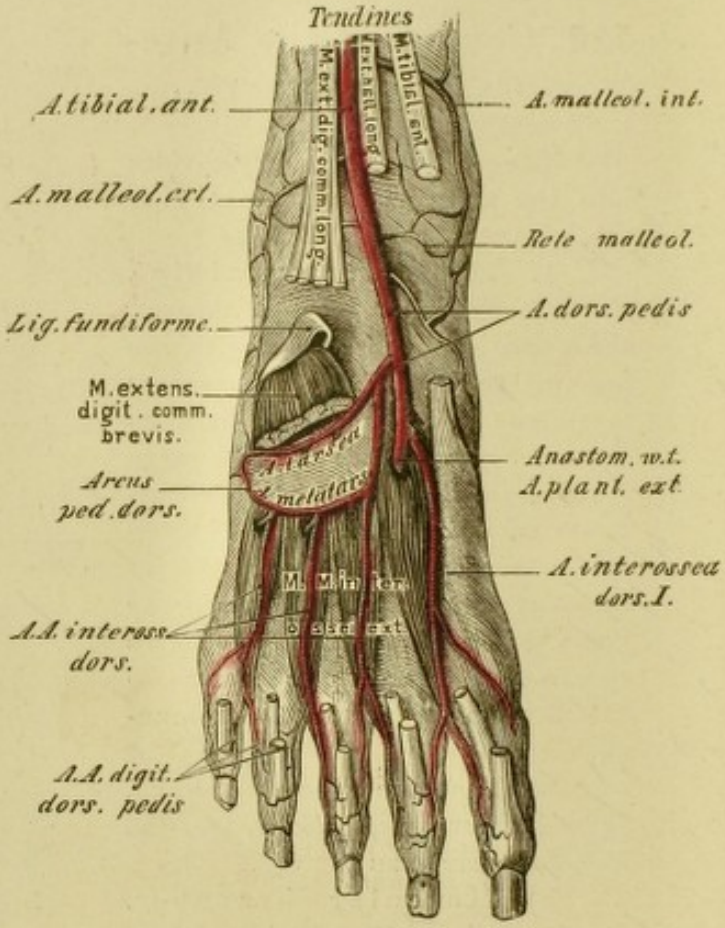
a) The tarsal, *Art. tarsea*, to the outer border of the foot, where it anastomoses with the external anterior malleolar and the metatarsal arteries;

b) The metatarsal, *Art. metatarsea*, arises further down either alone or together with the tarsal artery, and forms with it, at the outer border of the foot, an arch, the *Arcus pedis dorsalis*. It gives off three dorsal interosseous arteries, which divide into dorsal digital branches, *Arteriae digitales pedis dorsales*, and an external digital, *Art. digitalis dorsalis externa*, for the little toe.





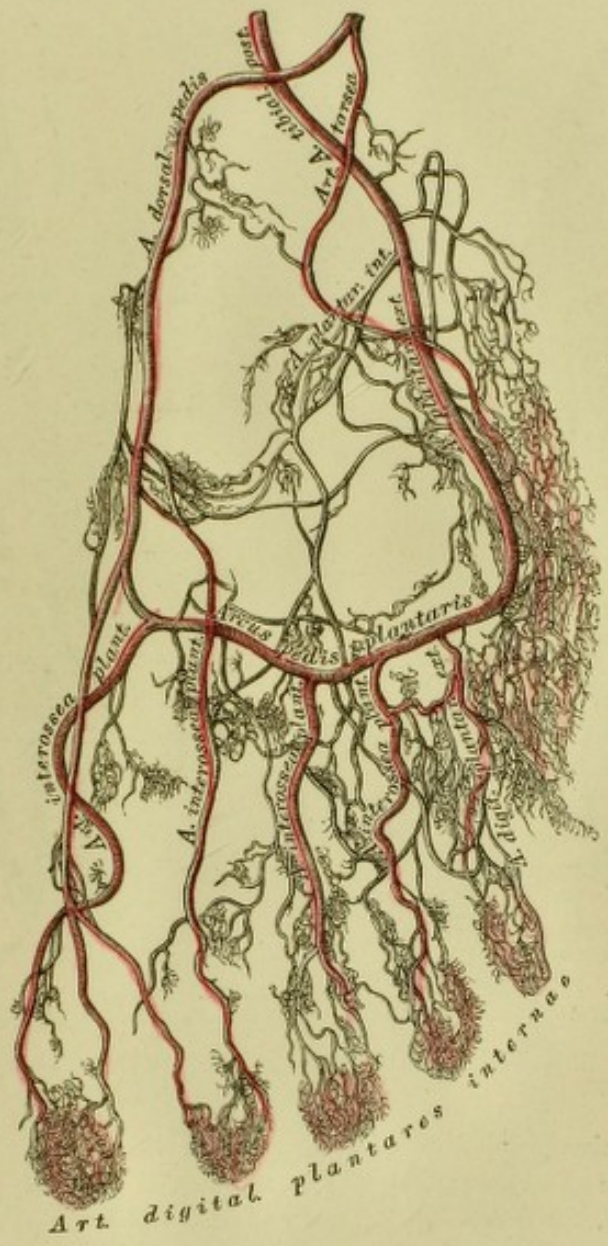
582. Course of the Posterior Tibial Artery.



581. The Arteries at the Dorsum of the Foot.

c) The first dorsal interosseous artery arises directly from the *Art. dorsalis pedis* and divides into three dorsal digital branches, *Arteriae digitales dorsales*, for both sides of the great toe and the inner side of the second toe. The *Art. dorsalis pedis* then passes between the bases of the I. and II. metatarsal bones into the *Planta pedis*, and there forms, with the external plantar artery, the plantar arch, *Arcus plantaris*.

2. The posterior tibial artery, *Art. tibialis postica*, descends upon the *M. tibialis posticus* and *M. flexor digitorum longus* to the ankle-joint, behind the internal malleolus; it then passes into the *Planta pedis* and divides into the external and internal plantar arteries.

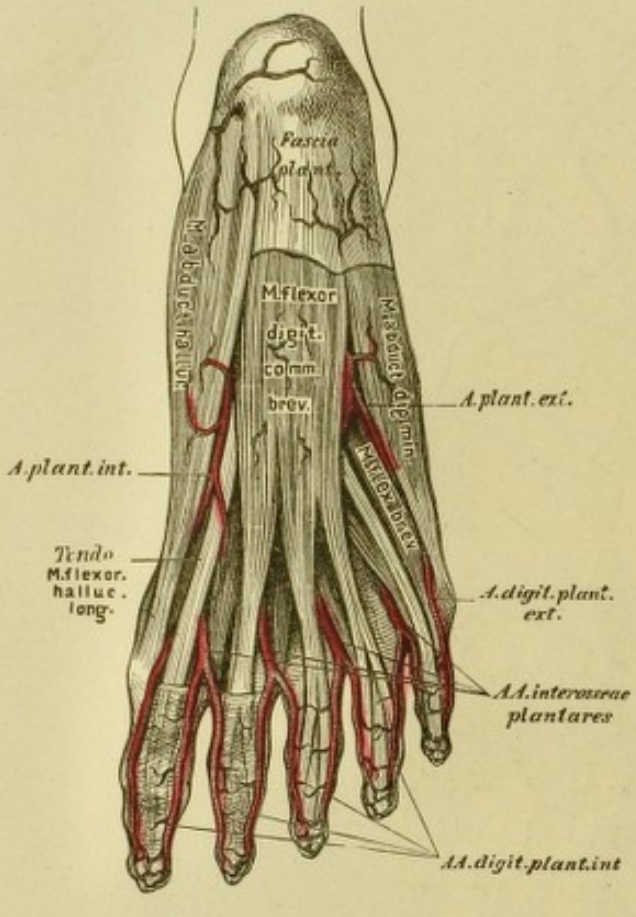


583. The Arteries of the Foot.

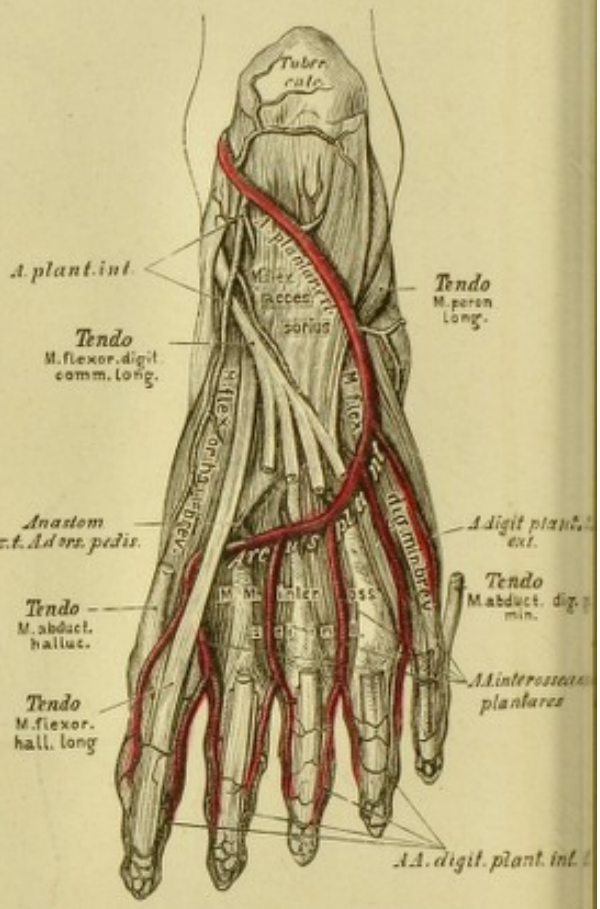
After a specimen of Hyrtl. $^2/_3$ natural size.

The largest branch of the posterior tibial artery is the peroneal, *Art. peronea.* It passes along the posterior side of the fibula between *M. flexor longus pollicis* and *M. tibialis posticus,* supplies the deep muscles in this region, and divides above the outer malleolus into the anterior and posterior peroneal.

Other branches of the posterior tibial artery are: the nutrient artery, *Art. nutritia tibiae;* 10—15 muscular branches; one communicating branch to the peroneal; the posterior malleolar branches, an external and an internal; finally internal calcanean branches.



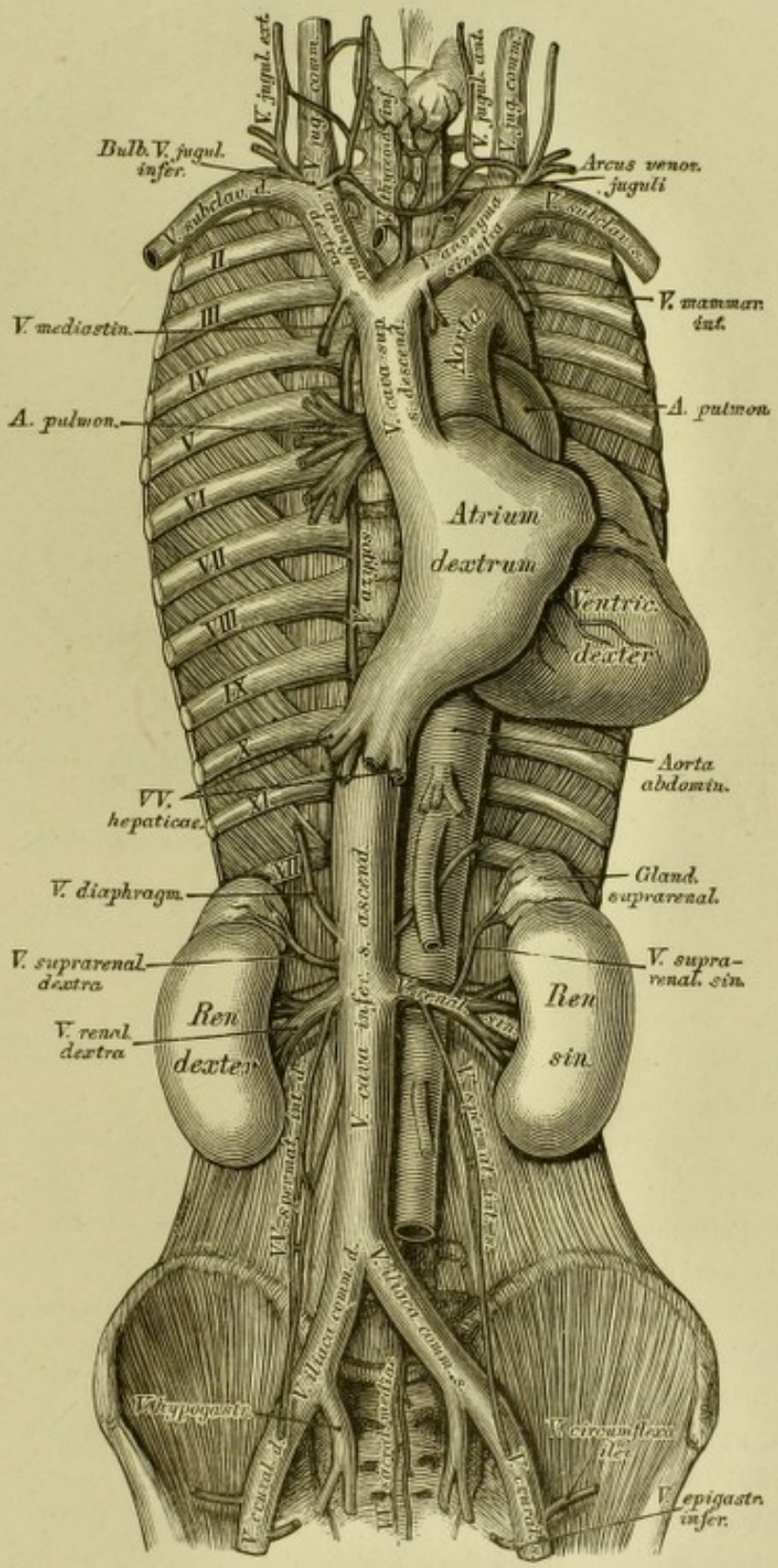
584. The Plantar Arteries. Superficial view.



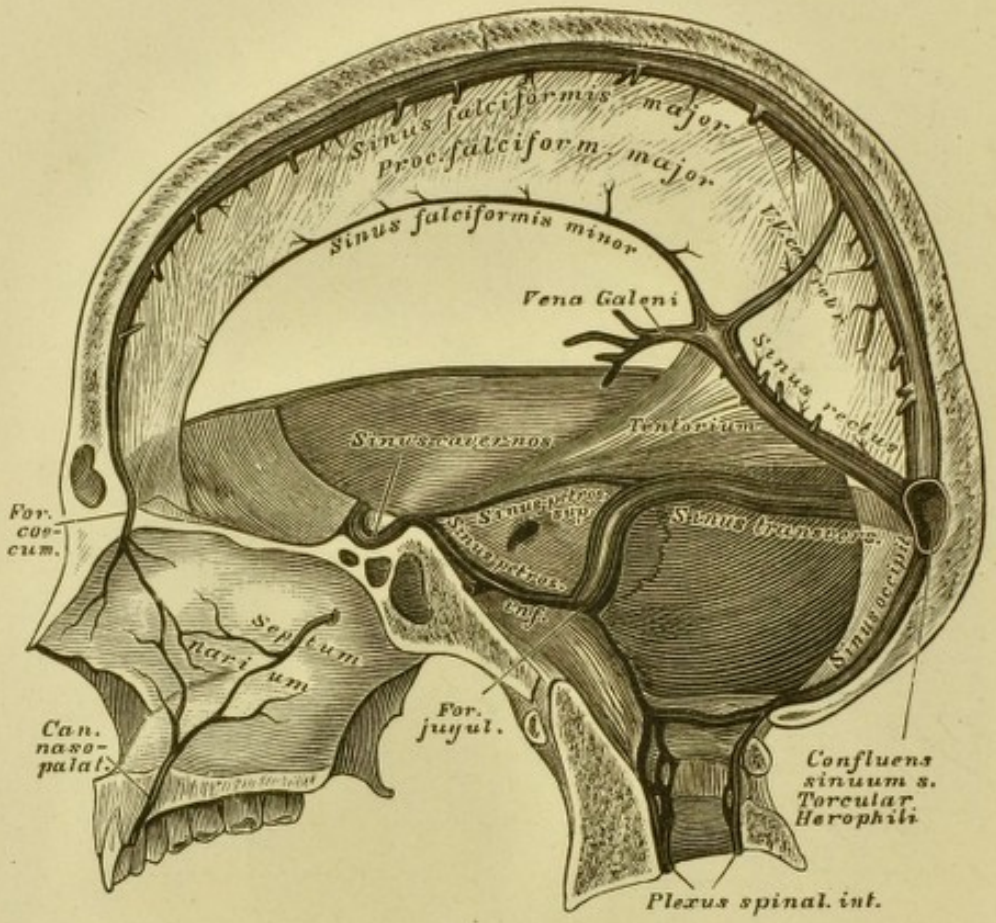
585. The Plantar Arteries. Deep view.

The terminal branches of the posterial tibial artery are the internal and external plantar, *Art. plantaris interna* and *Art. plantaris externa.* The internal, smaller, lies between the *M. abductor pollicis* and *M. flexor brevis digitorum*, and sends off superficial and deep branches for the skin and muscles at the inner border of the sole of the foot.

The external plantar artery passes outwards above the *M. flexor brevis digitorum*, and gives off branches for the integument and muscles, and the external digital, *Art. digitalis plantaris externa*, for the outer side of the little toe. Running inwards from the base of the fifth metatarsal bone to the interval between the first and second metatarsal bones, it joins the dorsal artery of the foot, thereby forming the plantar arch, *Arcus plantaris.* From the arch arise four interosseous arteries, *Arteriae interosseae plantares*, which send perforating branches to the dorsum of the foot, and then divide each into two plantar digital branches, for the contiguous borders of the toes. The first plantar interosseous artery however, gives off three branches, supplying also the inner side of the great toe with an internal plantar artery.



586. The Two *Venae Cavae* and their Branches.



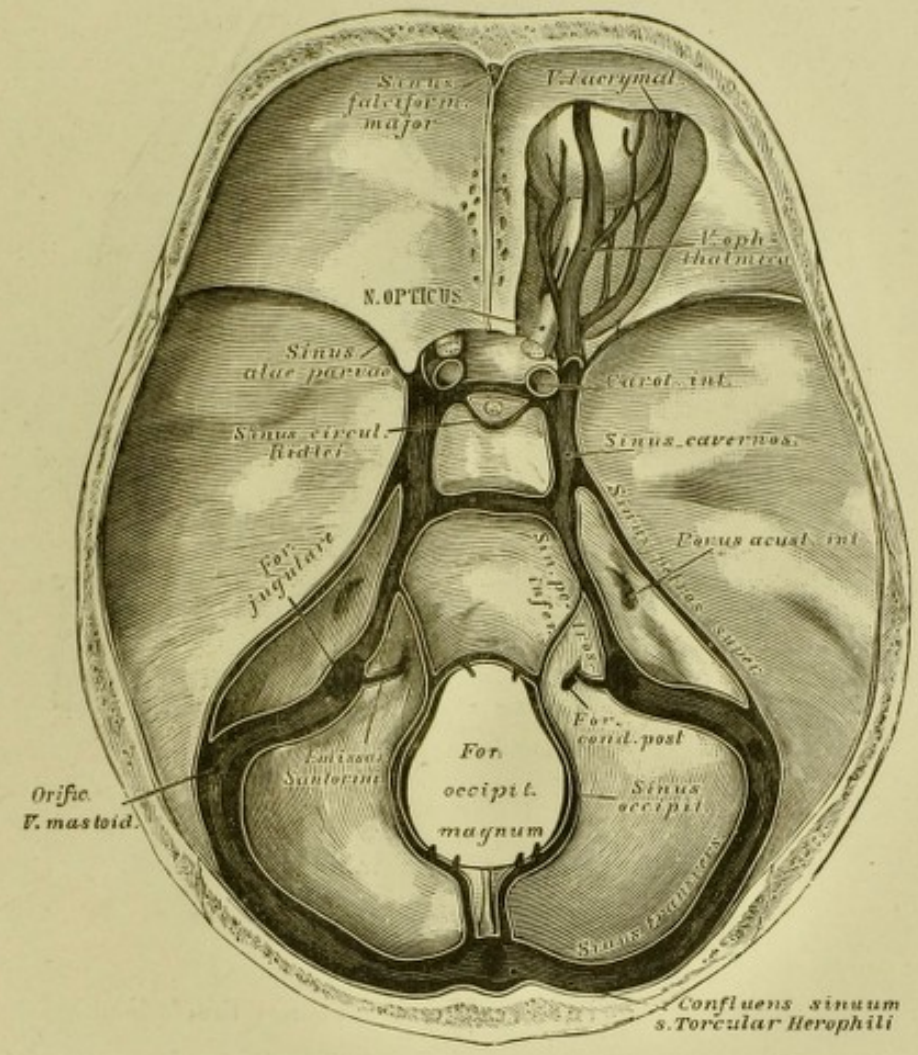
587. The Sinuses of the Dura Mater.

Lateral view.

The venous blood is returned to the right auricle by two principal trunks, the superior or descending and the inferior or ascending *Venae cavae.*

The superior *Vena cava* descends to the right auricle of the heart at the right side of the ascending arch of the aorta and in front of the right pulmonary vessels. It is formed by the union of the right and left innominate veins *s. Venae anonymae* and receives the *V. azygos.* Each *V. innominata* is formed by the union of the subclavian, internal (common) jugular and external jugular veins; each is joined by the following veins: the vertebral, internal mammary, superior intercostal, thymic, pericardiac, superior phrenic and anterior mediastinal; the left also by the *V. thyreoidea ima.*

The common jugular, *V. jugularis communis,* passes up as far as the superior triangle of the neck on the outer side of the common carotid, where it is formed by the union of the internal jugular and common facial veins.

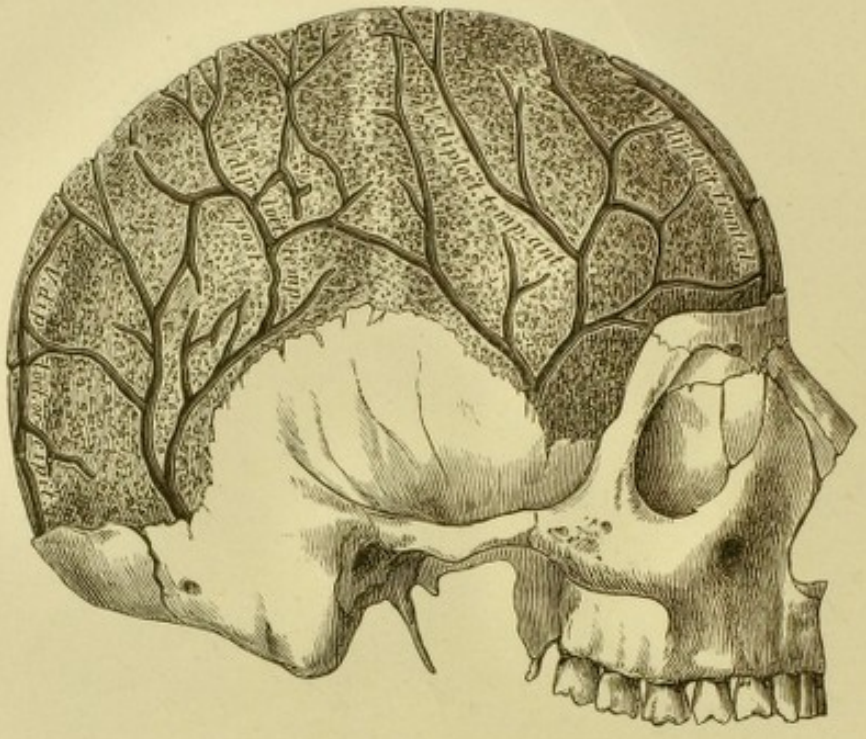


588. The Sinuses of the Dura Mater. Seen from above.

The internal jugular vein passes out by the jugular foramen, where it forms a dilatation, the sinus or *Bulbus superior*; it receives the pharyngeal veins, often a lingual vein. In the jugular foramen it is connected with the transverse sinus.

Of the sinuses of the dura mater some are double, one on each side, some single.

1. The largest single sinus is called the *Confluens sinuum s. Torcular Herophili;* it lies in front of the internal occipital protuberance and is the point of meeting of all the sinuses. 2. The transverse sinus is double. 3. The superior longitudinal sinus, *Sinus falciformis major,* occupies the attached margin of the *Falx cerebri.* 4. The inferior longitudinal sinus, *Sinus falciformis minor,* is contained in the posterior part of the free margin of the *Falx cerebri.* 5. The straight sinus *(rectus)* passes obliquely backwards. 6. The two cavernous sinuses at the sides of the *Sella turcica;* their continuations are the *Sinus alae parvae,* both of which are connected by means of the circular sinus, *Sinus circularis Ridlei.* 7. The superior petrosal sinuses are situated along the upper border of the petrous portions of the temporal bones. 8. The inferior petrosal sinuses situated in the groove formed by the junction of the inferior border of the petrous bone with the basilar process of the occipital. 9. The occipital sinus surrounds the *Foramen magnum.*



589. The Veins of the *Diploë,*

after removal of the outer table of the skull.

After Breschet (Gray).

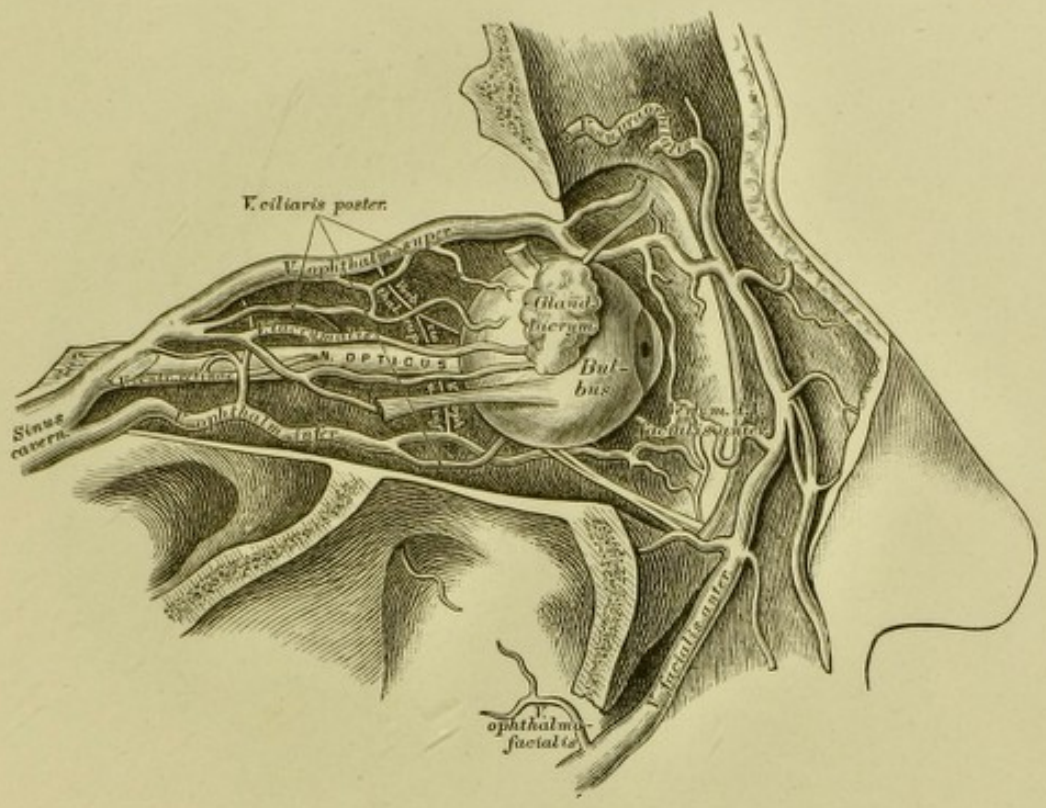
The cerebral veins, *Venae cerebrales,* are the following: Superior cerebral veins to the superior longitudinal sinus; *Vena Galeni* or great or deep cerebral vein to the straight sinus; inferior cerebral veins to the cavernous, superior petrosal and transverse sinuses; superior cerebellar veins to the straight sinus and inferior cerebellar to the inferior petrosal, transvere and occipital sinuses.

The meningeal veins open in the neighbouring sinuses.

The veins of the *Diploë* empty partly into the sinuses of the dura mater, partly into the veins of the pericranium.

The internal auditory veins are very small.

The ophthalmic vein commences at the inner angle of the eye, passes backwards at the inner wall of the orbit to the sphenoidal fissure, and empties into the cavernous sinus. It is formed by the following veins: the frontal, *V. sacci lacrymalis, V. glandulae lacrymalis, Venae musculares, Venae ciliares, V. centralis retinae* and the inferior ophthalmic.



590. The Veins of the Orbit.

After E. Sesemann. Natural size.

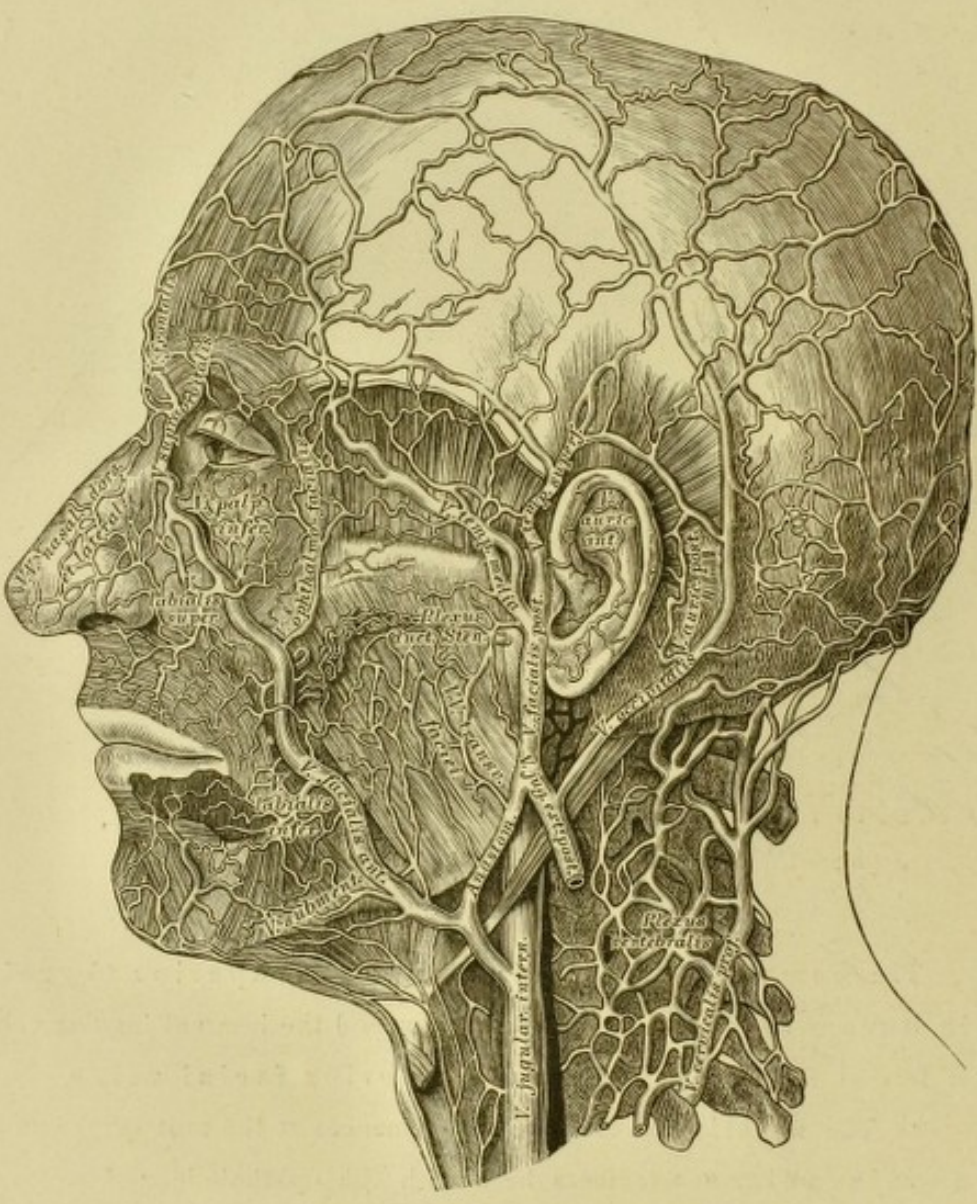
The common facial vein receives the superior thyroid vein between the angle of the lower jaw and the internal jugular vein. It is formed by the anterior and posterior facial veins.

a) The anterior facial vein commences at the root of the nose as angular vein, anastomoses here with the ophthalmic and receives the following veins: Supraorbital, dorsal and lateral nasal, inferior palpebral, superior and inferior labial, buccal, and masseteric, submental, palatine and ranine veins.

b) The posterior facial receives the following veins: Superficial temporal, middle temporal, anterior auricular, transverse facial, parotid and internal maxillary.

The superficial cervical veins are:

a) The external jugular, formed from the occipital and posterior auricular veins, receives the external posterior jugular vein and opens at the place of union of the subclavian and common jugular veins.

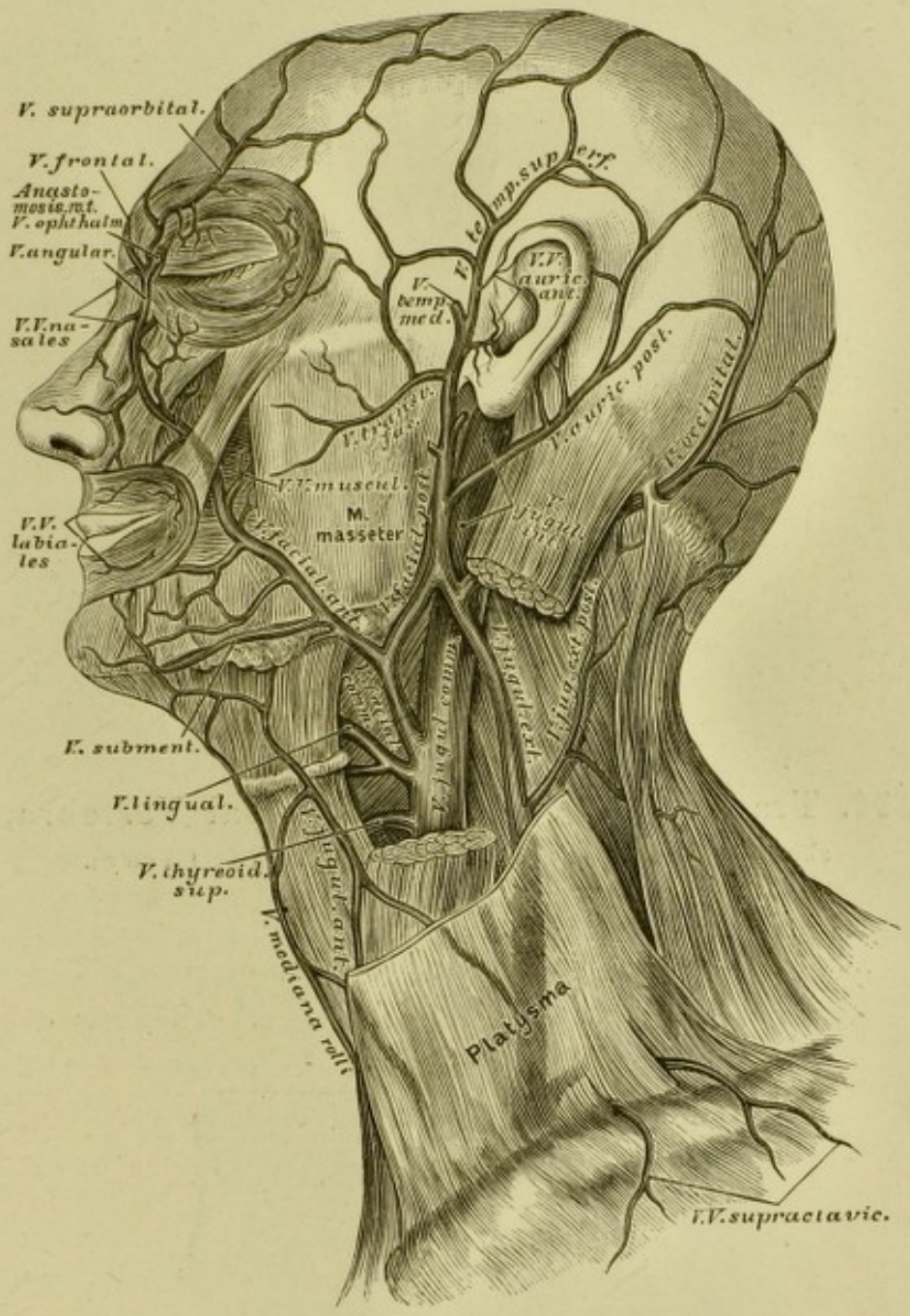


591. The Veins of the Head.

After E. Sesemann. $^1/_2$ natural size.

b) The anterior jugular vein commences near the hyoid bone from the convergence of several superficial branches from the submaxillary region; it passes down between the median line and the anterior border of the *M. sterno-cleido-mastoideus*, is connected with its fellow of the opposite side by means of the *Arcus venosus juguli* and passes horizontally outwards, to open into the common jugular.

c) The *V. mediana colli* passes down in the median line, and opens into the *Arcus venosus juguli*, or into the anterior or common jugular veins. It is often entirely absent.

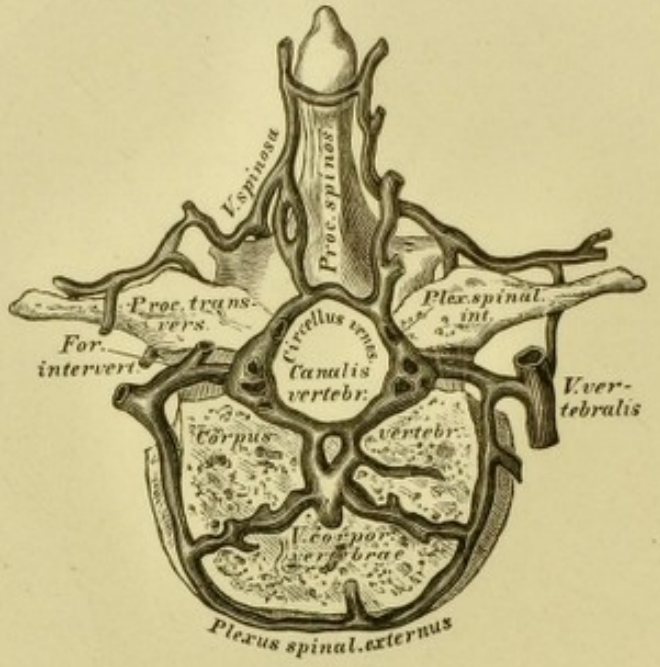


592. The Veins of the Face and Neck.

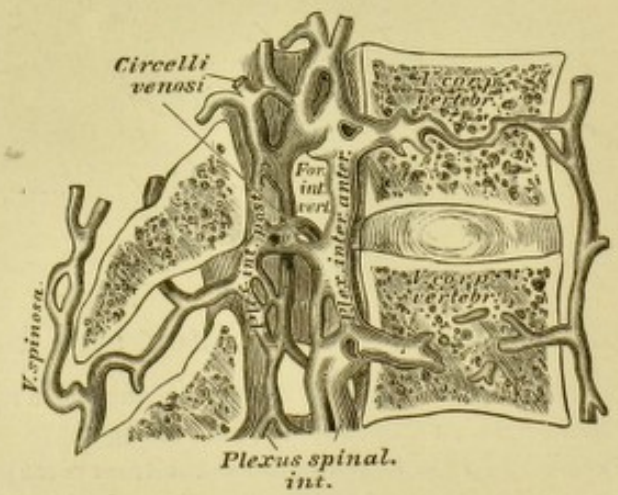
The deep veins of the neck besides the pharyngeal, lingual and superior thyroid are the following:

a) The vertebral runs in the canal of the transverse processes of the cervical vertebrae and receives the veins from the spinal canal and the cervical veins; finally it terminates in the innominate or subclavian veins.

b) The inferior thyroid receives veins from the pharynx and larynx and unites with the corresponding vein of the opposite side, thereby forming the *Plexus thyreoideus imus*, and then the *V. thyreoidea impar*, which opens into the left innominate vein.



593. Transverse Section of a Dorsal Vertebra,
showing the Spinal Veins. After Breschet (Gray).



594. Vertical Section of Two Dorsal Vertebrae,
showing the Spinal Veins. After Breschet (Gray).

The subclavian vein, *V. subclavia*, receives the veins of the arm and shoulder. These are:

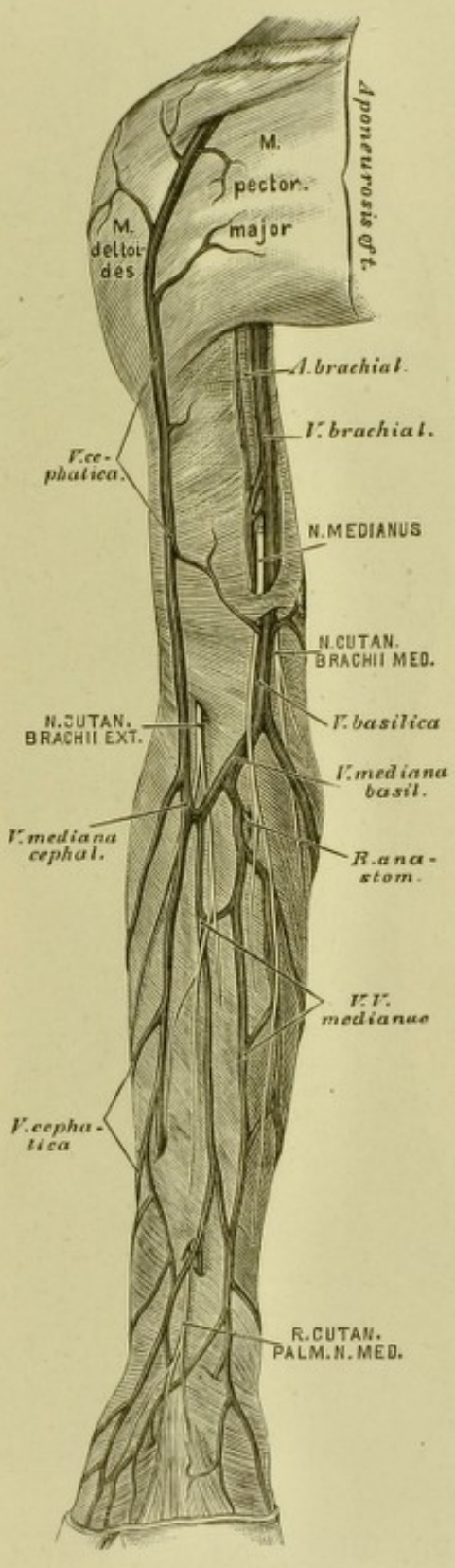
1. Deep brachial veins, *Venae profundae brachii*, for the brachial artery and its branches, which they accompany on both sides. They arise as palmar digital veins, form the superficial and deep venous arches, then radial and ulnar veins, finally two brachial veins which unite to form the single axillary vein, whose direct continuation is the subclavian vein.

2. Superficial brachial veins, *Venae subcutaneae brachii*, between skin and fascia, which, freely anastomosing with each other, arise from an arch, the *Rete venosum manus dorsale*.

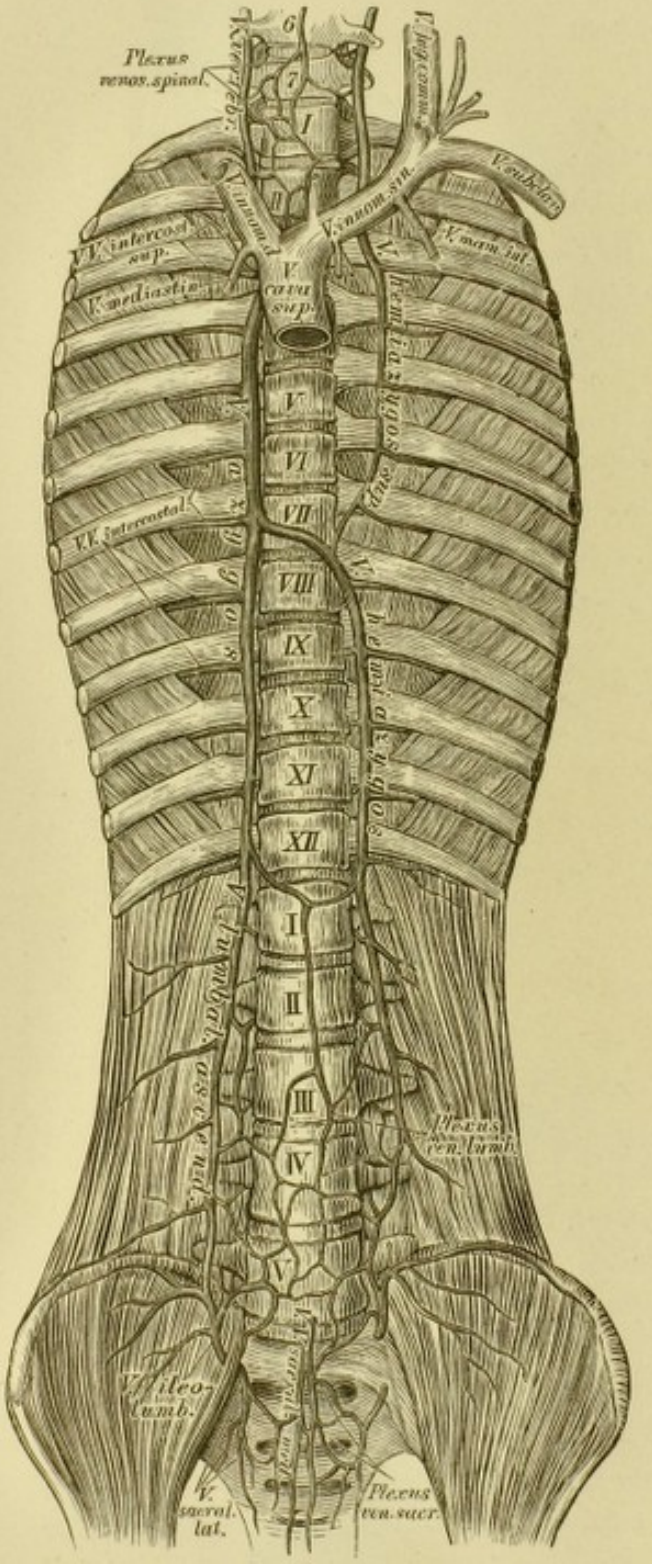
a) The cephalic vein commences at the dorsum of the thumb, passes along the inner side of the forearm, above the elbow in the *Sulcus bicipitalis externus*, then between *M. pectoralis major* and *M. deltoides*, and terminates between these muscles in the axillary vein just below the clavicle.

b) The basilic vein passes along the ulnar side of the forearm, at first usually double, then becoming single, ascends in the *Sulcus bicipitalis internus*, pierces the fascia in the middle of the upper arm and opens into the internal brachial vein.

c) The median vein is either single or double, and divides into the median cephalic and the median basilic; the latter is usually the larger. An anastomosing branch for the deep radial or brachial veins is always present.



595. The Superficial Veins of the Upper Extremity.



596. The *Vena azygos* and *Vena hemiazygos.*
(Semi-diagrammatic.)

The veins of the wall of the thorax unite to form the *V. azygos*. The right azygos vein commences opposite the I. or II. lumbar vertebra from the *Plexus venosus lumbalis*, enters the thorax through the aortic opening in the diaphragm and passes along the right side of the vertebral column to the III. dorsal vertebra, where it arches forwards over the root of the right lung and terminates in the superior *V. cava*. It receives 9 or 10 lower intercostal veins, several oesophageal, mediastinal and vertebral veins.

The left, small azygos vein or *V. hemiazygos* ascends only as far as the VII. or VIII. dorsal vertebra, and then passes back to the right azygos vein behind the aorta. The upper left intercostal veins usually unite to form the *V. hemiazygos superior*, which opens into the *V. hemiazygos*, but is also connected with the left innominate vein. The *V. azygos* and *hemiazygos* vary a great deal as regards their origin and course.

597. The Venous Plexus of the Spermatic Cord, *Plexus pampiniformis.*

The inferior *Vena cava* is formed by the junction of the right and left common iliac veins. It perforates the central tendon of the diaphragm, enters the pericardium, and terminates in the lower and back part of the right auricle of the heart. — Each common iliac vein is formed by the union of the external (*V. cruralis*) and internal (*V. hypogastrica*) iliac veins. The left common iliac vein is longer than the right, and receives the two *Venae sacrales mediae.*

The *V. cava inferior* receives:

a) The lumbar veins, which freely anastomose with each other and form the *Plexus venosus lumbalis;*

b) The internal spermatic veins arise from the pampiniform plexus of the spermatic cord, and ascend, the one on the right side directly to the *V. cava inferior*, the one on the left side to the renal vein;

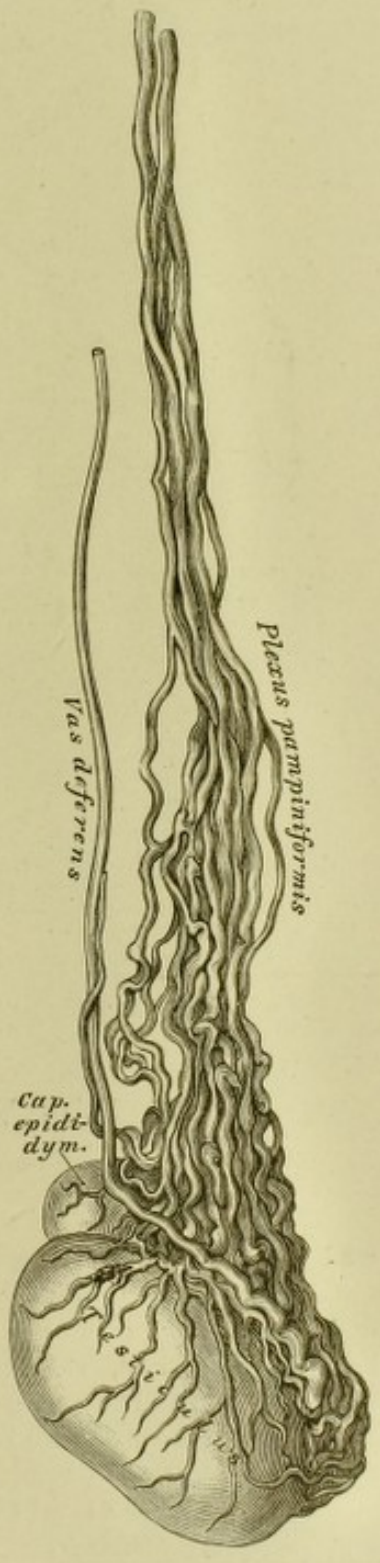
c) The renal veins, the left longer than the right;

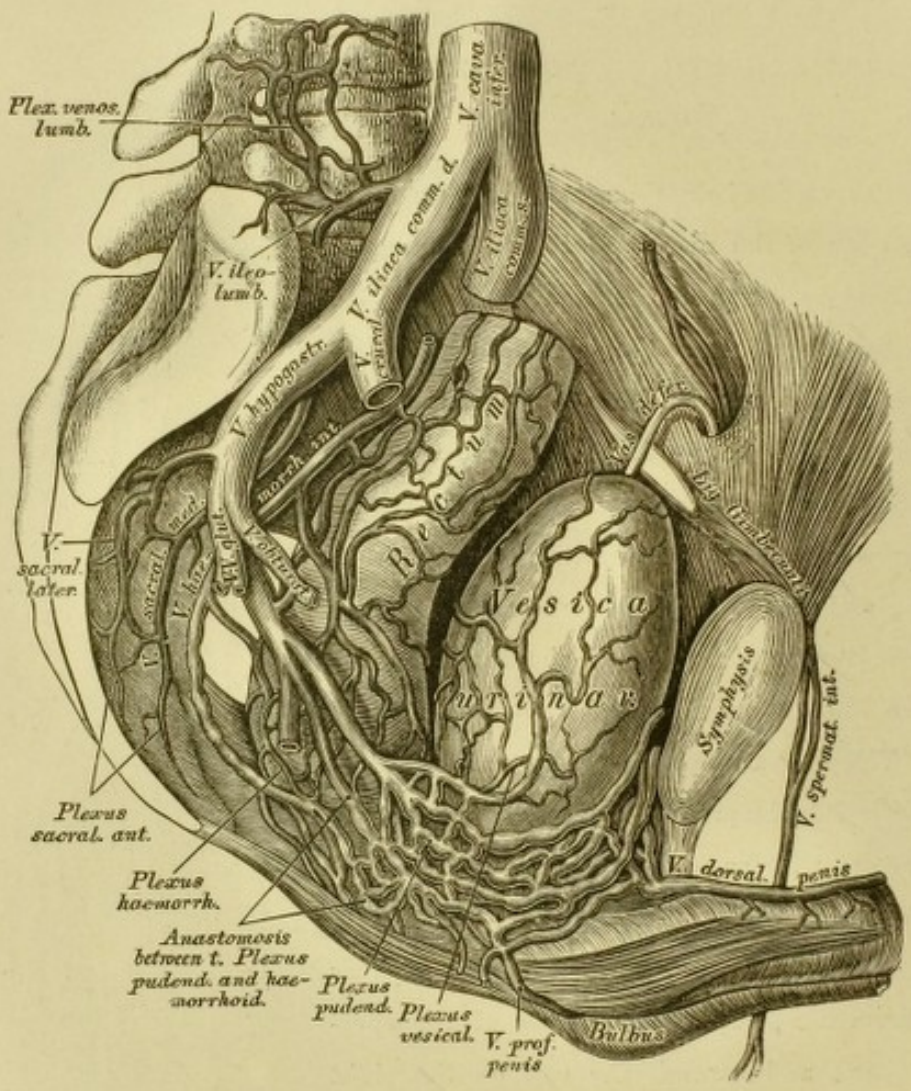
d) The suprarenal veins, the left of which usually opens into the left renal vein;

e) The hepatic veins, two or three larger and several smaller;

f) The phrenic veins.

In the foetus the umbilical vein also opens into the inferior *Vena cava*, whereby this vein receives arterial blood (see Fig. 607).





598. The Veins of the Male Pelvis.

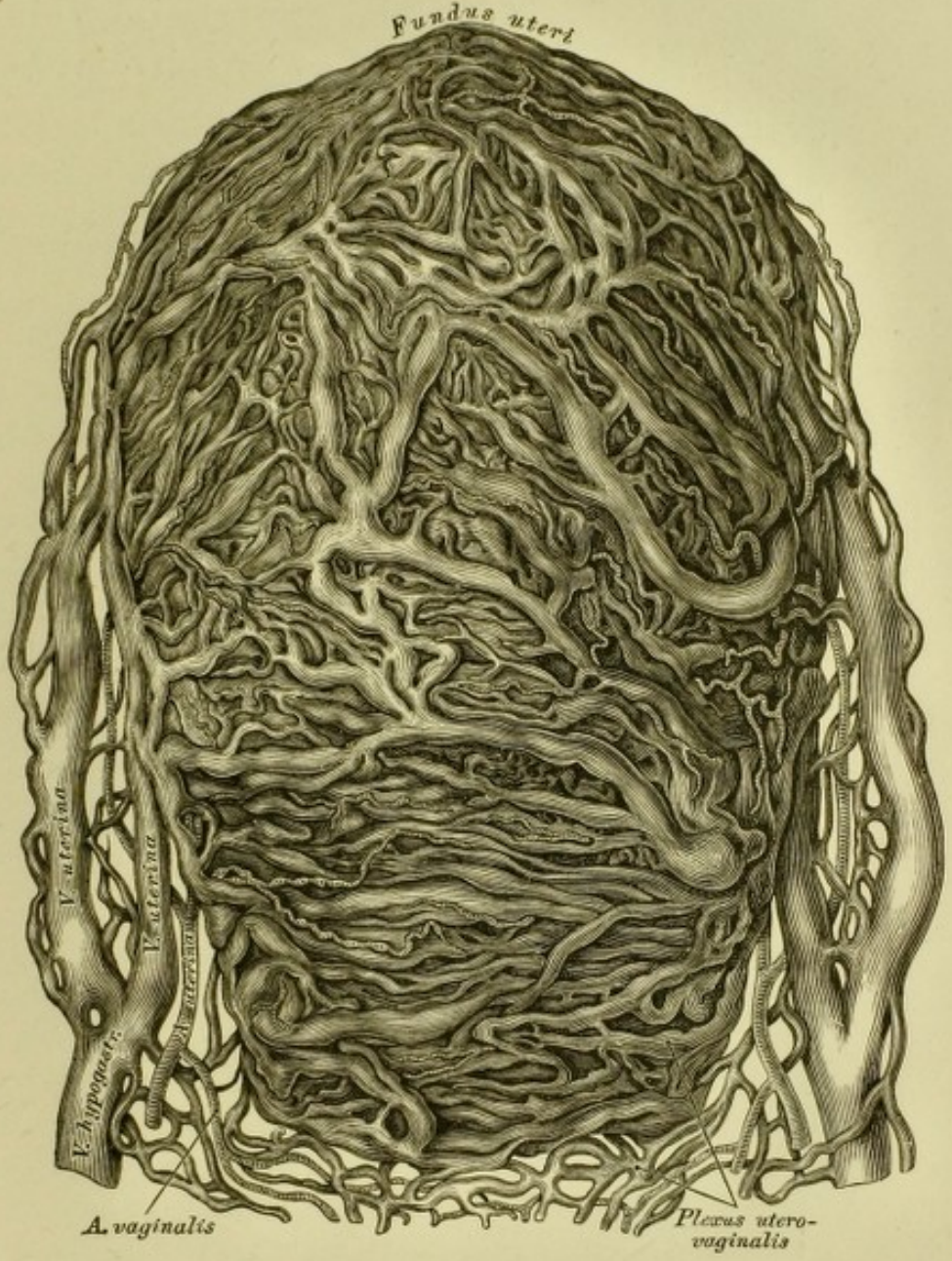
The common iliac vein is formed by the union of the internal iliac vein, *V. hypogastrica*, and the external iliac, *s. V. cruralis*.

The internal iliac vein is formed by the double superior and inferior gluteal veins, the ileo-lumbar, obturator, lateral sacral, the veins of the bladder, of the rectum and of the genital organs. The latter form the following plexuses:

The haemorrhoidal plexus communicating with the portal system;

The vesical plexus, communicating with the haemorrhoidal and pudendal plexuses;

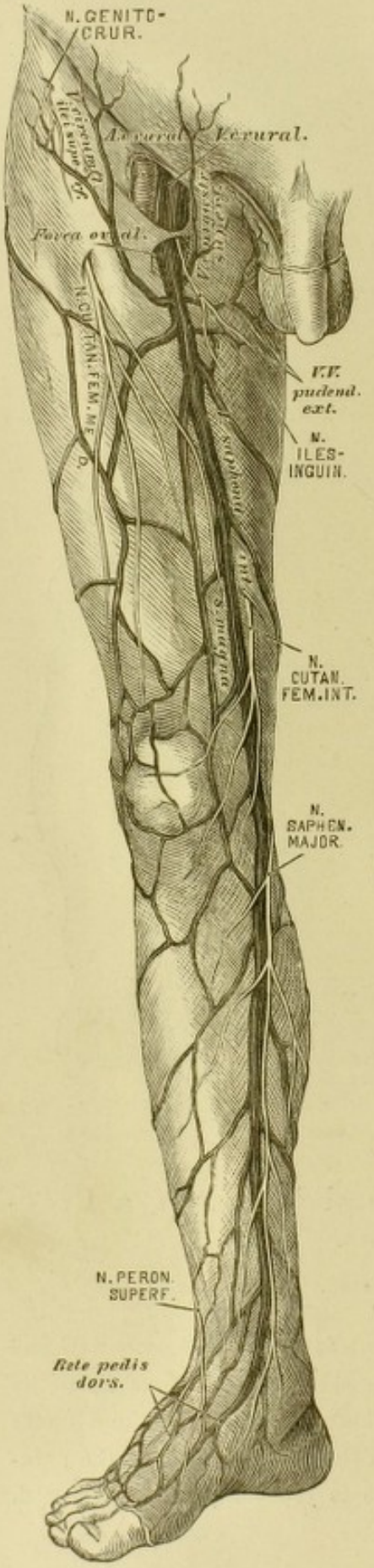
The pudendal plexus, surrounding the prostate in the male, formed by the prostatic veins, those of the *Vesiculae seminales*, the *Venae profundae penis* and the *V. dorsalis penis*.



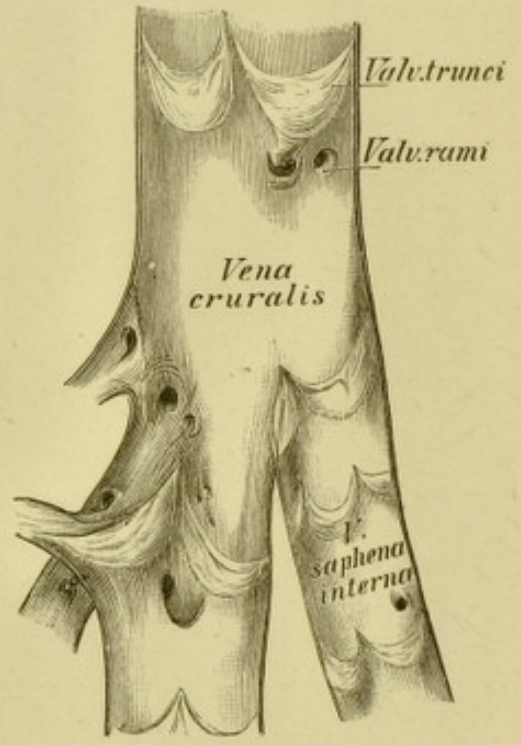
599. The Injected Arteries and Veins of a Pregnant Uterus.

View from before. $^2/_3$ natural size. After Hyrtl.

In the female the pudendal plexus is called utero-vaginal plexus. It surrounds the vagina and both sides of the uterus up to its fundus; it anastomoses with the other plexuses of the pelvis and opens by means of the short uterine veins into the internal iliac. In the pregnant state of the uterus, its venous plexus is especially well developed.



600. The Superficial Veins of the Lower Extremity.

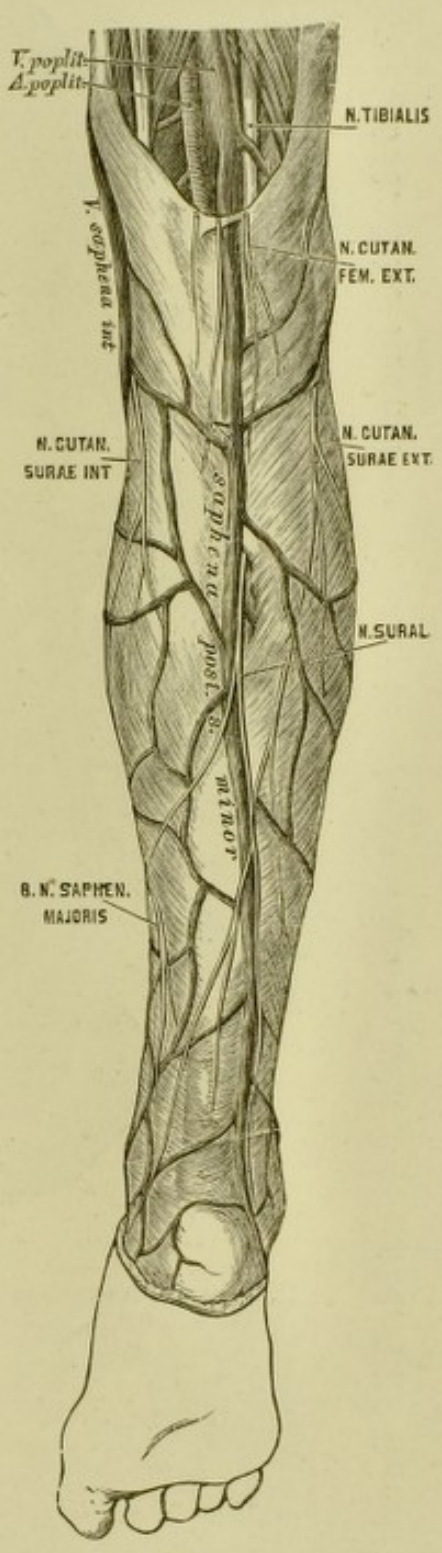


601. The External Iliac Vein *(Vena cruralis)* laid open.

Natural size.

602. The Superficial Veins of the Lower Extremity.

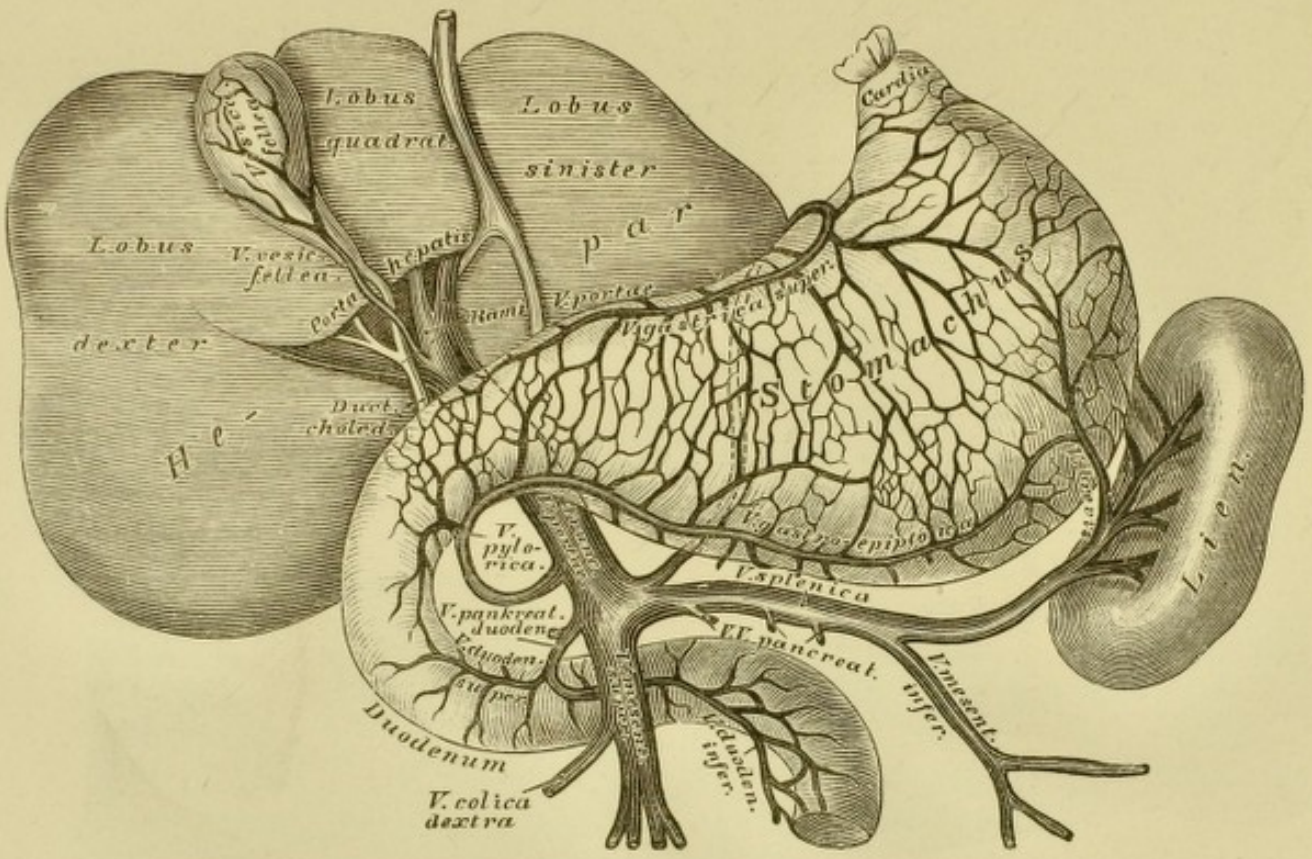
The veins of the lower extremity are superficial and deep. The deep accompany the arteries; those above the knee are usually single, those below, double. The external iliac or crural vein lies along the inner side of the external iliac artery; the femoral vein accompanies the femoral artery through the upper two thirds of the thigh; in the lower part of its course it lies external to the artery, higher up, it is behind it. The popliteal vein is formed by the junction of the venae comites of the anterior and posterior tibial vessels; in the lower part of its course it lies internal to the artery, but above the knee-joint is close to its outer side.



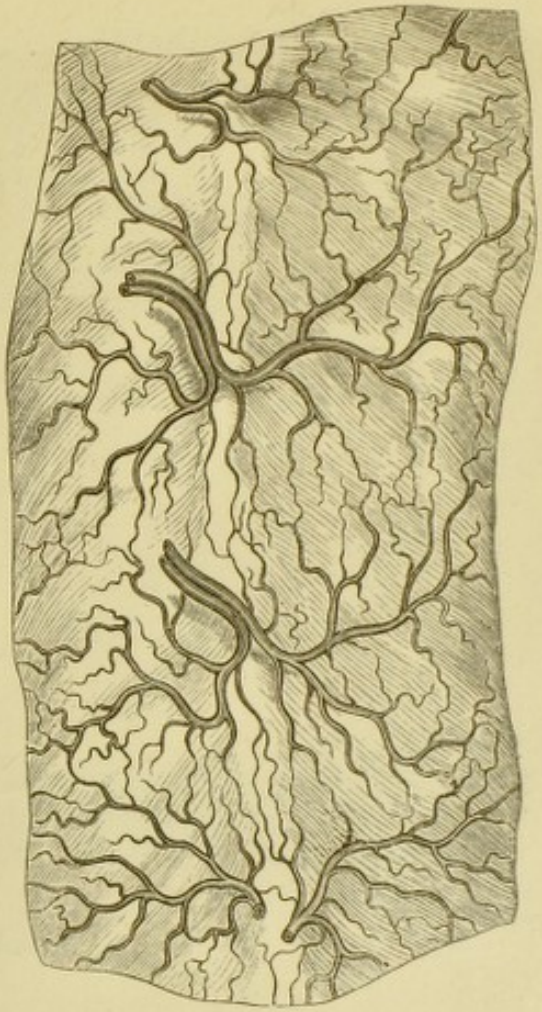
The superficial veins are formed from an arch, the *Rete venosum pedis dorsale*, and are the following:

a) The internal or long saphenous vein, principally from the inner portion of the *Rete dorsale*, ascends in front of the internal malleolus to the leg and behind the internal condyle of the femur to the thigh. It passes through the saphenous opening in the *Fascia lata (Fovea ovalis)* and terminates in the femoral vein. In it the superficial veins of the inner and partly of the posterior sides of the lower extremity empty, also the external pudic, superficial epigastric and inguinal veins. Sometimes it is double throughout its entire course.

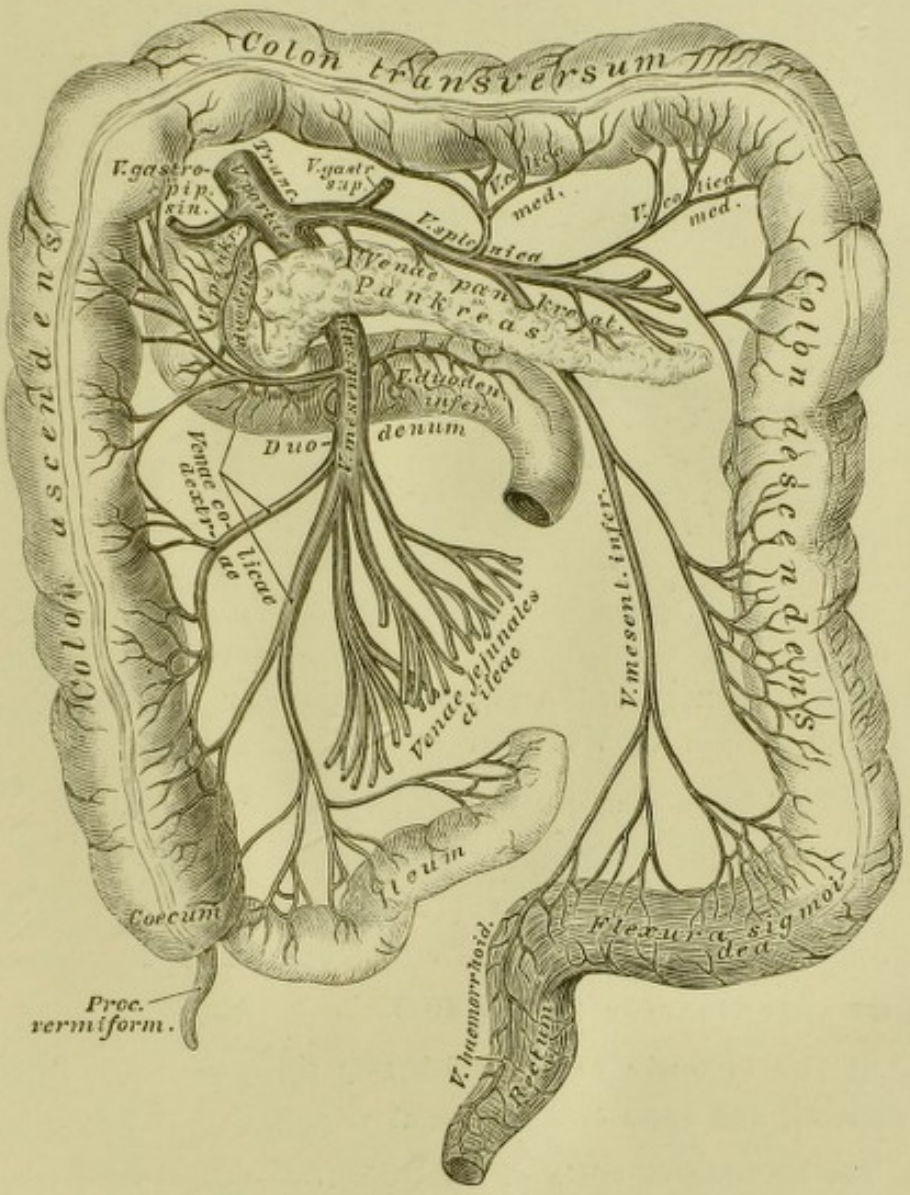
b) The external (posterior) or short saphenous vein ascends from the outer border of the foot behind the external malleolus close to the *Tendo Achilles*, then between both heads of the *M. gastrocnemius* to the popliteal space, where it pierces the popliteal fascia and opens into the popliteal vein.



603. The Branches of Origin of the *Vena portae.*



604. The Ramification of the Branches of Origin of the Portal Vein in the Duodenum.



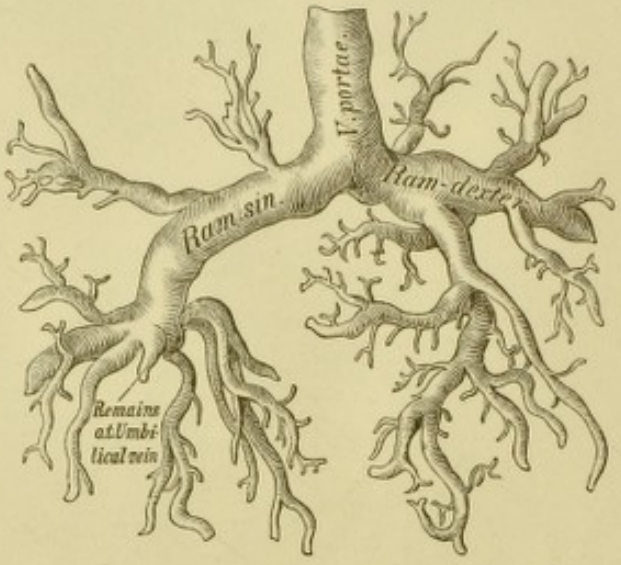
605. The Branches of Origin of the *Vena portae.*

The portal vein, *Vena portae*, receives its branches or roots of origin from the digestive organs and carries their blood to the liver. These roots unite to form the *Truncus venae portae*, which ramifies in the liver.

The branches of origin of the *V. portae* are:

a) The superior gastric vein, which runs along the upper curvature of the stomach from left to right, and receives the blood from the upper portion of the stomach and superior transverse portion of the duodenum.

b) The superior or great mesenteric vein, which receives the blood from those portions of the intestine, which are supplied by the superior mesenteric artery and the pancreatico-duodenal branch of the hepatic artery.



606. The Ramifications in the Liver of the Portal Vein of a Child.

After a specimen of Hyrtl. $^1/_2$ natural size.

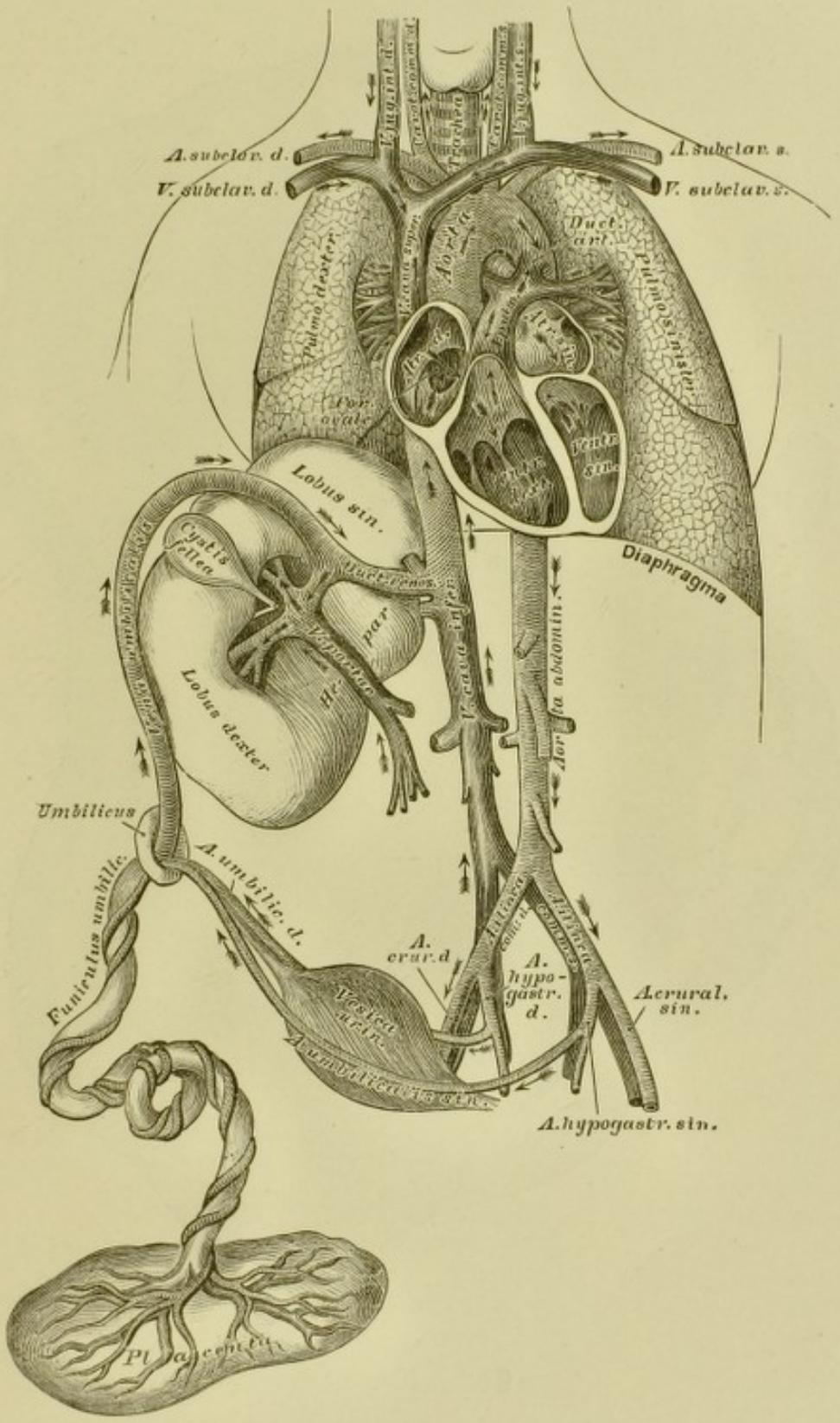
c) The inferior mesenteric vein, whose branches correspond to those of the inferior mesenteric artery, and which usually empties into the splenic vein (s. Fig. 605).

d) The splenic vein, which runs along the upper border of the pancreas, and opens into the portal vein.

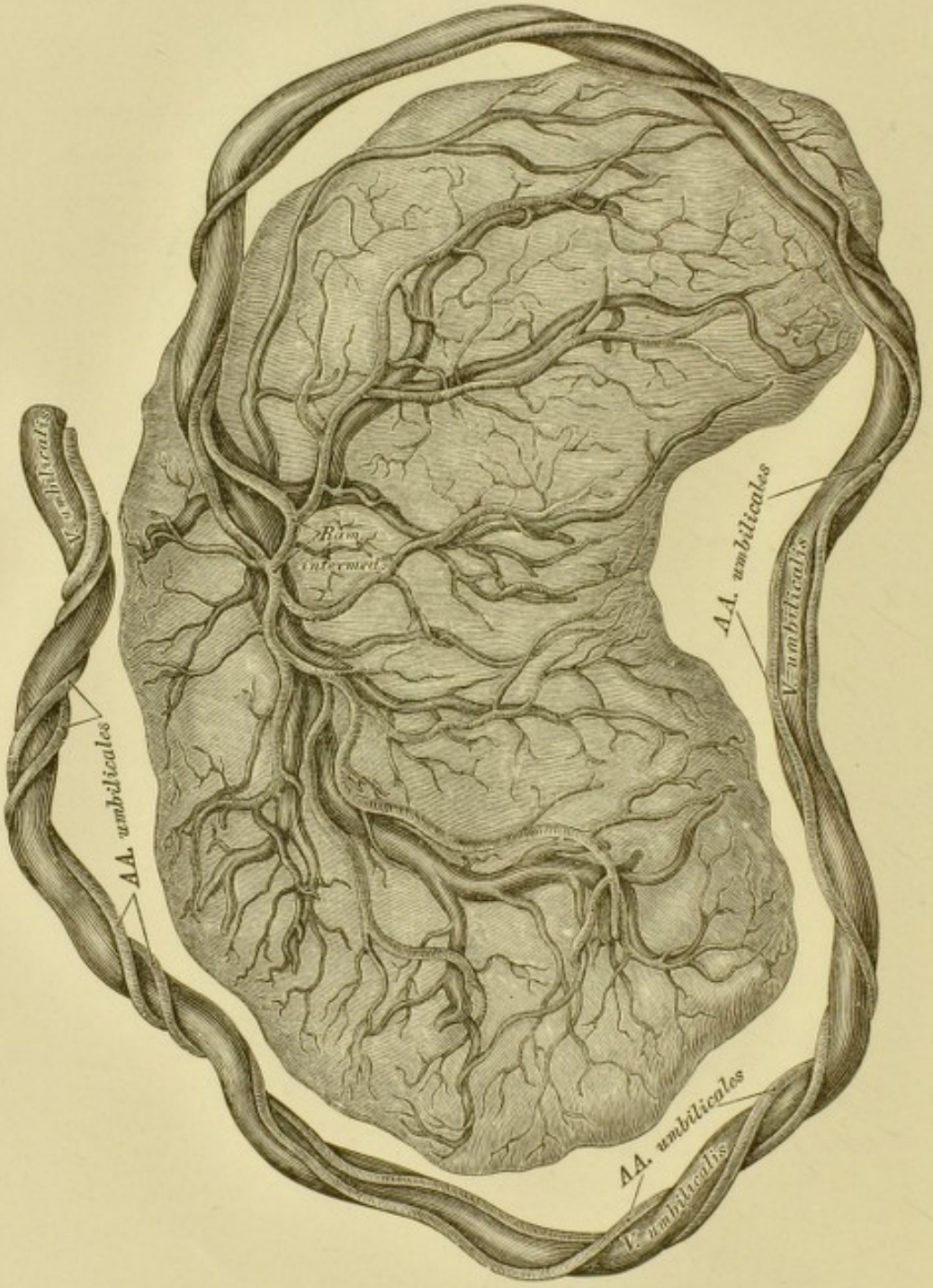
The branches of origin of the portal vein unite behind the head of the pancreas to form the *Truncus venae portae*, which receives the *V. gastro-epiploica* and the *V. cystidis felleae*.

The ramifications of the portal vein in the liver arise from two branches and, in the lobes of the liver, pass on into the capillaries.

The circulation of the foetal system is shown in Fig. 607. In it, the arterial blood *(V. umbilicalis)* is marked by transverse lines, the venous blood — system of the two *Venae cavae* — by longitudinal lines, the mixed blood, which circulates everywhere in the foetus, by lines crossing each other. The direction of the current of the blood is shown by the arrows.

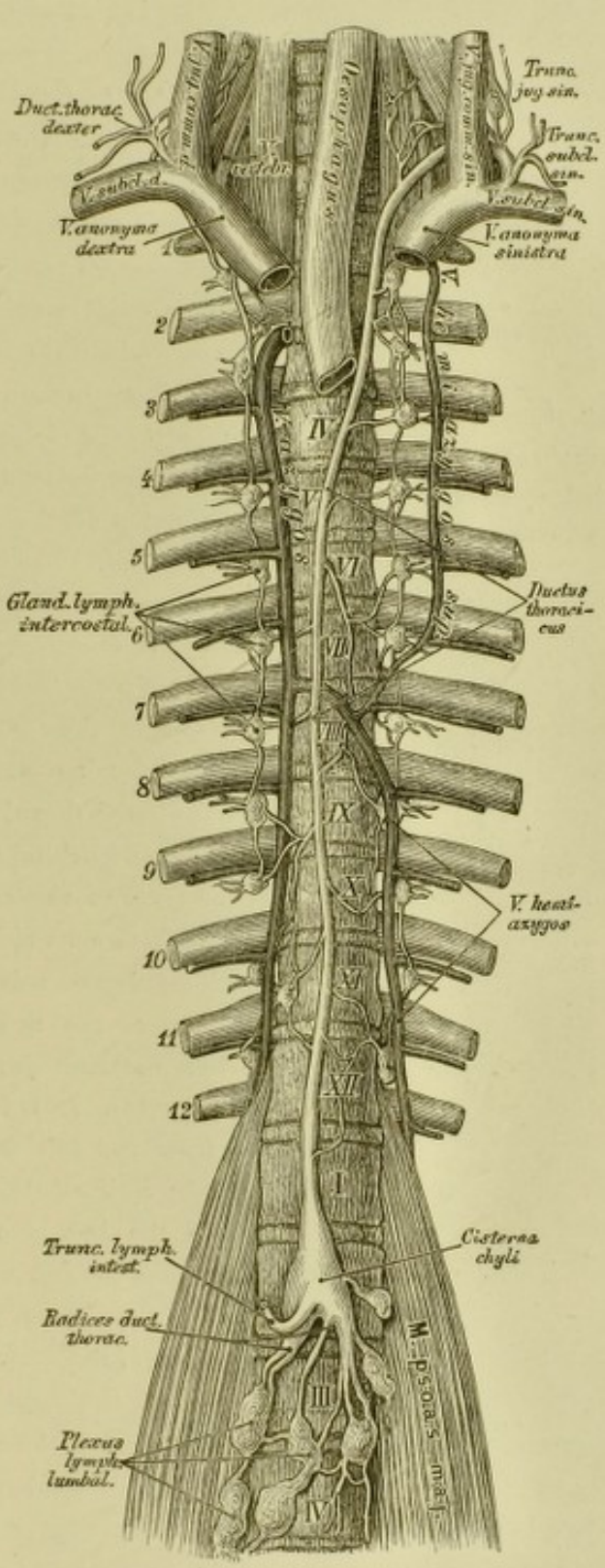


607. Diagram of the Foetal Circulation.

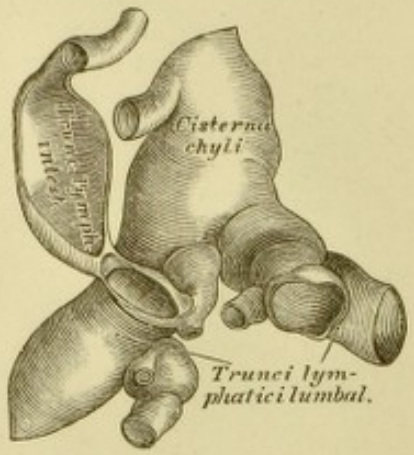


608. *Placenta.*

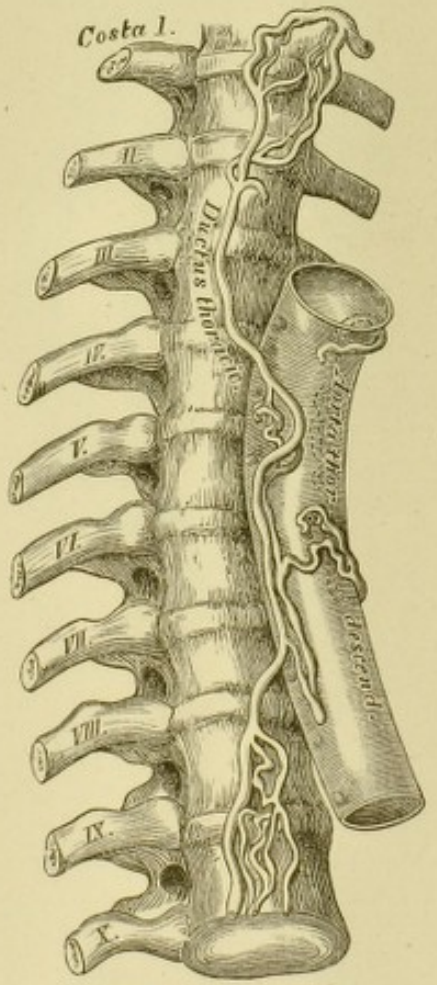
After a specimen of Hyrtl. $^{2}/_{3}$ natural size.



609. The Thoracic Duct.



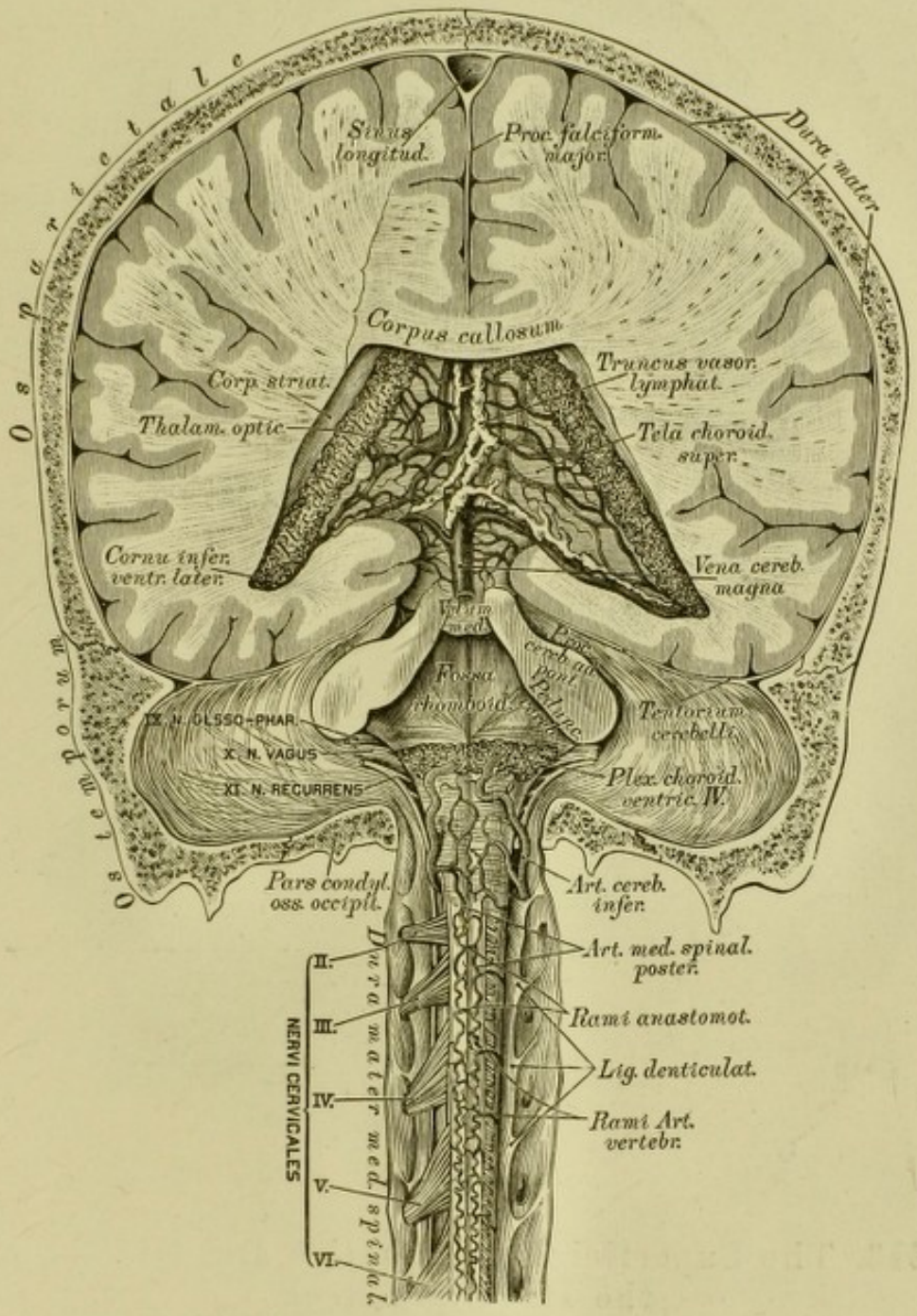
610. The *Cisterna s. Receptaculum chyli.* After a dried specimen. Natural size.



611. Plexiform Arrangement of a Thoracic Duct. After a specimen of Teichmann.

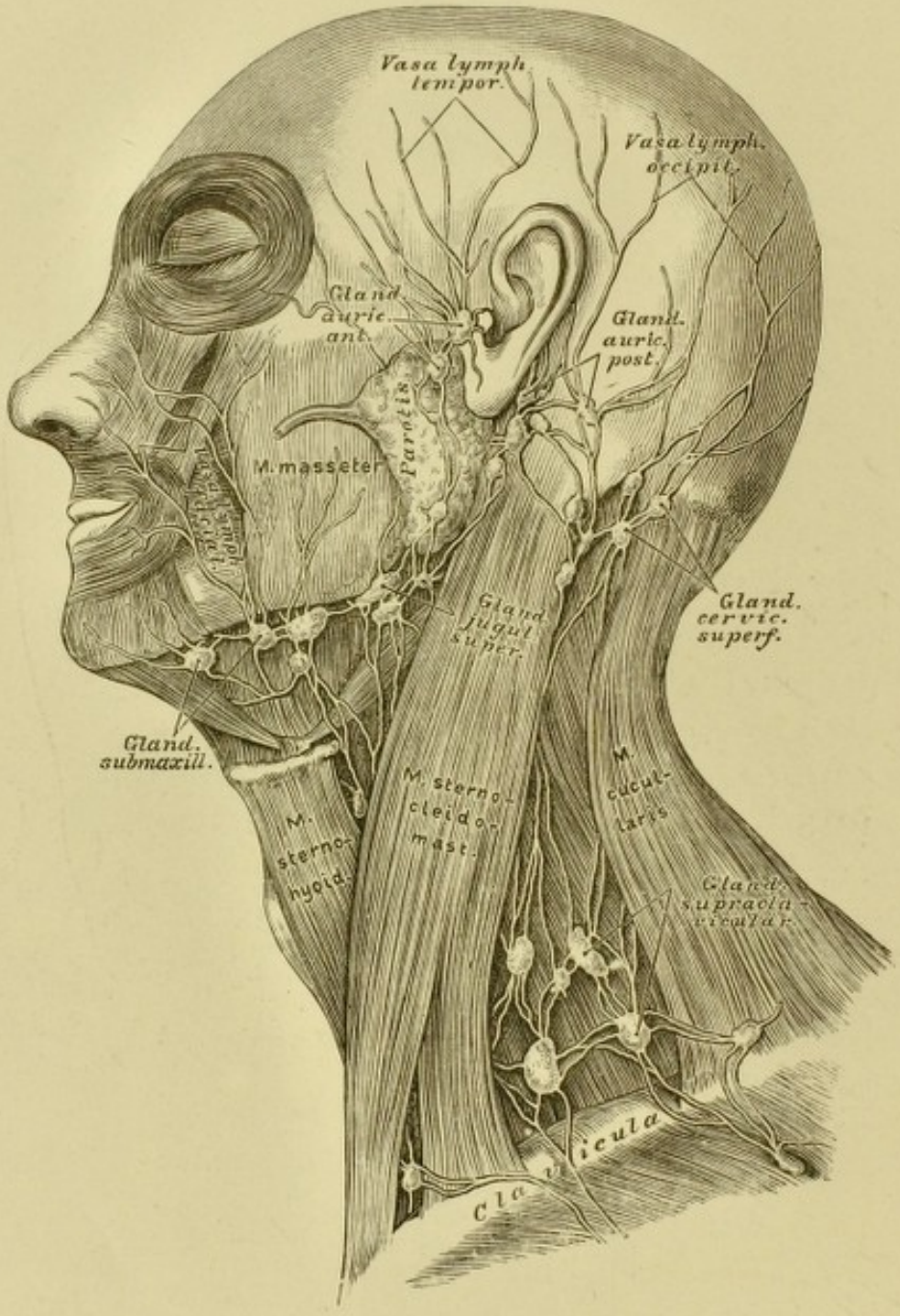
The thoracic duct, *Ductus thoracicus*, is the principal trunk of the lymphatic system. It commences at the anterior surface of the II. or III. lumbar vertebra to the right and behind the aorta, by three roots, *Radices ductus thoracici*, the right and left of which are called *Trunci lymphatici lumbales*, while the middle is called the *Truncus lymphaticus intestinalis*. The former commence from the lumbar plexuses, which collect the lymphatics of the pelvis and lower extremities; the latter forms the union of the lacteals of the alimentary canal. The place of union of these three roots is called *Cisterna s. Receptaculum chyli*.

The thoracic duct ascends into the thorax with the aorta, and there lies between the aorta and *V. azygos*. Opposite the fourth dorsal vertebra it passes to the left and behind the oesophagus, and at the level of the seventh cervical vertebra it turns outwards, at the same time arching downwards and forwards, to terminate at the angle of junction of the left common jugular and left subclavian veins. It receives the lymphatics from the left and lower part of the right half of the thorax, also those from the left side of the head and neck and the left upper extremity, by means of the *Truncus jugularis sinister* and *Truncus subclavius sinister*. The lymphatics of the upper part of the right half of the thorax, as well as those from the right side of the head and neck and the right upper extremity, form the right lymphatic or thoracic duct, *Ductus thoracicus dexter*, which opens into the right *V. innominata*.



612. The Blood- and Lymphatic Vessels of the Brain and Spinal Cord.

After Friedr. Arnold. $^2/_3$ natural size.

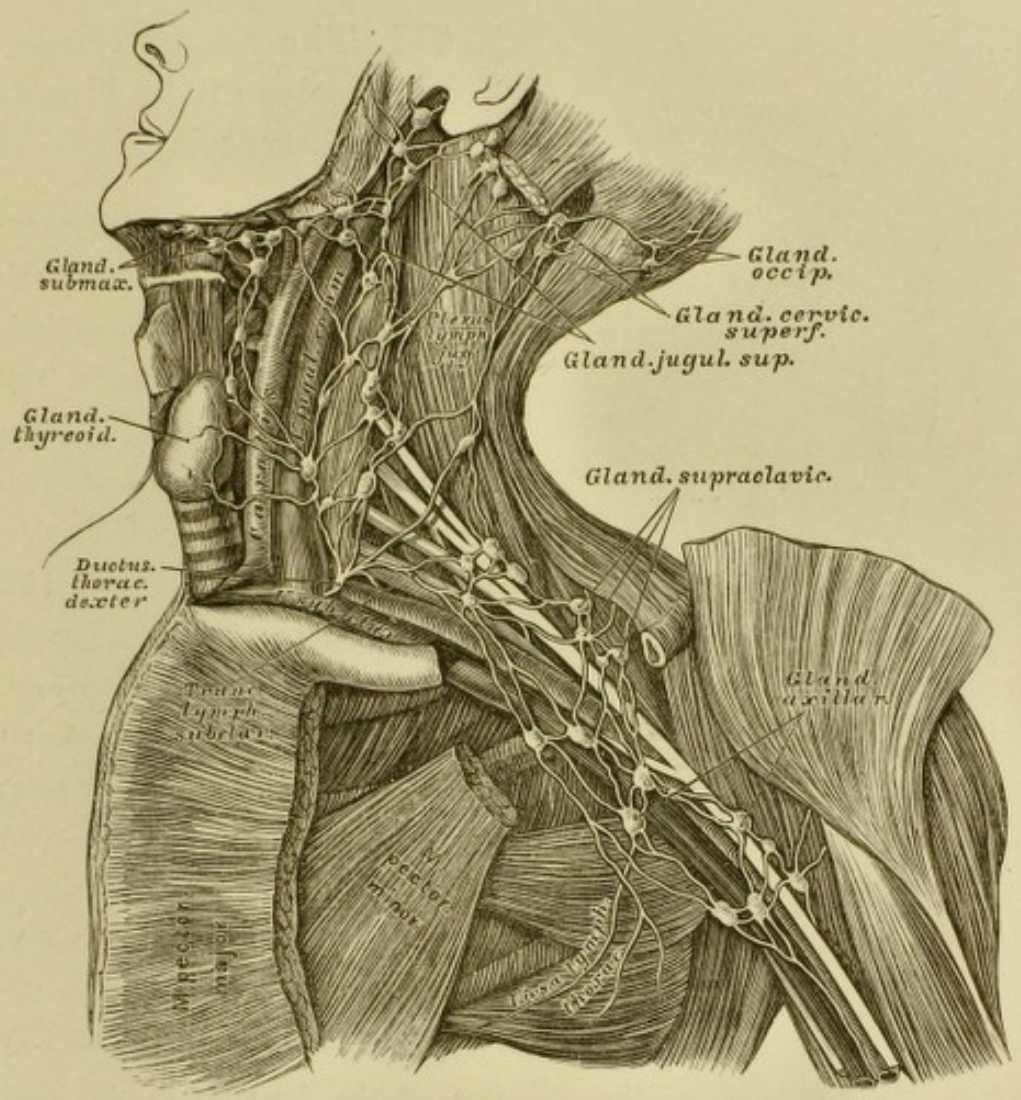


613. The Superficial Lymphatics and Glands of the Head and Neck.

The lymphatics of the head and neck converge to the superficial and deep lymphatic glands, finally to the *Plexus jugularis* situated around the common jugular vein, whose *Vas efferens* opens into the thoracic duct of the corresponding side, as *Truncus jugularis*. The glands are the following:

a) Anterior and posterior auricular glands; the anterior in the parotid gland, the posterior behind the ear.

b) Deep facial glands, in the spheno-maxillary fossa and at the side of the pharynx.



614. The Deep Lymphatics and Glands of the Neck and Axilla.

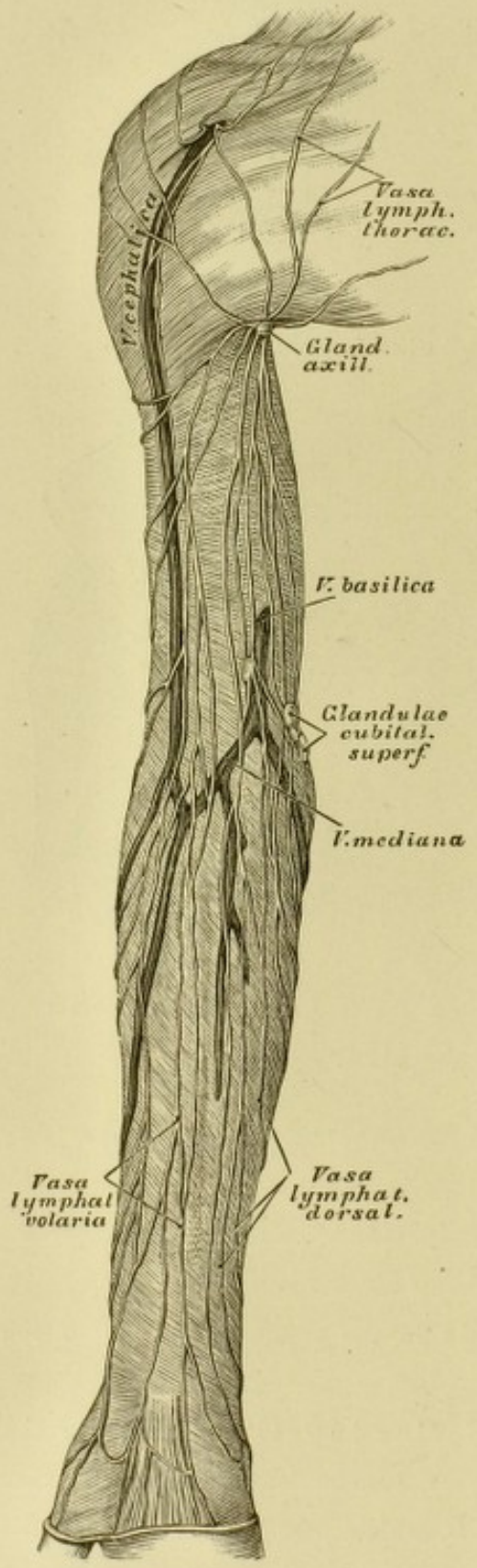
c) Submaxillary glands at the lower border of the lower jaw;

d) Superficial cervical glands at the upper lateral portion of the neck in front of and upon the *M. sterno-cleido-mastoideus.*

The lymphatics leaving these glands converge to the:

e) Superior jugular glands in the superior triangle of the neck, and to the

f) Supraclavicular or inferior jugular glands in the clavicular fossa, which, 15—20 in number, communicate with each other and form the *Plexus lymphaticus jugularis*, which passes up as far as the jugular foramen.



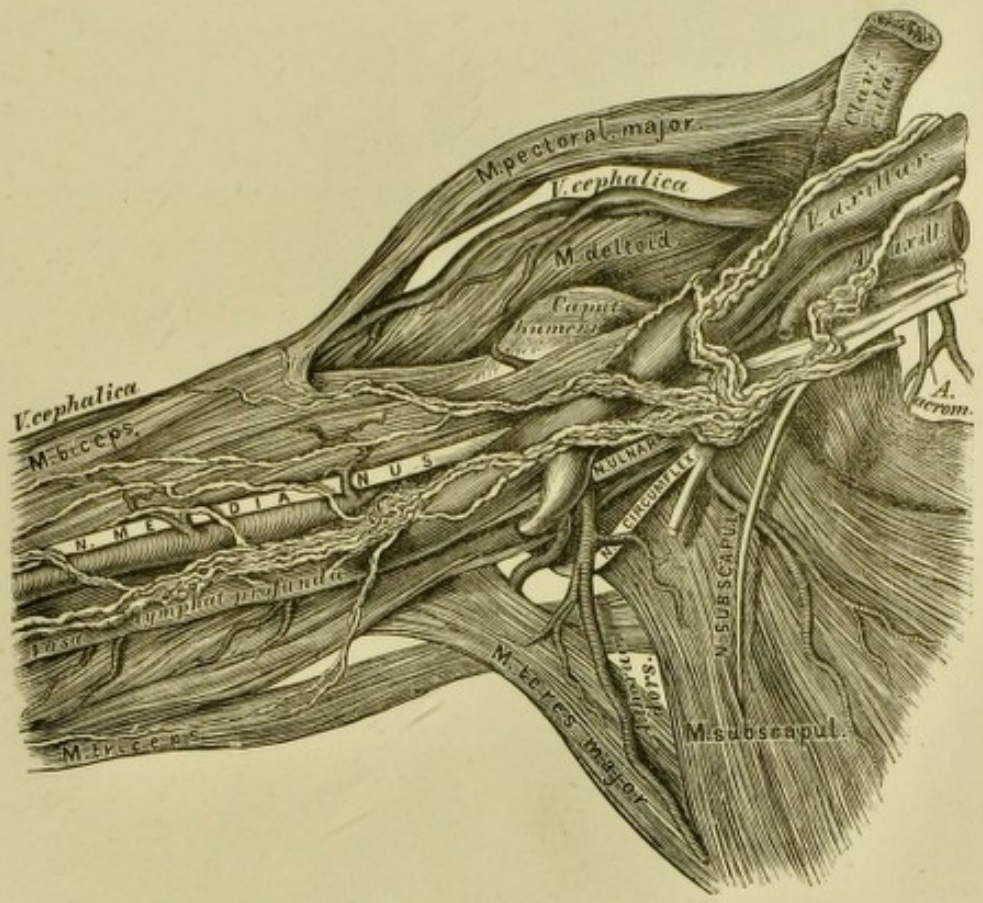
615. The Superficial Lymphatics of the Upper Extremity.

The lymphatics of the upper extremity, the thorax and shoulder, collect in the *Plexus lymphaticus axillaris*, with 8—12 axillary glands. This plexus forms the *Truncus lymphaticus subclavius*, which opens into the thoracic duct of the corresponding side.

The lymphatics of the upper extremity are partly superficial and partly deep.

a) The superficial lymphatics commence at the fingers; those from the palmar side ascend on the inner side of the forearm, those from the dorsal side at first on the outer side, then across the border of the ulna to the inner surface of the forearm. In the bend of the elbow are one or two *Glandulae cubitales*. The lymphatics pass some directly into the axilla, others with the cephalic vein to the space between *M. deltoides* and *M. pectoralis major*.

b) The deep lymphatics accompany the veins of the arm, but are less numerous than the superficial; they form a few cubital glands, *Glandulae cubitales*, and deep brachial glands, *Glandulae brachiales profundae*.



616. The Deep Lymphatics of the Axilla.

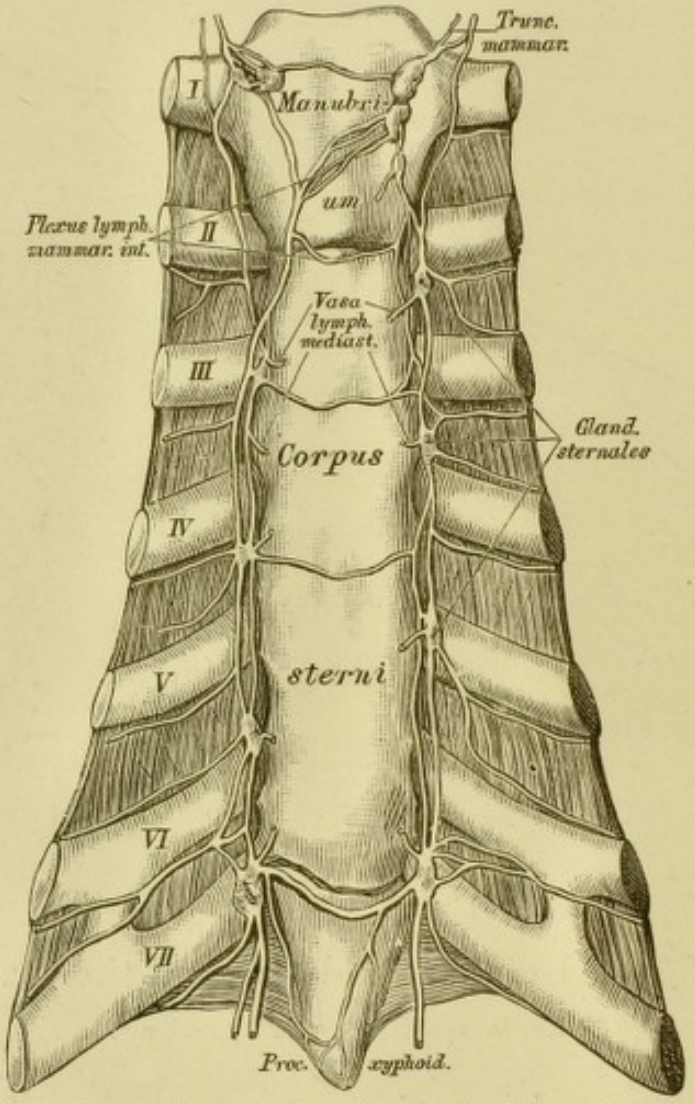
After a specimen of Patruban.

The lymphatics of the wall of the thorax are also both superficial and deep.

a) The superficial pass to the space between *M. deltoides* and *M. pectoralis major* and at the lower border of the *M. pectoralis major* to the axilla.

b) The deep accompany the bloodvessels of the thorax, receive the lymphatics of the mamma and are connected by branches with the internal lymphatics of the thorax.

The lymphatics of the shoulder pass out from the cervical, dorsal and lumbar regions, and ascend at the border of the *M. latissimus dorsi*, partly with the branches of the axillary artery.



617. The Lymphatics of the Thorax.

The lymphatics of the thoracic cavity are the following:

a) The intercostal lymphatics, which accompany the *Vasa intercostalia*. They pass out from the lateral wall of the thorax and abdomen, from the diaphragm, the pleura, the muscles of the back and the vertebral column and pass through 16—20 intercostal glands.

b) The mediastinal lymphatics emerge from the pericardium, the oesophagus and the posterior mediastinum and pass through 8—12 posterior mediastinal glands.

c) The internal thoracic lymphatics pass through 10—14 anterior mediastinal glands, also 6—8 sternal glands. They form the internal mammary plexus, which empties into the two *Ductus thoracici* by means of the *Trunci mammarii*.

d) The lymphatics of the lungs, partly superficial, partly deep, pass through the bronchial glands; on the left side they run to the thoracic duct, on the right side through the *Truncus broncho-mediastinicus* to the right lymphatic duct.

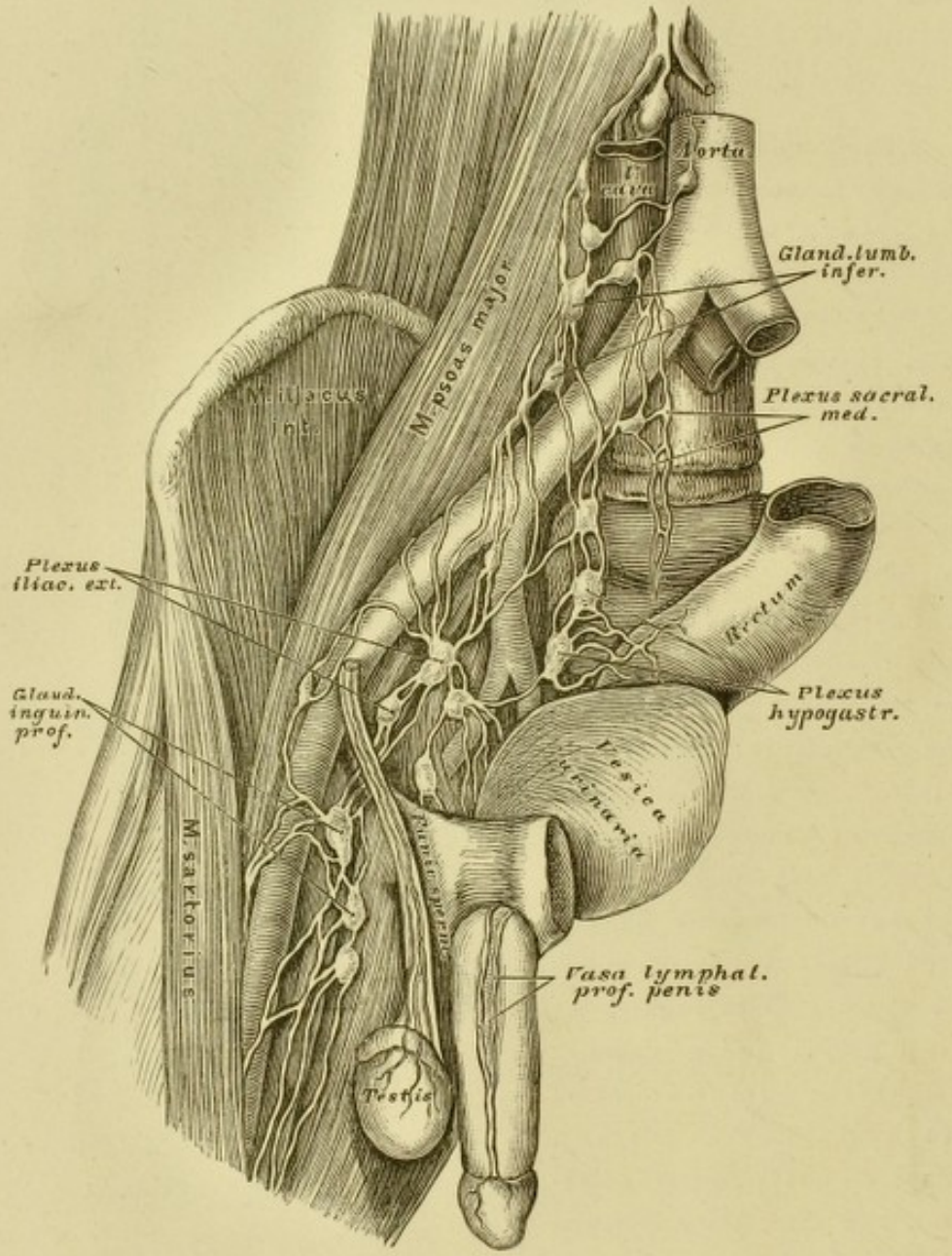
618. The Superficial Lymphatics of the Lower Extremity.

The lymphatics of the lower extremity converge to the inguinal glands, which are partly superficial and partly deep, and form the inguinal plexus by a number of anastomoses. The former lie between Poupart's ligaments and the *Fovea ovalis*, the latter upon the vessels of the thigh. The lymphatics are the following:

a) Lymphatics of the thigh. They pass partly above the *Fascia lata*, partly below it. The superficial ascend from the foot, pass with the great saphenous vein, partly also below the integument of the leg. The deep accompany the deep blood vessels and in the popliteal space pass through 1—4 deep popliteal glands.

b) The lymphatics of the hypogastric region pass down above Poupart's ligament, and enter the uppermost inguinal glands.

c) The lymphatics of the external genitals pass from the penis or the clitoris to the adipose tissue of the *Mons Veneris*, from there to the superficial inguinal glands. The lymphatics of the scrotum and *Labia majora* pass transversely outwards to the inguinal glands.



619. The Deep Lymphatics of the Pelvis and Groin.

From the inguinal glands the lymphatic trunks pass with the vessels into the pelvis, receive lymphatics from the anterior and lateral walls of the abdomen and form the external iliac plexus, which empties into the inferior lumbar glands. The hypogastric and middle sacral plexuses also empty into these glands. The hypogastric plexus is formed by branches, which accompany those of the hypogastric artery; the middle sacral plexus receives the lymphatics of the posterior pelvic wall, of the sacral canal and the rectum.

620. The Lymphatics of the Testis and Epididymis.

The lymphatics of the lumbar region and the viscera form the double lumbar plexus and the single mesenteric plexus; from these the two *Trunci lymphatici lumbales* and the single *Truncus lymphaticus intestinalis* are formed.

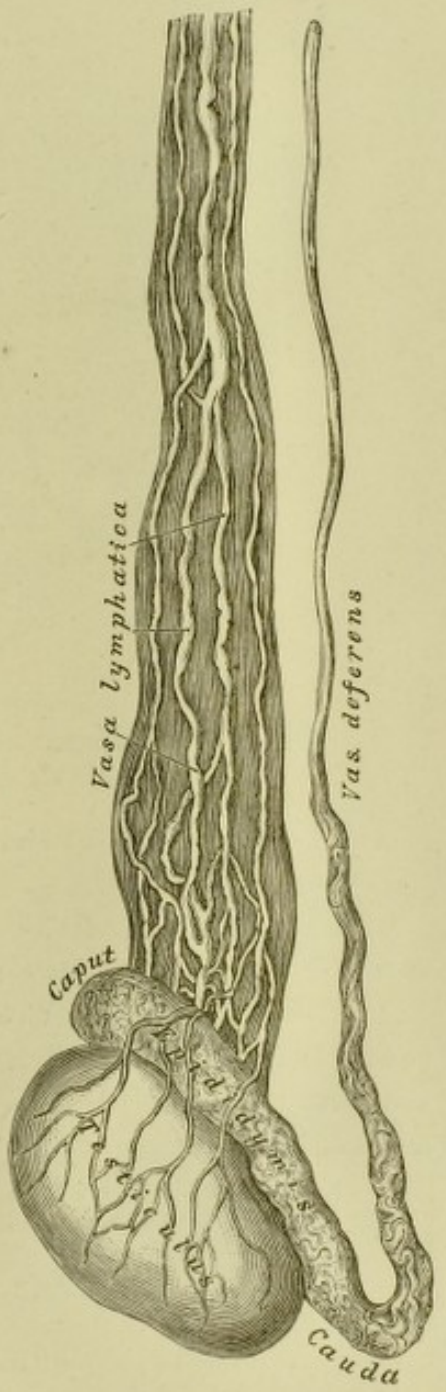
a) The lumbar plexuses lie upon the muscles of the lumbar region and the lumbar portion of the spinal column and form 20—30 lumbar glands, partly superior and partly inferior. Besides these plexuses the glands receive the following lymphatics:

The lymphatics of the testicle from the testis and its coverings, in the female from the ovary; in the latter, the lymphatics of the fundus of the uterus and the Fallopian tubes also open;

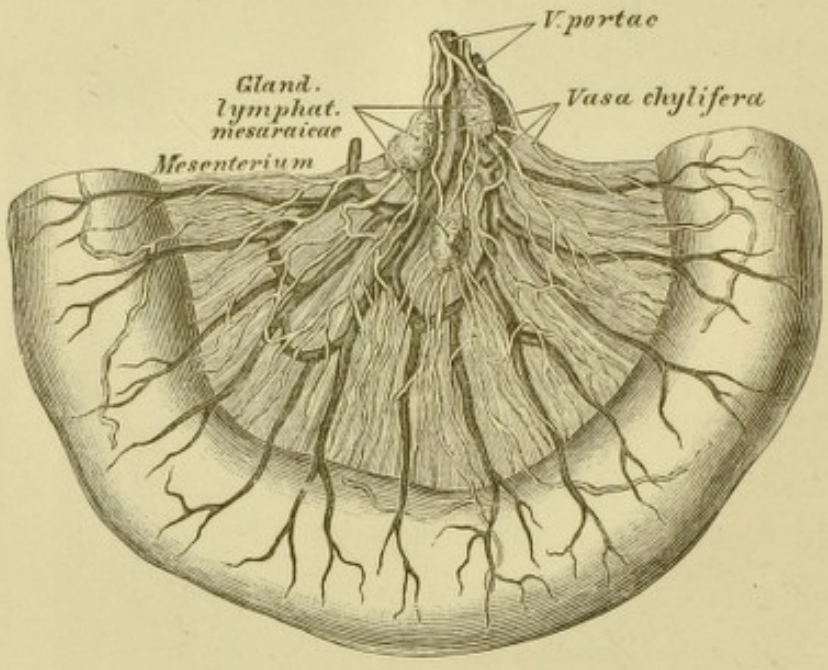
The lymphatics of the kidney and suprarenal capsule;

The lumbar lymphatics from the lateral abdominal wall;

The lymphatics of the sigmoid flexure and rectum on the left side.



b) The mesenteric or coeliac plexus is single, surrounds the aorta and its upper branches, also the portal vein and forms 16—20 coeliac glands.



621. The *Vasa chylifera* in the Mesentery.

The lymphatics which form the coeliac plexus are the following:

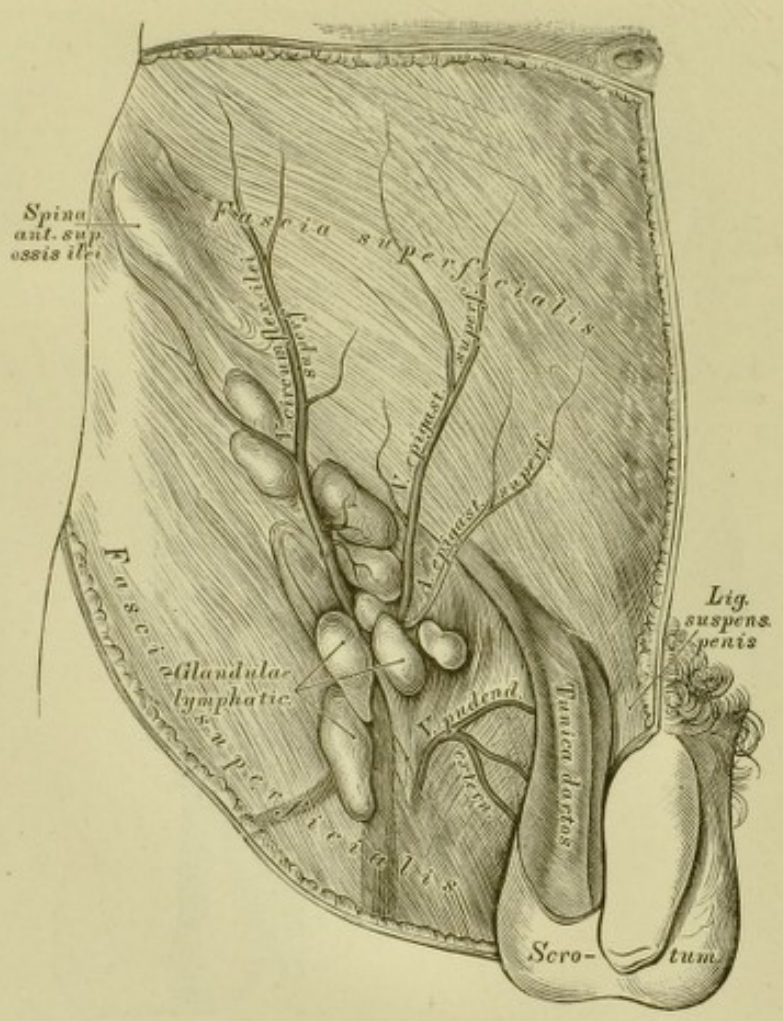
Lymphatics of the stomach, which again form three plexuses a left, an upper and a lower;

Lymphatics of the small intestine, really called lacteals, *Vasa lactea s. chylifera*, run between the layers of the mesentery and pass through a triple row of mesenteric glands, *Glandulae mesaraicae;*

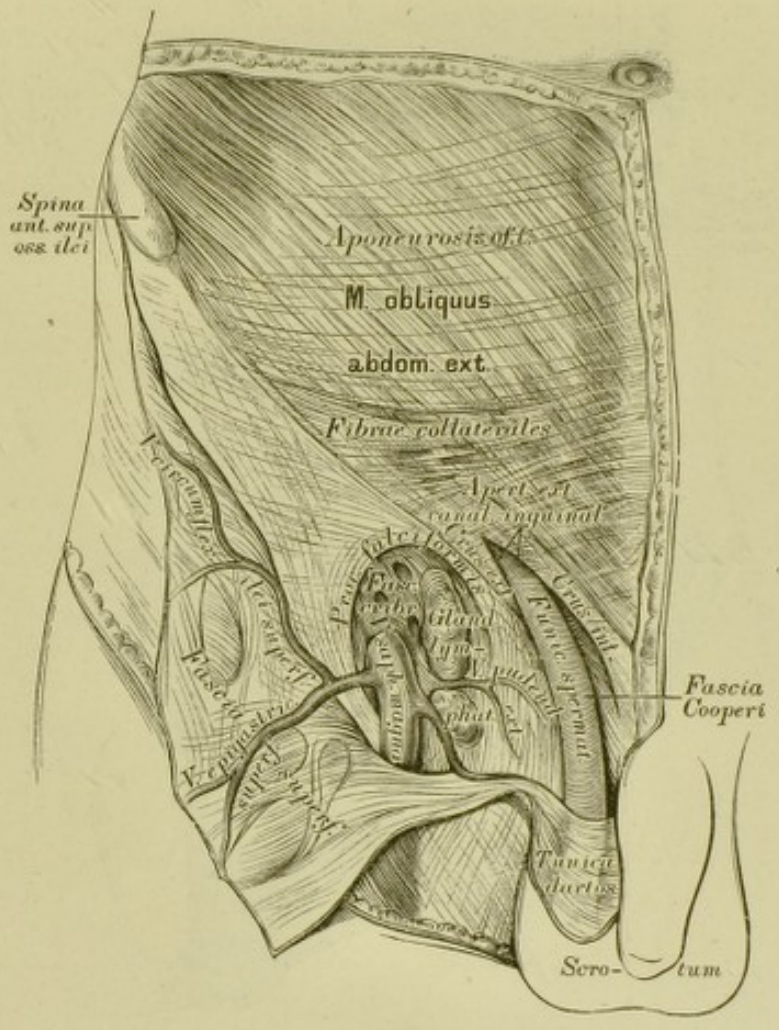
Lymphatics of the rectum; they form only 1—2 rows of small glands;

Lymphatics of the spleen and pancreas, running along the splenic vein;

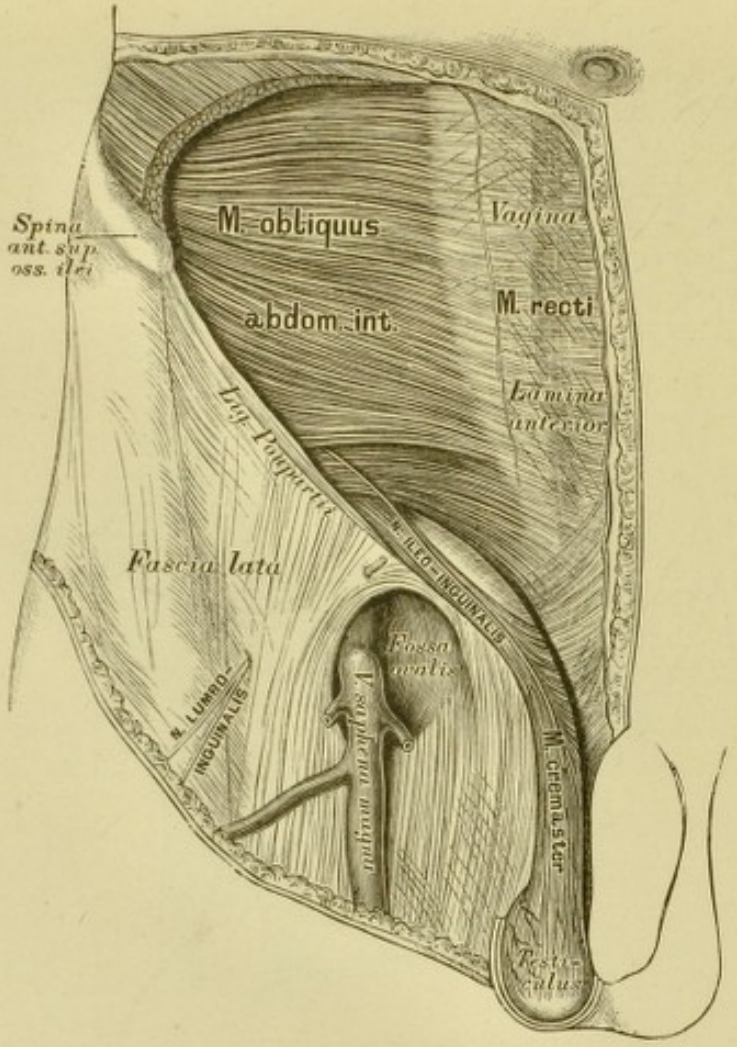
Lymphatics of the liver, superficial and deep. The superficial pass with the suspensory ligament of the liver from the convex surface of the liver to the diaphragm into the mammary and anterior mediastinal plexuses, partly also to the plexuses of the stomach and spleen, and to the posterior mediastinal glands. The deep lymphatics leave the *Porta hepatis*, receive the superficial lymphatics of the concave surface of the liver and form, before they open into the coeliac plexus, several hepatic glands.



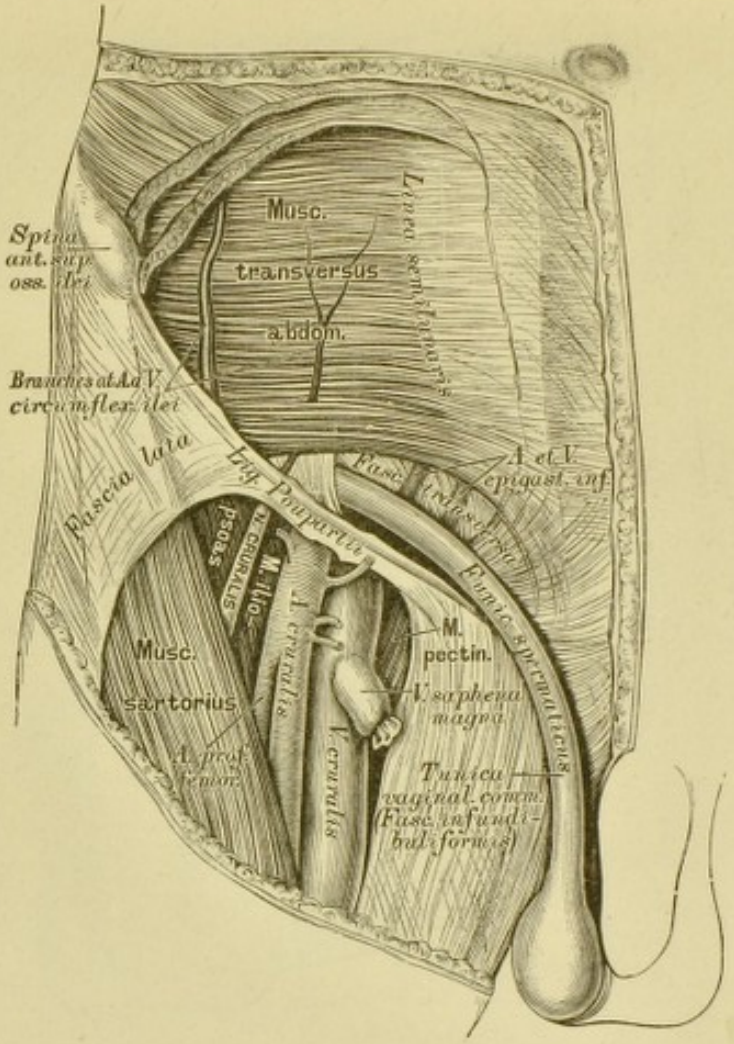
622. Topography of the Inguinal and Crural Regions. I.



623. Topography of the Inguinal and Crural Regions. II.



624. Topography of the Inguinal and Crural Regions. III.



625. Topography of the Inguinal and Crural Regions. IV.

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Errata.

Part I, Page 66, Fourth line „wich“.....should be „which“.
„ I, „ 81, „ „ „saddelike“ ... ... „ „ „saddle like“.

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