POCKET ANATOMY.

Sumner's.

POCKET ANATOMY:

A CONCISE ARRANGEMENT OF
ANATOMICAL FACTS,

FOR THE USE OF STUDENTS.

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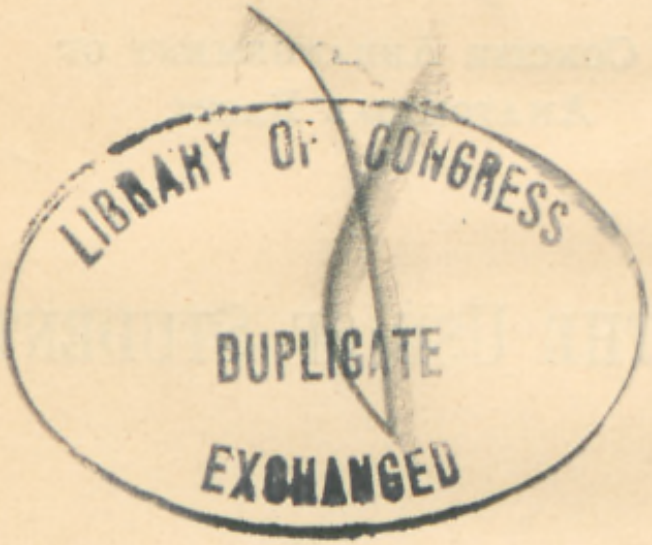

PREFACE.

In offering this Manual to the Student, it is hardly necessary to state that without a previous knowledge of Anatomy, acquired in the lecture and dissecting rooms, it will prove of little service. It is merely a compact arrangement of anatomical facts in such a manner as to aid the memory and assist in a clearer comprehension of a subject which the intricacy of detail renders difficult and obscure.

I am largely indebted for my methods of simplification to the assistance of Professors Hyrtl of Vienna, Braun of Leipzig, Virchow of Berlin, and Heath of London, whose beautiful preparations and dissections have done much to elucidate in my own mind many points, the description of which has perplexed some of our best anatomical authors.

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POCKET ANATOMY.

INTRODUCTION.

ANATOMY is the science which treats of the structure and relations of the *Tissues*, *Systems*, and *Organs*, which, taken together, make up an ORGANISM.

A TISSUE is the simplest material combination within the range of ANATOMICAL ANALYSIS. The molecular constitution of a tissue belongs to the sphere of chemistry, and can only be arrived at by CHEMICAL ANALYSIS.

A SYSTEM is a combination of Tissues for the performance of some general function in the organism.

AN ORGAN is a definite structure, to the formation of which tissues and systems contribute for the execution of some special and non-transferable function.

AN ORGANISM is a combination of Tissues, Systems, and Organs, which, in their normal structure and relation, exhibit the phenomena of life.

The structure of tissues belongs to *Histology;* their relations will be discussed with the systems and organs to which they contribute.

There are five systems entering into the composition of the human body: (1) Osseous, (2) Ligamentous, (3) Muscular, (4) Vascular, (5) Nervous.

THE OSSEOUS SYSTEM.

INCLUDING the teeth and ossicles of the ear, there are 238 bones entering into the formation of the human *Skeleton*, which, for the convenience of description, is divided into head, trunk, superior and inferior extremities.

THE HEAD, OR SKULL,

is divided into 2 parts—the *Cranium* and the *Face*. In the Cranium there are 8 bones: 4 single—Occipital, Frontal, Sphenoid, and Ethmoid; 2 pairs—Parietal and Temporal. In the Face there are 14 bones: 2 single—Vomer and Inferior Maxillary; 6 pairs—Nasal, Superior Maxillary, Lachrymal, Malar, Palate, and Inferior Turbinated.

THE OCCIPITAL BONE

is situated at the base and back part of the Cranium; it has 2 surfaces, 4 borders, and 4 angles.

The external surface is convex, and marked by a prominent tubercle near the middle, called the external occipital protuberance, for the attachment of the ligamentum nuchæ. Descending forward from this is a ridge, called the external occipital

crest. From this, on each side, lead out 2 parallel curved lines—superior and inferior—for the attachment of muscles. There are 5 foramina: the foramen magnum transmitting the spinal cord and its membranes, the spinal accessory nerves, and the vertebral arteries; the anterior condyloid foramen, one on each side, transmitting the hypoglossal (9th) nerve; the posterior transmitting a vein to the lateral sinus. On each side of the foramen magnum are the Condyles for articulation with the atlas, and farther out a process called the transverse, or angular, process. In front of the foramen is a square plate of bone called the basilar process, marked by a crest called the Pharyngeal Spine.

The internal surface is concave, divided by a crucial ridge into 4 fossæ for the lodgment of the posterior lobes of the cerebrum above and the cerebellum below. The ridges give attachment to the Falx Cerebri and Falx Cerebelli, and Tentorium Cerebelli. There are grooves for the sinuses of the Dura Mater, and eminences and depressions marking the convolutions of the brain. Where the grooves meet there is a depression called the *Torcular Herophili.*

This bone articulates with 6 others—2 parietal, 2 temporal, sphenoid, and atlas.

It gives attachment to 12 pairs of muscles: to the superior curved line—Occip. Front., Trapez., Stern. Mast.; to the space

between the curved lines—Complex., Splen. Cap., and Obliq. Sup.; to the inferior curved line and the space between it and the foramen magnum—Rect. Cap. Post. Maj. and Min.; to the transverse process—Rect. Lat.; to the basilar process—Rect. Cap. Ant. Maj. and Min., and Sup. Const. of Phar.

THE FRONTAL BONE

consists of 2 portions—a *vertical* or *frontal*, and a *horizontal* or *orbito-nasal*. The vertical portion forms the *forehead*, and has two surfaces. The external surface presents the remains of the frontal suture, and on each side of this an eminence called the frontal eminence. Below this is the superciliary ridge, continuous internally with the *nasal eminence*, and forming the supra orbital arch, at the inner third of which is seen the supra orbital notch, or foramen, for the transmission of the supra orbital vessels and nerve. The supra orbital arch terminates externally in the *external*, and internally in the *internal, angular process*. The nasal notch is the point of articulation with the nasal bone, and is continuous below with a long, pointed spine, called the *nasal spine*, or *glabella*.

The internal surface of the vertical portion presents a vertical groove—the edges of which form the frontal crest. The groove lodges the superior longitudinal sinus, and the edges afford attachment to

the dura mater. It terminates below in a foramen—the foramen cæcum, usually impervious. On each side of the groove the bone is deeply concave, lodging the anterior meningeal arteries and the anterior lobes of the cerebrum. Irregular fossæ are also seen for the lodgment of the Pacchionian bodies.

The horizontal portion consists of 2 plates, forming the roof of the orbits, and divided by a notch—the ethmoidal notch. It presents on each side of the nasal spine irregular cavities between the 2 tables called the *frontal sinuses*. They are lined with mucous membrane, and are continuous with the nose through the infundibulum.

The Frontal Bone articulates with 12 bones: 2 parietal; sphenoid, ethmoid; 2 nasal, 2 superior maxillary, 2 lachrymal, and 2 malar.

It affords attachment to 3 muscles on each side: Corrugator Supercilii, Orbicularis Palpebrarum, and Temporal.

THE TEMPORAL BONE

consists of 3 portions: *Squamous*, *Mastoid*, and *Petrous*. The Squamous portion forms part of the Temporal Fossa, and gives attachment to the Temporal muscle. The Zygomatic process comes off by 3 roots from the Squamous portion. It gives attachment to the Masseter muscle. The anterior root runs into the eminentia artic-

ularis. The middle root terminates in the Glaserian Fissure, which leads into the Tympanum, lodges the processus gracilis of the malleus, transmits the Laxator Tympani muscle, and Tympanic branch of the Internal Maxillary Artery. Through the canal of Huguier parallel to this fissure passes the chorda tympani nerve. At the junction of the anterior root with the Zygoma there is a tubercle giving attachment to the external lateral ligament of the lower jaw. Between the anterior and middle roots is the glenoid fossa for the condyle of the lower jaw. This fossa is bounded in front by the emin. artic.; behind by the vaginal process; externally by the auditory process, and middle root of the Zygoma. Between the fossa and the aud. proc. is the post-glenoid process. The post. part of the fossa lodges part of the parotid gland. The intern. surf. of the squam. port. presents depressions and eminences to mark the convolutions of the brain, and grooves for the branches of the middle meningeal artery.

The Mastoid Portion presents the *mastoid for.*, transmitting a vein to the lateral sinus and a small artery. The mastoid process gives attachment to the sterno-mastoid, splen. cap., and trachelo-mastoid muscles; the fossa near by to the digastric muscle; and the groove internal and parallel lodges the occipital artery. The hollow spaces

in the mastoid process are called *mastoid cells.*

The Petrous Portion presents a base, apex, 3 surfaces, and 3 borders.

The *anterior* surface presents 6 points:

Eminence for sup. semicirc. canal.

Depression for tympanum.

Hiatus Fallopii for petros. br. of vid. n.

Opening for smaller petros. n.

Carotid canal.

Depression for Casserian ganglion.

The *posterior* surface presents 3 points:

Meatus Aud. Intern. for fac. and aud. n. and aud. art.

Aqueductus Vestibuli for small art. and v. and proc. of dura mater.

Depression for small vein and proc. of dura mater.

The *inferior* surface presents 11 points:

Rough Quad. Surf. for Lev. Pal. and Tens. Tymp.

Opening of Carotid canal for int. car. art. and car. plex.

Aqueduct. Cochleæ for vein from cochlea.

Jugular Fossa.

Canal for Jacobson's Nerve = tymp. br. gloss. phar.

Canal for Arnold's Nerve = Auric. br. pneumogast.

Smooth jugular surf.

Vaginal process.

Styloid process for Stylo-phar., Stylo-

gloss., and Stylo-hyoid muscles; and Stylo-hyoid and Stylo-max. ligaments.

Stylo-mastoid foramen for stylo-mast. art. and fac. n.

Auricular Fissure for exit of auric. br. pneumog.

The *Sup. border* is grooved for sup. pet. sinus.

The *Post. border* is grooved for inf. pet. sinus.

The *Ant. border* presents 2 canals separated by the proc. cochleariformis, the upper transmitting the tens. tymp., and the lower one the Eustachian tube.

Articulates with 5 bones—Occip., Par., Sphen., Inf. Max., and Malar.

Fourteen muscles are attached: to Squam. port. Temporal; to Zygoma Masseter; to mast. port. Occip. Front., Stern. mast., Splen. Cap., Trach. Mast., Digastricus and Retrahens Aurem; to Styloid proc. Stylo-phar., Stylo-gloss., and Stylo-hyoideus; to petrous port. Lev. Pal., Tens. Tymp., and Stapedius.

THE SPHENOID BONE

presents a body, greater and lesser wings, and pterygoid processes. It assists in forming the outer wall of the orbit and the temporal fossa.

On its superior surface it presents from before backward:

Ethmoidal Spine.

Groove for olfactory n.

Optic Groove.

Optic Foramina for opt. n. and opthal. art.

Foramen Lacerum Anterius, or Sphenoid Fissure, for 3d, 4th, opthal. br. of 5th, and 6th nerves, and opthal. v.

For. Rotundum for sup. max. n.

For. Vesalii for small v.

For. Ovale for inf. max. and small pet. nerves and small mening. art.

For. Spinosum for mid. mening. art.

Olivary process.

Ant., mid., and post. clinoid processes.

Sella Turcica for pituitary body.

Cavernous Groove for cav. Sin. and Int. Car. Art.

On the ant. and inf. surfaces it presents:

Vert. lamella of bone for Eth.

Sphenoidal Sinuses.

Vidian Canal for vid. art. and n.

Rostrum for vomer.

Vaginal process.

Pterygo-palatine Canal for pterygo-palatine vessels and pharyngeal nerve.

The Pterygoid processes form the post. wall of the spheno-max. fossa, and part of inner wall of Zygom. fossa. It supports Meckel's ganglion, and presents 2 fossæ—scaphoid and pterygoid.

The Sphenoid articulates with all the bones of the Cranium and 5 of the Face—2 Malar, 2 Palate, and Vomer.

It gives attachment to 12 muscles: Temp., Ext. and Int. Pteryg., Sup. Cons., Tens. Pal., Lax. Tymp., Lev. Palp., Obliq. Sup., Sup., Int., Inf., and Ext. Recti.

THE ETHMOID BONE

presents a Horizontal or Cribriform plate, a Perpendicular plate, and Lateral Masses.

The sup. surf. presents:

Crista Galli for falx cerebri.

Slit for nasal nerve.

Foramina for olfact. nerves.

The ext. surf. of lat. mass is called *Os planum;* the inf. proc. unciform process.

By its turbinated processes it assists in forming the inner wall of the nose. The canal leading through the bone to the middle meatus is called the infundibulum.

Art. with 15 bones: Sphen., 2 Sphen. turb., Front., 2 Nas., 2 Sup. Max., 2 Lach., 2 Pal., 2 Inf. turb., and Vomer.

No muscles attached.

BONES OF THE FACE.

THE NASAL BONES

form the bridge of the nose. The outer surface is covered by the Compress. Naris muscle. A foramen about the center transmits a small vein. The inner surface is marked by a groove for a branch of the nasal nerve. To the inferior border is attached the lateral cartilage of the nose.

It articulates with the Front., Eth., opposite Nasal, and Sup. Max.

No muscles attached.

THE SUPERIOR MAXILLARY BONES

assist in forming 3 cavities: the roof of the mouth, the floor and outer wall of the nose, and floor of the orbit; 2 fossæ, Zygomatic and spheno-maxillary; 2 fissures, spheno-maxillary and pterygo-maxillary. It has 4 processes—malar, nasal, alveolar, and palatine. The body is hollowed out to form the Antrum of Highmore, into which project the roots of the 1st and 2nd molars.

It is marked by 2 fossæ, incisive and canine. The infraorbital foramen just above the latter transmits the infraorbital vessels and nerve which run along a groove on the orbital surface. The internal surface assists in forming the middle and inferior meatuses of the nose and the lachrymal canal.

When articulated, it presents on the palate surface the anterior and posterior palatine canals, the former for the passage of the anterior palatine vessels, the naso-palatine nerve passing through the intermaxillary suture; the latter for post. pal. ves.

It articulates with 9 bones: Front., Eth., Nas., Mal., Lach., Inf. turb., Pal., Vom., and fellow of the opposite side.

It gives attachment to the Orbic. Palp., Obliq. Inf., Lev. lab. sup. alæque nasi, Lev.

lab. sup. prop., Lev. ang. or., Comp. Nar., Dep. Al. Nas., Masseter, and Buccinator.

THE LACHRYMAL BONES (*Ossa unguis*) complete the lach. groove, and assist in forming the orbit. Each articulates with 4 bones: Front., Eth., Sup. Max., and Inf. turb.; and gives attachment to the Tensor Tarsi.

THE MALAR BONES

assist in forming the outer wall and floor of the orbit, and the Temporal and zygomatic fossæ. Each bone has 2 surfaces, ext. and int., and 4 processes, front., orb., max., and Zygom. It is perforated by foramina for small nerves and vessels. It gives attachment externally to the Lev. lab. sup. prop., Zyg. maj. and min.; internally to the Temporal and Masseter muscles.

THE PALATE BONES

assist in the formation of the floor and outer wall of the nose, the roof of the mouth, and the floor of the orbit; the zygom., spheno-max., and pteryg. fossæ. Each bone consists of 2 portions, vertical and horizontal, and thus, when articulated, completes the sup., mid., and inf. meatuses of the nose. It presents a foramen, sphenopalatine, transmitting the spheno-palatine vessels and nerve, and opening into the sup. meat.

It artic. with 7 bones: Sphen., Eth., Sup. Max., Inf. turb., Vom., Sphen. turb., and opposite Palate.

It gives attachment to the Tens. Palat., Azyg. uv., Int. and Ext. Pteryg.

THE INFERIOR TURBINATED BONES

present each 2 surfaces, 2 borders, and 2 extremities. It assists in forming the nasal fossæ and the lach. canal.

It artic. with 4 bones: Eth., Sup. Max., Lach., and Pal.

No muscles attached.

THE VOMER

forms part of the septum of the nose. It is marked by a groove for the naso-palatine nerve.

It articulates with the Sphenoid, Eth., Sup. Max., 2 Palate, and cartilage of the septum.

No muscles attached.

THE INFERIOR MAXILLARY BONE

presents a ramus vertical and a body horizontal.

The Rami in the fœtus are almost parallel with the body; in youth oblique, in manhood vertical, in old age oblique. The outer surface is covered by the Masseter muscle. The internal surface presents the inf. dent. canal for the inf. dent. vessels and nerve, and a spine for the intern. lat. lig.

of the lower jaw; a groove—the mylo-hyoid—for the mylo-hyoid vessels and nerve; 2 processes—*Condyloid*, for articulation with Temp. and attach. of Ext. Pteryg.; *Coronoid*, for attachment of Temporal and Masseter muscles. The sigmoid notch between the two transmits the masseteric artery and nerve.

The body is marked by 4 tubercles in front of attach. of Genio hyo-glossi muscles above and Genio-hyoidei below. The alveolar process lodges the teeth. The mental foramen transmits the mental artery and nerve.

This bone artic. on each side with the glenoid fossæ of the temporal bone.

It gives attachment externally to the Lev. Menti, Dep. lab. inf., Dep. ang. or., Platysm. Myoides, Buccin., and Masseter; internally to the Gen. hyo-gloss., Gen. hyoideus, Mylo-hyoid, Digastric, Sup. Constr., Temp., Int. Pteryg., Ext. Pteryg.

THE SUTURES OF THE SKULL

are as follows:

At the vertex sagittal, 2 parietal; coronal, front., and par.; lambdoid, occip., and par.

At the side spheno-par., squamo-par., masto-par.

At the base basilar (occip. and sphen.), pet. occip., masto-occip., petro-sphen., squamo-sphen.

The sutures of the face are not named. The transverse suture connects the bones of the face and head.

THE BASE OF THE SKULL

presents upon its internal surface 3 fossæ.

The *anterior* is formed by the orbital plate of the frontal, the crib. plate of the ethmoid, the eth. proc. and less. wing of the sphen.

It presents from before backward:

Groove for sup. long. sinus.

Grooves for ant. mening. art.

Foramen Cæcum.

Crista Galli.

Slit for nasal nerve.

Groove for nasal nerve.

Ant. eth. for. for ant. eth. art. and nas. nerve.

Orifices for olfactory nerves.

Post. eth. for. for post. eth. art. and v.

Ethmoidal spine.

Olfactory grooves.

The *middle fossa* is bounded in front by the post. marg. of the lesser wing of the sphen., the ant. clin. proc. and ant. marg. of opt. groove; behind by the pet. port. of temp. and bas. sut.; externally by squam. port. of temporal and ant. inf. ang. of par. bone, and is sep. from its fellow by the sella turcica.

It presents from before backward:

Optic groove for opt. commissure.

Optic foramen for opt. nerve and ophthal. art.

Olivary process.

Ant. clin. proc. for attach. dura mater.

Mid. clin. proc.

Sella turcica for pituit. body.

Post. clin. proc.

Cavernous groove for int. carot. art., cav. sin., and orb. nerves.

Grooves for mid. mening art.

For. lac. ant., or sphen. fissure, for 3, 4, opht. br. of 5, 6, and opth. vein.

For. rot. for sup. max. nerve.

For. vesalii for small vein.

For. ovale for inf. max. nerve, small petrosal n., and small mening. art.

For. spinosum for mid. mening. art.

For. lac. med., or carotid canal, for car. art. and plex. n.

Hiatus fallopii for petros. br. vidian n.

Groove for small petros. n.

Depress. for casser. gang.

Emin. of sup. semicirc. can.

The *posterior fossa* is formed by the occip., pet. and mast. post. of temp. and post. inf. ang. of phar. bone.

It presents from before backward.

Basilar process.

For. mag. for spin. cord and membranes, vert. art., and spin. access. n.

Groove for inf. petros. sin.

For. lac. post., or jug. for., for inf. jug. v. and 8th pr. nerves.

Meat. aud. inf. for aud. and fac. n. and aud. art.

Aqueduct. vestibuli for small art. and v.

Ant. cond. for. for hypoglossal n. (9).

Post. cond. for. for small vein to lat. sin.

Mast. for. for v. to lat. sin.

Post. mening. grooves.

Grooves for lat. and long. and occip. sinuses.

Torcular Herophili.

The external surface presents from before backward:

Two foramina in the intermaxillary suture—one, the anterior, transmitting the left, and the posterior (the larger) the right, nasopalatine nerve.

Two placed laterally to these, transmitting the anterior palatine vessels.

Depressions for palatal glands.

Posterior palat. for. and groove for posterior palat. vessels and descend. pal. nerve.

Accessory palatine foramina.

Ridge for tens. pal.

Post. nas. spine for azyg. uv.

Hamular process.

Pteryg. pal. canals for pteryg. pal. ves. and pharyngeal nerve.

Phar. spine for sup. cons.

For. for Eustach. tube and tens. tymp.

Canal for Jacobson's nerve.

Canal for Arnold's nerve.

Auricular fissure for exit of Arnold's n.

Aqueduct. coch. for vein to cochlea.

Glaserian fissure for proc. grac. lax. tymp., and tymp. branch of int. max. art.

Canal of Huguier for chorda tympani.

Stylo-mastoid for. for stylo-mastoid art. and exit of facial nerve, and other points mentioned on intern. surface.

THE LATERAL REGION OF THE SKULL is divided into 3 fossæ—the temporal, zygomatic, and spheno-maxillary.

The temporal fossa is formed by 5 bones —frontal, malar, temporal, parietal, and sphenoid. It is filled by the Temporal muscle.

The zygomatic is formed by the zygoma, the sup. max., and the portion of the great wing of the sphenoid below the crest. It contains the lower part of the Temp., the Ext. and Int. Pteryg. muscles, the int. max. art., the inf. max. nerve, and their branches. Two fissures open into it—the spheno-maxillary and the pterygo-maxillary.

The spheno-maxillary is horizontal, and joins at right angles with the pterygo-maxillary. It opens into the orbit, and connects it with the temp. zyg. and spheno-max. fossæ. It transmits the sup. max. nerve, infraorb. art., and ascending branches from Meckel's ganglion.

The pterygo-maxillary is vertical, and connects the spheno-max. fossa with the zygomatic, and transmits branches of the intern. max. art.

The spheno-maxillary fossa is formed by the sphenoid, sup. max., and palate. Three fissures terminate into it—sphen., spheno-max., and pterygo-max.; it communicates with 3 fossæ—the orbital, nasal, and zygomatic. Five foramina open into it—for. rot., vidian, pterygo-pal., spheno-pal., orif. of post. pal. canal.

THE ORBITS

are formed (both of 11) each of 7 bones—frontal, sphenoid, ethmoid, superior maxillary, malar, lachrymal, and palate. Nine openings communicate with each orbit—optic, for. lac. ant., spheno-max. fissure, supraorbital, infraorbital, ant. and post. ethmoid, malar, and lachrymal canal.

THE NASAL FOSSÆ

are formed by the front., sphen., eth., and all the bones of the face except the malar and inf. max.

Each communicates with 4 sinuses—front., eth., sphen., and max.; with 4 cavities; with the orbit by the lach. canal; with mouth by ant. pal. can.; with cran. by olfact. foramina; with spheno-max. fossa by spheno-max. for.; sometimes, also, with each other by an opening in the septum.

The outer wall presents the meatuses of the nose—superior, middle, and inferior.

The sup. meat., the smallest, is between the sup. and mid. turb. bones of the eth.,

and presents the opening of 2 for.—spheno-pal. and post. eth. cells.

The mid. meat., bet. mid. and inf. turb. bones, presents 2 for.—orifice of infundibulum and orifice of antrum.

The inf. meat., bet. inf. turb. and floor of nas. fossa, is the largest, and presents the or. of the lach. can.

THE HYOID BONE

presents a body, 2 greater and lesser cornua.

It gives attachment to 11 muscles: Stern. hy., Thyr. hy., Om. hy., Digast., Styl. hy., Myl. hy., Gen. hy., Gen. hy. gloss., Hy. gloss., Mid. Cons., Lingual.; to 4 ligaments —styl. hy., thyr. hy., hyo-epiglottic, and thyr. hy. membrane.

THE SPINE.

There are 33 vertebræ in the spine—7 cervical, 12 dorsal, 5 lumbar, 5 sacral, 4 coccygeal.

Each vertebra consists of a *body*, or interior solid segment, and an *arch*, or posterior segment.

On the anterior surface the body is perforated by a few small apertures for the passage of nutrient vessels, and on the posterior surface by a single large irregular aperture for the exit of the *venæ basis vertebræ*.

The pedicles are projections backward

from the body, concave above and below, and forming, by articulation, the intervertebral notches for the transmission of the spinal nerves.

The laminæ are 2 bony plates, completing the vertebral arch behind. They give attachment above and below to the *ligamenta subflava.*

The articular processes are 4 in number —2 above and 2 below.

The spinous process projects backward from the laminæ, and gives attachment to muscles.

The transverse processes are 2 in number, and also serve for attachment of muscles.

THE CERVICAL VERTEBRÆ

are known by a foramen in the transverse processes for transmission of the vertebral artery, vein, and plexus of nerves, and also by their bifid spinous processes.

PECULIAR VERTEBRÆ.

THE ATLAS supports the head. It has no body nor spinous process. Its *anterior arch* forms one-fifth of the bone, and presents anteriorly in its center a tubercle for the attachment of the Longus Colli muscle; posteriorly a facet for articulation with the odontoid process of the axis. The posterior arch forms two-fifths of the circumference of the bone. It terminates behind in a

rudimentary spinous process, which gives origin to the rectus capitis posticus minor. Behind each superior articular process is a groove, sometimes a foramen, which transmits the vertebral artery and the suboccipital nerves. The lateral masses are the largest parts of the atlas, presenting 2 oval articulating facets above, and 2 circular below. On the inner margin on each side is a tubercle for the attachment of the transverse ligament. The transverse processes are large, and give attachment to rotating muscles of the head.

THE AXIS is the pivot for the head to rotate upon. It is distinguished by the *odontoid* (tooth-like) process, which gives attachment on each side to the odontoid, or check, ligaments. The body gives attachment on each side of a central ridge to the Longus Colli muscle.

THE SEVENTH, or VERTEBRA PROMINENS, is known by its long horizontal spinous process, to which the ligamentum nuchæ is attached. The foramen in the transverse process is sometimes wanting in one or both sides. On the left side it transmits frequently the vertebral artery; sometimes the vein passes through on both sides, but generally the artery and vein pass through the foramen in the sixth cervical.

THE DORSAL VERTEBRÆ

are known by the facets on the body, and

transverse processes for the head, and tubercle of the articulating rib.

PECULIAR VERTEBRÆ.

1st. Dorsal. An entire facet above; a demi facet below.

9th. A demi facet above.

10th. One entire facet.

11th. An entire facet; no facet on transverse process, which is rudimentary.

12th. An entire facet; no facet on transverse process; inferior articular process convex and turned outward.

THE LUMBAR VERTEBRÆ

are known by their quadrilateral horizontal spinous processes, large bodies; the superior articular processes concave and looking inward, the inferior convex and looking outward and forward.

The fifth lumbar is distinguished by having the body thicker in front than behind; by its small spinous process and large transverse.

ATTACHMENT OF MUSCLES.

Atlas—10—Long. Col., Rect. Ant. Min., Rect. Lat., Rect. Post. Min., Obliq. Sup. and Inf., Splen. Col., Lev. Ang. Scap., Interspin., and Intertrans.

Axis—11—Long. Col., Obliq. Inf., Rect. Post. Maj., Semi. Spin. Col., Multif. Spin., Lev. Ang. Scap., Splen. Col., Transvers.

Col., Scalen. Post., Intertrans., and Interspin.

To the *other vertebræ*—32—*anteriorly:* Rect. Ant. Maj., Long. Col., Scal. Ant. and Post., Pso. Mag. and Parv., Quad. Lumb., Diaphragm, Obliq. Int., and Transvers.; *posteriorly:* Trapez., Lat. Dors., Lev. Ang. Scap., Rhomb. Maj. and Min., Serrat. Post. Sup. and Inf., Splen., Sacro. Lumb., Long. Dors., Spin. Dors., Cerv. Ascend., Trans. Col., Trach-mast. Complex, Semispin. Dors. and Col., Mult. Spin., Interspin., Supraspin., Intertrans., Levat. Cost.

THE SACRUM

is a large triangular bone, wedged in between the 2 ossa innominata. It forms with the last lumbar vertebra a very prominent angle called the promontory. It has an ant. and post. surface, 2 lateral surfaces, a base, an apex, and a central canal. At each end of the 4 transverse ridges indicating the original division of the bone are the anterior sacral foramina, transmitting the ant. branches of the sacral nerves. On the post. surf. are the post. sac. foram. The lat. surf. presents in front a broad, ear-shaped (auricular) surface for artic. with the ilium. The sacrum articulates with 4 bones—last lumbar vert., coccyx, and 2 ossa innominata.

It gives attachment in front to the Pyri-

formis and Coccygeus muscles, behind to the Gluteus Max. and Erect. Spinæ, to the Oblique Sacro-iliac and great Sacro-sciatic ligaments.

THE COCCYX

is formed of 4 segments of bone, with no canal nor foramina. It articulates with the sacrum, and gives attachment to the Coccygeus on each side, behind to the Gluteus Maximus, at the apex to the Sphincter Ani, and in front to the Levator Ani.

THE THORAX

is formed by the sternum and costal cartilages in front, the 12 ribs on each side, and the bodies of the dorsal vertebræ behind.

THE STERNUM

consists of 3 portions—manubrium, gladiolus, and ensiform or xiphoid, appendix.

It articulates with the clavicles and 7 costal cartilages on each side.

It gives attachment to 10 muscles: Sterno-hyoid, Sterno-thyroid, Sterno-cleido mastoid, Triangularis Sterni, Aproneurosis of Ext. and Int. Oblique, and Transversalis, Rectus, and Diaphragm.

THE RIBS

are 12 in number on each side. The first 7 are the *true ribs*, and are called *vertebro-*

sternal; the remaining 5 are *false* ribs. The first 3 are called *vertebro-costal;* the last 2 are connected only with the vertebræ, and are called *vertebral*, or floating, ribs.

Each rib presents 2 extremities and a shaft.

The vertebral extremity presents a head, neck, and tuberosity. The head is marked in the middle of the series by a kidney-shaped articular surface, divided by a ridge into 2 facets for artic. with the vertebræ.

The neck is flattened, and gives attachment to the ant. costo-transverse ligament, posteriorly to the mid. costo-trans. lig.

The tuberosity consists of an articular and non-articular portion. The articular portion art. with the transverse proc. of the lower of the 2 vertebræ to which the head is attached. The *non-art.* port. gives attachment to the post. costo-transverse ligaments.

The shaft gives attachment to the Ext. and Int. Intercostal muscles. It is marked by an *angle*, the point where the rib makes its thoracic turn. To this angle is attached the Sacro-lumbalis. If the rib is laid upon its lower border on a plane surface, the angle and sternal extremity will touch the surface, while the vertebral extremity will be tilted upward.

The shaft presents a groove for the intercostal vessels and nerve. At the sternal

extremity is an oval depression for the lodgment of costal cartilage.

The peculiar ribs are the

1st. Shortest. Surfaces horizontal; single artic. fac.; tubercle for scal. ant.; grooves for subclav. art. and v.; no angle; depression for scal. med.

2d. Angle slightly marked, and close to tuberosity; ridge for scal. post.; rough emin. for serrat. mag.

10th. Single art. fac., tub. and ang.

11th. Single art. fac. No tub.; angle.

12th. No tub. and no angle.

The ribs give attachment to 19 muscles on each side: Ext. and Int. Intercost., Scal. Ant., Med., and Post., Pect. Min., Serrat. Mag., Obliq. Ext., Transversalis, Quad. Lumb., Diaphragm, Latiss. Dorsi., Serrat. Post. Sup. and Inf., Sac. Lumb., Musc. Acc. ad. Sac. Lumb., Long. Dors., Cervic. Ascend., Levat. Cost.

The COSTAL CARTILAGES give attachment to 10 muscles: Subclav., Sterno-thyr., Pect. Maj., Int. Oblique, Transversalis, Rectus, Diaphragm, Triang. Stern., Int. and Ext. Intercostals.

THE EXTREMITIES

are 4 in number—2 upper and 2 lower.

THE UPPER EXTREMITY

is connected to the trunk by the *shoulder*,

which consists of the *clavicle* and the *scapula.*

THE CLAVICLE

articulates with the sternum, scapula, and cartilage of the first rib. It gives attachment to 6 muscles: ant. and internally to the Pect. Maj.; ant. and ext. to Deltoid; post. and int. to Sterno-cleido mast.; post. and ext. to Trapezius.; inf. to Subclavius and Sterno-hyoid.

It presents inf. and int. a rough impression for rhomboid lig., and ext. a tuberosity for conoid lig. and oblique line for trapezoid lig.

THE SCAPULA

presents 2 surfaces, 3 borders, and 3 angles.

The ant. surf., or venter, is filled by the Subscapularis muscle. The post. surf., or dorsum, is filled by the infraspinatus below the spine, and supraspinatus above the spine, and near the axillary border are attached the Teres Minor, and Major, and Lat. Dorsi. Projecting from the dorsum is the spine which gives attachment to the Trapezius and Deltoid. The superior border gives attachment to the Omo-hyoid; the vertebral border to the Serratus Magnus, Lev. Ang. Scap., Rhomb. Min. and Maj.; axillary border, Triceps, Teres Min. and Maj.; glenoid cavity, long head of the Biceps; coracoid process to the short head of the Biceps, Coraco-brachialis and Pectoralis

Minor; to the inf. ang., Lat. Dorsi (occasionally)—in all 17 muscles.

To the coracoid proc. is attached also the trapezoid ligament.

The transverse ligament closes the suprascapular notch into a foramen for the transmission of the suprascapular nerve.

THE HUMERUS

articulates with the scapula, ulna, and radius. It presents a shaft and 2 extremities.

The shaft is marked by a groove for musc. spir. n. and sup. prof. art., muscular surfaces and nutrient foramen.

The sup. extremity is marked by head, neck, and 2 tuberosities, greater and lesser. The inf. extremity is marked by trochlea for art. with ulna, ext. and int. condyles, olecranon depression behind, and coronoid and radial depressions in front.

It gives attachment to 24 muscles: To the greater tuberosity—Supraspin., Infraspin., and Teres Minor; to the lesser tuberosity—Subscapularis; to the anter. bicipital ridge—Pector. Maj.; to the post. bicip. ridge and groove—the Latiss. Dorsi and Teres Maj.; to the shaft—Deltoid, Coraco-brachialis, Brachialis Anticus, Ext. and Int. heads of the Triceps; to the intern. condyle—Pron. Rad. Ter., and Com. Tend. of Flex. Carp. Rad., Palm. Long., Flex. Sub. Dig., Flex. Carp. Uln.; to the ext. cond. ridge—Sup.

Long., Ext. Com. Dig., Ext. Min. Dig., Ext. Carp. Uln., Anconeus, and Sup. Brevis.

THE FORE-ARM is made up of the *ulna* and *radius*.

THE ULNA forms the elbow. The upper extremity presents the olecranon and coronoid processes, and the greater and lesser sigmoid cavities.

The shaft presents 3 borders and 3 surfaces, marked by muscular attachments.

The lower extremity presents the *head* for artic. with rad., and *styloid process*.

It articulates with the humerus and radius.

It gives attachment to 14 muscles: To the olecranon—Triceps, Anconeus, one head of the Flex. Carp. Uln.; to the coronoid process—Brach. Ant., Pron. Rad. Ter., Flex. Sub. Dig., Flex. Prof. Dig., and Flex. Long. Pollicis; to the shaft—Flex. Prof. Dig., Pronat. Quad., Flex. Carp. Uln., Ext. Carp. Uln., Anconeus, Sup. Brev., Ext. Os. Met. Pol., Ext. Sec. Internod. Pol., and Ext. Indicis.

THE RADIUS forms the chief part of the wrist.

The upper extremity presents a head, neck, and tuberosity. The shaft presents 3 surfaces and 3 borders, and an *oblique line*.

The lower extremity presents an articular surface for the ulna called the sigmoid cavity, and another for the carpus.

It articulates with 4 bones—humerus, ulna, scaphoid, and semilunar.

It gives attachment to 9 muscles: To the tuberosity—the Biceps; oblique line—Sup. Brev., Flex. Sub. Dig., Flex. Long. Poll.; to the shaft—anteriorly, Flex. Long. Poll., Pron. Quad.; posteriorly, Ext. Os. Met. Poll., Ext. Prim. Int. Poll.; externally, to Pron. Rad. Ter.; to styloid process—Sup. Long.

THE CARPUS

is made up of 8 bones, arranged in 2 rows. Those of the upper row from the radial to the ulna side are the scaphoid, semilunar, cuneiform, and pisiform; those of the lower row, in the same order, trapezium, trapezoid, magnum, and unciform.

The scaphoid gives attachment to ligaments, and articulates with 5 bones: rad. above, trapezium and trapezoid below, magnum and semilunar internally.

The semilunar gives attachment to ligaments, and articulates with 5 bones: rad. above, mag. and unc. below, scaph. and cun. on either side.

The cuneiform gives attachment to ligaments, and articulates with 3 bones: semilunar externally, pisiform in front, the unciform below, and with the inter. art. fib. cart. separating it from the ulna.

The pisiform bone gives attachment to 2 muscles—the Flex. Carp. Uln. and Abduct.

Min. Dig.; and 1 lig.—ant. annular.; and art. with 1 bone—the cuneiform.

The trapezium presents a groove for the tendon of flex. carp. rad. It art. with 4 bones: scaph. above, trapezoid and 2d metacarp. internally, and the 1st metacarp. below. It gives attachment to 3 muscles: Abduct. Poll., Flex. Os. Met. Poll., part of Flex. Brev. Poll., and 1 lig.—ant. annular.

The trapezoid gives attachment to ligaments, and part of the Flex. Brev. Poll. muscle. It art. with 4 bones: scaph. above, 2d metacarp. below, trapezium externally, and magnum internally.

The os magnum is the largest bone of the carpus; gives attachment to ligaments, and part of the Flex. Brev. Poll. It articulates with 7 bones: scaph. and semilun. above, 2d, 3d, and 4th metacarpal bones below, the trapezoid on the radial side, and the unciform on the ulnar side.

The unciform bone gives attachment to 2 muscles: Flex. Brev. Min. Dig., Flex. Oss. Met. Min. Dig., and to the ant. annul. lig. It articulates with 5 bones: semilunar above, 4th and 5th metacarpal below, the cun. internally, and the os mag. externally.

THE METACARPAL bones are 5 in number.

They articulate as follows:

1st with trapezium; 2d with trapezium, trapezoid, mag., and 3d metacarpal; 3d with mag. and 2d and 4th met.; 4th with

mag. unc., 3d and 5th met.; 5th with unc. and 4th met.

They give attachment to muscles as follows:

To met. bone of thumb, 3: Flex. Os. Met. Poll., Ext. Os. Met. Poll., and 1st Dors. Interosseous.

To 2d met. bone, 5: Flex. Carp. Rad., Ext. Carp. Rad. Long., 1st and 2d Dors. Inteross., and 1st Palm. Inteross.

To 3d met. bone, 5: Ext. Carp. Rad. Brev., Flex. Brev. Poll., Adduct. Poll., 2d and 3d Dors. Inteross.

To 4th met. bone, 3: 3d and 4th Dors. Inteross., and 2d Palm.

To 5th, 4: Ext. Carp. Uln., Flex. Carp. Uln., Flex. Os. Met. Min. Dig., and 4th Dors. Inteross.

THE PHALANGES

are 14 in number, 3 for each finger, and 2 for the thumb. They articulate with the metacarpal bones posteriorly.

The muscles are attached as follows:

To base of 1st phal. of thumb, 4: Ext. Prim. Int. Poll., Flex. Brev. Poll., Abduct., and Adduct. Poll.

To 2d phal. of thumb, 2: Flex. Long. Poll., and Ext. Sec. Int. Poll.

To base of 1st phal. of index finger: 1st Dors. and 1st Palm. Inteross.

To base of 1st phal. middle finger: 2d and 3d Dors. Inteross.

To ring finger: 4th Dors. and 2d Palm. Inteross.

To little finger: 3d Palm. Inteross., Flex. Brev. Min. Dig., and Abduct. Min. Dig.

To 2d phalanges of fingers: Flex. Sub. Dig., Ext. Com. Dig., Ext. Indicis, Ext. Min. Dig.

To 3d phalanges, 2: Flex. Prof. Dig., Ext. Com. Dig.

THE LOWER EXTREMITY

consists of the thigh, leg, and foot, connected together by

THE OS INNOMINATUM.

This is made up of 3 bones—ilium, ischium, and pubes.

The Ilium presents 2 surfaces, 2 borders, and a crest.

The external surface, or dorsum, is marked by 3 curved lines, superior, middle, and inferior, for the attachment of muscles.

The internal surface presents below the iliopectineal line, and anteriorly a large smooth concave surface—the venter.

The crest is convex, and terminates at each end in the ant. and post. sup. spin. proc. It has 2 lips, and an intermediate space for the attachment of muscles.

The ant. bord. is concave, and presents 2 eminences, separated by a notch—ant. sup., and ant. inf. spin. proc.

The post. bord., also, presents 2 projec-

tions—post. sup., and post. inf. spin. proc. Below the inf. is the great sacro-sciatic notch.

The ilium gives attachment to 14 muscles: To the outer lip of the crest—Tens. Vag. Fem., Ext. Obliq., and Lat. Dors.; between the lips—Intern. Obliq.; to the internal lip—Transvers., Quad. Lumb., and Erect. Spinæ; to the outer surface—Glut. Max., Med., and Min., reflected tend. of Rect., and part of Pyr.; to intern. surf.—Iliacus. The sacro-iliac ligaments are also attached to this bone.

The Ischium forms the inf. and post. part of the os innom. It has a body and a ramus. It presents a spine separating 2 notches—greater and lesser sacro-sciatic notches, converted into foramina by sacro-sciatic ligaments.

The *greater* transmits the pyriformis, gluteal vessels and nerve above this muscle, the sciatic and internal pudic vessels and nerve, and a nerve to the obturator internus, below it.

The *lesser* transmits the tendon of the obtur. int., the nerve supplying it and the pudic vessels and nerve as they pass back into the pelvis.

At the junction of the post. and inf. borders is the tuberosity, presenting an ext. and int. lip, and an intermediate space.

The ischium gives attachment to 13 muscles: To its outer surface—Obtur. Ext.; to

its inter. surf.—Obt. Int. and Lev. Ani; to spine—Gem. Sup., Lev. Ani, and Coccyg.; to tuberosity — Biceps, Semitend., Semimemb., Quad. Fem., Adduct. Mag., Gem. Inf., Transversus Perinæi, Erector Penis.

The sacro-sciatic ligaments are also attached.

The Pubes forms the art. part of os innom. It presents 2 rami—horizontal and perpendicular.

Above is seen the ilio-pectineal line, marking the junction with the ilium, terminating internally in a tubercle called the spine of the pubes.

Bet. the spine and inner extrem. is the crest. The junction of the crest with the symphysis is called the angle of the pubes.

It gives attachment to 15 muscles: Ext. and Int. Oblique, Rect., Transversalis, Pyramidalis, Psoas Parvus, Pect., Add. Long., Add. Brev., Grac., Obt. Ext. and Int., Lev. Ani, Comp. Ureth., and Accel. Urinæ.

In the articulated bones of the pelvis are seen the *acetabulum*, or *cotyloid cavity*, for articulation with the femur; the obturator, or thyroid foramen, transmitting through the membrane which fills it the obturator vessels and nerve.

THE PELVIS

is made up of 4 bones: 2 ossa innominata, sacrum, and coccyx, divided by the ilio-pectineal line into the *false* and *true* pelvis.

The false pelvis is that portion above the ilio-pectineal line.

The true pelvis is that below this line.

THE MEASUREMENTS OF THE PELVIS

are:

At the inlet: antero-posterior, or sacro-pubic, 4 inches; transverse, 5 inches; oblique, 5 inches.

The cavity of the pelvis: at the symphysis pubes, 1½ in. in depth; in the middle, 3½ in.; and posteriorly, 4½ in.

At the outlet: antero-posterior (from tip of coccyx to symphysis pubes), 4 in., but very variable; transverse bet. the 2 isch. tub., 4 in.

The axis of the inlet is directed downward and backward; of the outlet, downward and forward; of the cavity, curved like the sacrum.

In the female, the hips are more prominent, and the inlet and outlet are larger; the sacrum is less curved.

THE FEMUR

presents a shaft and 2 extremities.

The upper extremity has a head, neck, and greater and lesser trochanters, with an intertrochanteric line.

The shaft presents 3 borders and 3 surfaces.

The post. bord. is called the *linea aspera.*

It bifurcates below to inclose the popliteal space.

The lower extremity presents the internal and external condyles, and intercondyloid notch.

The femur artic. with 3 bones: os innominatum, tibia, and patella.

It gives attachment to 23 muscles: To the great trochanter, 8—Glut. Med., Glut. Min., Pyr., Obtur. Int., Obtur. Ext., Gem. Sup., Gem. Inf., and Quad. Fem.; to the lesser trochanter, 2—Psoas. Mag. and Iliacus; to the shaft, 10—posteriorly, Vastus Ext., Glut. Max., short head of the Biceps, Vast. Int., Adduct. Mag., Pectin., Adduct. Brev., and Adduct. Long.; anteriorly, Crureus and Subcrureus; to the condyles, 3—Gastrocnemius, Plantaris, and Popliteus.

The intercondyloid notch lodges the crucial ligaments.

THE LEG consists of 3 bones—patella, tibia, and fibula.

THE PATELLA

is a sesamoid bone, articulating with the condyles of the femur, and giving attachment to the Quadriceps Extensor (= Rect., Crur., Vast. Int. and Ext.) above, and ligamentum patellæ below.

THE TIBIA

is situated on the inner side of the leg.

The upper extremity presents a head with 2 tuberosities.

The shaft presents 3 surfaces and 3 borders.

The lower extremity presents the internal malleolus and grooves for the passage of Tib. Post., Flex. Long. Dig., and Flex. Long. Poll.

It art. with 3 bones—femur, fibula, and astragalus.

It gives attachment to 10 muscles: To the inner tuber.—Semimembran.; to the outer tuber.—Tib. Ant., and Ext. Long. Dig.; to the shaft—internally, Sart., Grac., and Semitend.; externally, Tib. Ant.; posteriorly, Poplit., Sol., Flex. Long. Dig., and Tib. Post.; to the tubercle—the ligamentum patellæ.

THE FIBULA

is situated on the outer side of the leg.

The sup. extrem. presents an art. fac. for tib. and styloid process.

The lower extrem. is called the external malleolus.

The shaft presents 3 surfaces and 3 borders.

It artic. with 2 bones—tibia and astragalus.

It gives attachment to 9 muscles: To the head—Biceps, Soleus, and Peron. Long.; to the shaft—anteriorly, Ext. Long. Dig., Peron. Tert., and Ext. Long. Poll.; inter-

nally, Sol., Tib. Post. and Flex. Long. Poll.; externally, Peron. Long., and Brev.

THE FOOT consists of the tarsus, metatarsus, and phalanges.

THE TARSUS

consists of 7 bones—calcaneum, astragalus, cuboid, scaphoid, internal, middle, and external cuneiform.

THE CALCANEUM

has 6 surfaces.

It articulates with 2 bones—astragalus and cuboid.

It gives attachment to 8 muscles: Part of Tib. Post., Tendo Achillis, Plantaris. Abductor Poll., Abduct. Min. Dig., Flex. Brev. Dig., Flex. Access., and Ext. Brev. Dig.

THE CUBOID

is marked by a groove on its under surface for the tendon of the Peroneus Longus.

It presents 6 surfaces.

It articulates with 4 bones—os calcis, ext. cun., 4th and 5th metatars.

It gives attachment to part of Flex. Brev. Poll.

THE ASTRAGALUS

has 6 surfaces.

It artic. with 4 bones—tibia, fibula, os calcis, and scaphoid.

It gives attachment to ligaments, but no muscles—transmitting, however, through a groove on its posterior surface, the tendon of the Flex. Long. Poll.

THE SCAPHOID

presents 6 surfaces.

It articulates with 4 bones—astrag. and 3 cun.

It gives attachment to part of the Tib. Post.

THE INTERNAL CUNEIFORM

presents 6 surfaces.

It articulates with 4 bones—scaph., mid. cun., 1 and 2 metatars.

It gives attachment to 2 muscles: Tib. Ant. and Post.

THE MIDDLE CUNEIFORM

presents 6 surfaces.

It articulates with 4 bones—scaph., int. and ext. cun., and 2d metatars.

It gives attachment to no muscles.

THE EXTERNAL CUNEIFORM

presents 6 surfaces.

It articulates with 6 bones—scaph., mid. cun., cub., 2, 3, and 4 metatars.

It gives attachment to part of Tib. Post. and Flex. Brev. Poll.

THE METATARSUS

is made up of 5 bones. They art. with the tarsus behind and phalanges in front. They give attachment to muscles as follows:

To 1st, 3: Part of Tib. Ant., Per. Long., and 1st Dors. Inteross.

To 2d, 3: Adduct. Poll., 1st and 2d Dors. Inteross.

To 3d, 4: Adduct. Poll., 2d and 3d Dors., and 1st Plant. Inteross.

To 4th, 4: Adduct. Poll., 3d and 4th Dors., and 2d Plant. Inteross.

To 5th, 5: Peron. Brev. and Tert., Flex. Brev. Min. Dig., 4th Dors., and 3d Plant. Inteross.

THE PHALANGES

are 14 in number.

They give attachment to muscles as follows:

To 1st *phalanges*—great toe: Inner tend. of Ext. Brev. Dig., Abduct. Poll., Adduct. Poll., Flex. Brev. Poll., Transversus Pedis.

Second toe: 1st and 2d Dors., Inteross.

Third toe: 3d Dors. and 1st Plant. Inteross.

Fourth toe: 4th Dors. and 2d Plant. Inteross.

Fifth toe: Flex. Brev. Min. Dig., Abduct. Min. Dig., and 3d Plant. Inteross.

To 2d *phalanges*—great toes: Ext. Long. Poll. and Flex. Long. Poll.

Other toes: Flex. Brev. Dig., one slip from Ext. Brev. Dig. (except in little toe), and Ext. Long. Dig.

To 3d *phalanges:* 2 slips from com. tend. of Ext. Long. Dig., and Ext. Brev. Dig., and Flex. Long. Dig.

THE LIGAMENTOUS SYSTEM

may be best explained in connection with the *joints*, or *articulations*, into the formation of which they enter.

THE ARTICULATIONS

may be divided into 3 classes: *Synarthrosis*, or immovable; *Amphiarthrosis*, or mixed; and *Diarthrosis*, or movable joints.

These may again be subdivided as follows:

Synarthrosis into the different forms of *Sutura*, *Schindylesis* or fissure articulation, *Gomphosis* or socket articulation.

Diarthrosis into *Arthrodia*, or gliding joints; *Enarthrosis*, or ball and socket joints; *Ginglymus*, or hinge joint; *Diarthrosis Rotatorius*, or *Lateral Ginglymus*, pivot joint.

THE TRUNK.

VERTEBRAL ARTICULATIONS.

The ligaments of the bodies of the vertebræ are 3 in number—*anterior common*, *posterior common*, and *intervertebral substance*.

The laminæ are connected by the *ligamenta subflava*.

The articular processes are connected by the *capsular* ligaments.

The spinous processes are connected by the *interspinous* and *supraspinous.*

The transverse processes are connected by the *intertransverse* ligaments.

The movements of the spinal column are—extension, flexion, rotation, circumduction, and lateral movement.

THE ATLO-AXOID ARTICULATION

has 6 ligaments—2 ant. atlo-axoid, post. atlo-axoid, transverse, and 2 capsular.

Action—rotation.

THE OCCIPITO-ATLOID

has 7 ligaments—2 ant. occip. atloid, 2 lat., 2 capsular, and 1 posterior.

Action—flexion, extension, and slight rotation.

THE OCCIPITO-AXOID

has 4—3 odontoid, and 1 occipito axoid.

Action—*check* ligaments to limit rotation of the cranium.

TEMPORO-MAXILLARY

has 4 ligaments—ext. and int. lateral, stylo-maxillary, and capsular; 1 interarticular fibro cartilage, and 2 synovial membranes.

Action—arthrodial, or gliding.

COSTO-VERTEBRAL

has 3 ligaments—ant. costo-vertebral or stellate, capsular, and interarticular.

COSTO-TRANSVERSE

—between neck and tubercle of the ribs, and the transverse processes of the vertebræ—4 ligaments, ant., mid., and post. costo-transverse, and capsular.

COSTO-STERNAL

has 3 ligaments—ant. and post. costo-sternal, and capsular.

THE STERNUM

is united by ant. and post. sternal ligaments.

THE VERTEBRO-PELVIC

has 2 proper ligaments—lumbo-sacral and lumbo-iliac.

PELVIC ARTICULATIONS.

Sacrum and Ilium—ant. and post. sacro-iliac ligaments.

Sacrum and Ischium—great or post. sacro-sciatic, and lesser or ant. sacro-sciatic ligaments.

Sacrum and Coccyx—ant. and post., sacro-coccygeal, and interarticular fibro-cartilage. Action limited—slightly forward and backward.

Pubes—ant., sup., post., and sub-pubic, and interart. fib. cart.

UPPER EXTREMITY.

STERNO-CLAVICULAR.

Ant. and post. sterno-clavicular, interclavicular, costo-clavicular (or rhomboid), and inter. art. fib. cart. Two synovial membranes are found in this joint.

Action—*arthrodial.*

SCAPULO-CLAVICULAR.

Sup. and inf. acromio-clavicular, coraco-clavicular (trapezoid and conoid), and int. art. fib. cart. Two synovial membranes.

Action—gliding and rotatory.

PROPER SCAPULAR LIGAMENTS.

Coraco-acromial and transverse.

SHOULDER JOINT.

Capsular, glenoid, and coraco-humeral, together with the long head of the biceps, which acts as a ligament.

It has a synovial membrane.

Action — forward, backward, abduction, adduction, circumduction, and rotation.

ELBOW JOINT.

Anterior and posterior, internal and external, lateral.

Extensive synovial membrane.

Action—ginglymoid, or hinge joint, limited to flexion and extension.

RADIO-ULNAR ARTICULATION.

Superior Articulation — orbicular ligament. Action—rotation of the head of the radius covered by synovial membrane in the orbicular ligament.

Middle Articulation—oblique and interosseous.

Inferior Articulation—ant. and post. radio-ulnar, and triangular inter. art. fib. cart., with synovial membrane; rotation of radius around head of ulna. Rotation forward is pronation, and backward supination.

WRIST JOINT.

External and internal lateral; anterior and posterior ligaments, and synovial membrane.

Action—enarthrodial—flexion, extension, abduction, adduction, and circumduction.

CARPUS.

First row—2 dorsal, 2 palmar, and 2 interosseous.

Second row—anterior or palmar, posterior or dorsal, ext. and int. lateral.

A common synovial membrane invests the bones of the carpus. Between the pi-

siform and cuneiform there exists a separate membrane.

CARPO-METACARPAL.

The metacarpal bone of the thumb articulates with the trapezium by a capsular ligament and synovial membrane.

The metacarpal bones of the fingers articulate with the carpus by dorsal, palmar, and interosseous ligaments, and a synovial membrane, which is a continuation of that between the carpal bones. There are thus 5 synovial membranes in the wrist.

The metacarpal bones articulate with each other by the dorsal and palmar interosseous ligaments, and the reflected synovial membrane.

METACARPO-PHALANGEAL ARTICULATION.

Anterior and 2 lateral ligaments. The posterior ligament is supplied by the extensor tendon.

Action—flex., ext., adduct., abduct., and circumduct.

PHALANGEAL ARTICULATION.

Anterior and 2 lateral. Posterior supplied by extensor tendon.

Action—flexion and extension.

LOWER EXTREMITY.

HIP JOINT.

Capsular attached to rim of acetabulum

and intertrochanteric line ant. and post., investing neck of femur.

Ilio-femoral or *y*-shaped ligament from ant. inf. spine of ilium to ant. int. trochant. line.

Ligamentum teres to cotyloid cavity and head of femur.

Cotyloid or cartilaginous to rim of acetabulum.

Transverse, crossing notch at lower part of acetabulum.

Extensive synovial membrane.

The muscles in relation to this joint are important. In front—Psoas and Iliacus, sep. from caps. lig. by synov. bursa; above—short head of Rectus and Glut. Min., the latter adherent to the capsule; internally—Obt. Ext. and Pect.; behind—Pyriformis, Gem. Sup. and Inf., Obt. Int. and Ext., and Quad. Fem.

Action—enarthrodial—flex., ext., adduct., abduct., circumduct., and rotation.

KNEE JOINT.

External Ligaments—anterior or ligamentum patellæ, posterior or ligamentum posticum Winslowii, internal lateral, 2 external lateral, and capsular.

Internal Ligaments—anterior or external crucial, posterior or internal crucial, 2 semilunar fibro cartilages, transverse, coronary, ligamentum mucosum, ligamenta alaria.

The synovial membrane is the largest in the body.

Action—flexion, extension, and slight rotation inward and outward.

TIBIO-FIBULAR ARTICULATION.

Superior—ant. and post. superior tibio-fibular and synovial membrane occasionally continuous with that of the knee joint.

Middle—interosseous membrane.

Inferior—inferior interosseous, anterior tibio-fibular, posterior inferior tibio-fibular, transverse.

The synovial membrane is derived from the ankle joint.

Action—gliding.

ANKLE JOINT.

Anterior or tibio-tarsal, internal and external lateral, synov. memb.

Action—flex. and extens.; no lat. motion.

TARSAL ARTICULATION.

First row—external and posterior calcaneo-astragaloid and interosseous.

Two synovial membranes.

Second row—dorsal, plantar, and 4 interosseous.

Two rows with each other—dorsal, superior and internal calcaneo-cuboid, plantar, long and short calcaneo-cuboid.

Four synovial membranes are found in the tarsus.

Action—arthrodial.

TARSO-METATARSAL.

Dorsal, plantar, and 3 interosseous.

Three synovial membranes.

METATARSAL BONES WITH EACH OTHER.

Dorsal, plantar, and interosseous.

Action—arthrodial.

METATARSO-PHALANGEAL.

Plantar and 2 lateral.

Action — flexion, extension, abduction, and adduction.

PHALANGEAL.

Similar to those of the hand.

THE MUSCULAR SYSTEM.

HEAD AND FACE.

CRANIAL REGION.

Occipito-frontalis — *Or.* outer two-thirds of sup. curved line of occiput and mast. port. of temp. *Ins.* internally continuous with pyram. nasi.; in the middle with corrug. supercilii and orb. palp., and externally continuous with orb. palp. over ext. ang. proc.; aponeurotic on the vertex.

AURICULAR REGION.

Attollens Aurem—*O.* apon. of occip. front. *I.* cranial surf. of pinna.

Attrahens Aurem—*O.* apon. of occip. front. *I.* front of helix.

Retrahens Aurem—*O.* mast. port. of temp. *I.* cran. surf. of concha.

PALPEBRAL REGION.

Orbicularis Palpebrarum — *O.* int. ang. proc. of front. bone; nas. proc. of sup. max.; tendo-palpebrarum. *I.* continuous with occip. front. and corrug. supercilii.

Corrugator Supercilii—*O.* inner extremity of superciliary ridge. *I.* under surf. of orbicularis.

Tensor Tarsi—*O.* lachrymal bone. *I.* tarsal cartilage near the *punctum lachrymale.*

ORBITAL REGION.

Levator Palpebræ Superioris—*O.* under surf. of lesser wing of sphenoid. *I.* upper border of sup. tars. cart.

Rectus Superior—*O.* upper margin of optic foramen, and fib. sheath of opt. nerve. *I.* sclerotic coat, 3 lines from marg. of cornea.

Rectus Inferior—*O.* common tendon with rect. int., called ligament of Zinn. *I.* sclerotic coat.

Rectus Internus—*O.* com. tend. with rect. inf. *I.* sclerotic coat.

Rectus Externus—*O.* by 2 heads, the upper from outer marg. of opt. for.; the lower from lig. of Zinn, and small pointed process on the lower margin of sphen. fiss.

Superior Oblique—*O.* inner marg. of opt. for. *I.* by a tendon playing round a cartilag. pulley at int. ang. proc. of front. bone, into sclerotic coat.

Inferior Oblique—*O.* orb. plate of sup. max. *I.* sclerotic coat at its outer part.

NASAL REGION.

Pyramidalis Nasi—*O.* continuous with occip. front.

Levator Labii Superioris Alæque Nasi—*O.* nas. proc. sup. max. *I.* by 2 slips, one

into cart. of ala of nose, the other blended with orb. and lev. labii proprius.

Dilatator Naris Posterior—*O.* nas. notch of sup. max. *I.* integument near nostril.

Dilatator Naris Anterior—*O.* cart. of ala. *I.* integument near its margin.

Compressor Nasi—*O.* above and external to incisive fossa. *I.* fibro-cart. of nose; continuous with opposite fellow.

Compressor Narium Minor—*O.* alar cart. *I.* integ. at end of nose.

Depressor Alæ Nasi—*O.* incisive fossa of sup. max. *I.* septum and back part of ala of nose.

SUPERIOR MAXILLARY REGION.

Levator Labii Superioris—*O.* above infra-orbital for. *I.* muscular substance of upper lip.

Levator Anguli Oris—*O.* canine fossa. *I.* angle of mouth.

Zygomaticus Major—*O.* malar bone. *I.* angle of mouth.

Zygomaticus Minor—*O.* malar bone. *I.* continuous with outer margin of lev. lab. sup.

INFERIOR MAXILLARY REGION.

Levator Labii Inferioris (levator menti)—*O.* incisive fossa. *I.* integuments of chin.

Depressor Labii Inferioris (quadratus menti)—*O.* ext. oblique line of lower jaw. *I.* integument of lower lip.

Depressor Anguli Oris (triangularis menti)—*O.* ext. oblique line of lower jaw. *I.* angle of mouth.

INTERMAXILLARY REGION.

Orbicularis Oris—Sphincter muscle developed in integuments about the mouth.

Buccinator—*O.* alveolar proc. of upper jaw and pterygo-max. lig. *I.* alv. proc. of lower jaw.

Risorius—*O.* fascia over masseter. *I.* angle of mouth.

TEMPORO-MAXILLARY REGION.

Masseter—*O.* malar proc. of sup. max. and zygoma. *I.* ext. surf. of ramus, and coronoid proc. of lower jaw.

Temporal—*O.* temporal fossa. *I.* coronoid proc. of lower jaw.

PTERYGO-MAXILLARY REGION.

Internal Pterygoid—*O.* pteryg. fossa and tub. of palate bone. *I.* lower and back part of inner surf. of ramus of lower jaw.

External Pterygoid—*O.* pteryg. ridge; outer surf. of pteryg. plate; tub. of pal. and sup. max. bones. *I.* in front of neck of condyle of lower jaw.

NECK.

SUPERFICIAL CERVICAL REGION.

Platysma Myoides—*O.* clavicle and acro-

mion. *I.* body of lower jaw below oblique line.

Sterno-cleido Mastoid—*O.* sternum and inner third of clavicle. *I.* mastoid proc. of temp. and sup. curved line of occip. bone.

INFRA-HYOID REGION.

Sterno-hyoid—*O.* sternum and clavicle. *I.* lower border of hyoid bone.

Sterno-thyroid—*O.* first bone of sternum. *I.* ala of thyroid cartilage.

Thyro-hyoid—*O.* side of thyroid cartilage. *I.* body and greater cornu of hyoid bone.

Omo-hyoid—*O.* upper border of scapula; tendinous in the center, and bound down by a process of cervical fascia to clavicle. *I.* lower border of hyoid bone.

SUPRA-HYOID REGION.

Digastric consists of 2 bellies—*O.* digastric groove in temp. bone; tendinous in center, piercing the stylo-hyoid and held to hyoid bone by an aponeurotic loop. *I.* close to symphysis of lower jaw on the inner and lower side.

Stylo-hyoid—*O.* styloid process; perforated by digastric. *I.* body of hyoid bone.

Mylo-hyoid—*O.* mylo-hyoid ridge. *I.* body of hyoid bone.

Genio-hyoid—*O.* inferior genial tubercle. *I.* body of hyoid bone.

LINGUAL REGION.

Genio Hyo-glossus—*O.* sup. genial tubercle; fan-shaped lower fibers passing to body of hyoid bone, and superior fibers to the tongue.

Hyo-glossus—*O.* side of body, greater and lesser cornu. *I.* side of tongue.

Lingualis—*O.* and *I.* under surface of the tongue.

Stylo-glossus—*O.* styloid process. *I.* side of tongue.

PHARYNGEAL REGION.

Inferior Constrictor—*O.* cricoid and thyroid cartilages. *I.* fibrous raphe in post. med. line of pharynx.

Middle Constrictor—*O.* gr. and less. cornu of hyoid bone and stylo-hyoid ligament. *I.* post. med. fibrous raphe.

Superior Constrictor—*O.* lower third of marg. of intern. pteryg. plate, and hamular process; palate bone and reflected tend. of Tens. Pal. muscle; pterygo-max. lig.; alv. proc. of inf. max.; and side of tongue. *I.* median raphe and pharyngeal spine on basilar process of occip. bone.

Stylo-pharyngeus—*O.* styloid process. *I.* constrictor muscle; post. bord. of thyroid cart.

PALATAL REGION.

Levator Palati—*O.* under surface of apex of petrous port. of temp. bone, and cart.

port. of Eustachian tube. *I.* post. surf. of soft palate blending with its fellow of the opposite side.

Tensor Palati—*O.* scaphoid fossa in sphen., and cart. port. of Eustachian tube. It winds around the hamular process. *I.* by a broad aponeurosis into the anterior surface of soft palate, uniting with that of the opposite muscle; the muscular fibers are attached to transverse ridge on palate bone.

Azygos Uvulæ—*O.* post. nas. spine of palate bone, and apon. of soft palate. *I.* into the uvula.

Palato-glossus (constrictor isthmi faucium)—*O.* ant. surf. of soft palate. *I.* side and dorsum of the tongue blending with opposite muscle and stylo-glossus. This muscle forms the ant. pillar of the soft palate.

Palato-pharyngeus—*O.* from soft palate by a fasciculus cut into two by the levator palati. *I.* post. bord. of thyroid cart. and side of pharynx; decussates with its fellow and joins stylo-pharyngeus. It forms the post. pillar of the soft palate.

ANTERIOR VERTEBRAL REGION.

Rectus Capitis Anticus Major—*O.* by 4 slips from ant. tubercles of trans. proc. of 3d, 4th, 5th, and 6th vertebræ. *I.* bas. proc. of occip. bone.

Rectus Capitis Anticus Minor—*O.* ant. surf. of lateral mass of atlas and root of transverse proc. *I.* bas. proc. of occip. bone.

Rectus Lateralis—*O.* upper. surf. of trans. proc. of atlas. *I.* jugular surf. of occip. bone.

Longus Colli consists of 3 portions—superior oblique, inferior oblique, and vertical.

1. Sup. Obl.—*O.* ant. tub. of trans. proc. of 3d, 4th, and 5th cerv. vert. *I.* tubercle on ant. arch of atlas.

2. Inf. Obl.—*O.* bodies of first 2 or 3 dorsal vert. *I.* trans. proc. of 5th and 6th.

3. Vert. part—*O.* and *I.* between the bodies of the lower 3 cerv. and upper 3 dors. vert. below, and bodies of 2d, 3d, and 4th cerv. vert. above.

LATERAL VERTEBRAL REGION.

Scalenus Anticus—*O.* tubercle on inner bord. and upper surf. of 1st rib. *I.* ant. tub. on trans. proc. of 3d, 4th, 5th, and 6th cerv. vert.

Scalenus Medius—*O.* upper surf. of 1st rib. *I.* post. tub. on trans. proc. of lower 6 cerv. vert.

Scalenus Posticus—*O.* out. surf. of 2d rib. *I.* post. tub. of trans. proc. of lower 2 or 3 cerv. vert.

THE TRUNK.

MUSCLES OF THE BACK.

Trapezius—*O.* sup. curved line of the occiput; ligamentum nuchæ; supraspinous

ligament; spin. proc. of 7th cerv. vert., and all the dorsal. *I.* sup. fibers—post. bord. of clav. its outer third; mid. fibers—acromion proc. and spine of scap. Inf. fibers, tubercle at the outer part of surf. of spine. Between the 2 Trapezii is found the *ligamentum nuchæ*, extending from the spin. proc. of 7th cerv. to ext. occip. protub.

Latissimus Dorsi—*O.* spinous processes of 6 inferior dorsal, those of the lumbar and sacral vertebræ, and supraspinous ligament; crest of ilium; 3 or 4 lower ribs. *I.* bicipital groove of the humerus.

Levator Anguli Scapulæ—*O.* by 4 slips from tubercles on transverse processes of 3 or 4 upper cervical vertebræ. *I.* post. bord. of scapula.

Rhomboideus Minor—*O.* lig. nuchæ and spin. proc. of 7th cerv., and 1st dors. *I.* triang. smooth surf. at root of spine of scap.

Rhomboideus Major—*O.* spin. proc. of 4 or 5 upper dors. vert. and sup. spin. lig. *I.* tend. arch and inf. ang. of scap.

Serratus Posticus Superior—*O.* lig. nuchæ and spin. proc. of last cerv., and 2 or 3 upper dors. vert. *I.* by 4 digit. into upper bord. of 2d, 3d, 4th, and 5th ribs.

Serratus Posticus Inferior—*O.* spin. proc. of last 2 dors. and upper lumbar vert., and interspin. lig. *I.* by 4 dig. into lower borders of 4 lower ribs.

Splenius—*O.* lig. nuchæ; spin. proc. of

last cerv. and 6 upper dors. vert., and supraspin. lig. The muscle divides into Splenius Capitis *I.* into mast. port. of temp. bone and rough surf. on occip. bone; Splenius Colli *I.* into post. tubercles of transverse proc. of 3 or 4 upper cerv. vert.

Erector Spinæ — *O.* sacro-iliac groove, spines of sacrum, spinous processes of lumbar, and 3 lower dorsal vert., and sup. spin. lig. Opposite last rib it divides into (1) Sacro-lumbalis *I.* into angles of 6 lower ribs; prolonged from these by *musculus accessorius ad sacro-lumbalem* to angles of 6 upper ribs; this is likewise continued upward from the angles of the 4 or 5 upper ribs, to be inserted into post. tubercles of trans. proc. of 4th, 5th, and 6th cerv. vert., and receives the name Cervicalis Ascendens. (2) Longissimus Dorsi *I.* into trans. and ant. proc. of lumbar vertebræ, all those of dorsal, and 7 to 11 ribs. This muscle is then continued up as *Transversalis Colli*, from trans. proc. of 3d, 4th, 5th, and 6th dors. vert. to the post. turb. of trans. proc. of 5 lower cerv.; and Trachelo-mastoid from trans. proc. of 3d, 4th, 5th, and 6th dors. vert., and art. proc. of 3 or 4 lower cerv. to post. marg. of mastoid proc. of temp. bone.

Spinalis Dorsi connects the spinous proc. of upper lumb. and dors. vert. together.

Spinalis Colli connects the spinous process of cerv. vert.

Complexus—*O.* from tips of trans. proc.

of upper 3 dors. and 7th cerv., and art. proc. of the 3 cerv. above this. *I.* bet. 2 curved lines on occipital bone.

Biventer Cervicis—*O.* trans. proc. of upper dors. vert. *I.* sup. curved line of occip. bone.

Semispinalis Dorsi connects the trans. proc. of lower dors. vert. from 10th to 6th with spin. proc. of upper 4 dors. and lower 2 cerv. vert.

Semispinalis Colli connects the trans. proc. of upper 4 dors. with the art. proc. of lower 4 cerv. and spin. proc. of cerv. from axis to 5th.

Multifidus Spinæ fills up the groove on each side of the spinous processes from the sacrum to the axis.

Rotatores Spinæ bet. trans. proc. and laminæ of dorsal vert.—11 on each side.

Supraspinales lie on spinous processes of cerv. region.

Interspinales lie in pairs between the spinous processes.

Extensor Coccygis—*O.* last bone of sacrum. *I.* lower part of coccyx.

Intertransversales are placed between transverse processes.

Rectus Capitis Posticus Major—*O.* spin. proc. of axis. *I.* inf. curved line of occip. bone.

Rectus Capitis Posticus Minor—*O.* tubercle on post. arch of atlas. *I.* rough surf. beneath inf. curved line.

Obliquus Inferior—*O.* apex of spin. proc. of axis. *I.* apex of trans. proc. of atlas.

Obliquus Superior—*O.* trans. proc. of atlas. *I.* bet. 2 curved lines of occip. bone.

ABDOMEN.

External Oblique—*O.* by 8 digit. from 8 inf. ribs. *I.* out. lip of crest of ilium, linea alba and Poupart's ligament. Contains ext. abdom. ring.

Internal Oblique—*O.* outer half of Poupart's ligament; middle lip of crest of ilium; and lumbar fascia. *I.* 4 lower ribs; linea alba; crest of pubes where it unites with the Transversalis to form conjoined tendon.

Transversalis—*O.* outer third of Poup. lig.; inner lip of crest of ilium, cartilages of the 6 lower ribs, spin. and trans. proc. of the lumbar vertebræ. *I.* by conjoined tendon in the pubes, and linea alba.

Rectus—*O.* by 2 tendons from pubes and fellow of opposite side. *I.* cart. of 5th, 6th, and 7th ribs.

Pyramidalis—*O.* pubes and ant. pub. lig. *I.* linea alba.

Quadratus Lumborum—*O.* ilio-lumbar ligament; crest of ilium. *I.* lower bord. of last rib; apices of trans. proc. of 3d, 4th, and 5th lumbar vert.

THORAX.

Intercostales Externi (11 in number)—*O.*

from outer lip of groove on lower bord. of each rib. *I.* upper bord. of lip below.

Intercostales Interni (11 in number)—*O.* inner lip of groove on lower bord. of each rib. *I.* upper bord. of rib below.

Infracostales—*O.* inner surf. of one rib. *I.* inner surf. of rib below.

Triangularis Sterni—*O.* side of sternum. *I.* cost. cart. of 2d, 3d, 4th, and 5th ribs.

Levatores Costarum (12 in number)—*O.* trans. proc. of dors. vert. *I.* rough surf. of rib below.

The Diaphragm arises from the back of the ensiform cartilage and from the inner surfaces of the 6 lower ribs; from the *ligamenta arcuata*, *externa* and *interna*, of which the internal one passes from the body to the trans. proc. of 1st lumb. vert., and the ext. one from same trans. proc. to last rib, the two crossing the Psoas and Quad. Lumb.

The *ligamentum arcuatum externum* is only the artificially isolated border of the fascia covering the Quad. Lumb., which is the ant. lamella of the fascia lumborum derived from the post. tendon of the Transversalis.

The *ligamentum arcuatum internum* is formed by the posterior tendinous border of the diaphragm.

The *crura* arise from the front of the bodies of the upper lumbar vertebræ; the right crus is the larger, and reaches as low

as the 3d vert. and intervert. substance, while the left only reaches the 2d lumb. vert.

All the fibers of the diaphragm are inserted into the central cordiform or trefoil tendon, but the crura decussate with one another and form a figure of 8 before they pass into the tendon.

Openings—1. *Aortic*, in the loops formed by the crura, transmitting the aorta, vena azygos major, and thoracic duct. 2. Esophageal, in the loops formed by the crura, transmitting esophagus, and 2 pneumogastric nerves. 3. Opening for *vena cava*, quadrilateral, in right division of the cordiform tendon; transmitting only the *vena cava inferior*.

The *right crus* transmits the sympathetic and greater and lesser splanchnic nerves of the right side; the left crus the greater and lesser splanchnic of the left side and vena azygos minor.

Four serous membranes are connected with the diaphragm—pleura on each side, pericardium, and peritoneum.

In forced expiration the diaphragm attains its highest point at the level of the 4th rib on the right side, and the 5th on the left. In forced inspiration it descends 2 inches.

UPPER EXTREMITY.

ANTERIOR THORACIC REGION.

Pectoralis Major—*O.* ant. surf. of sternal

half of clavicle; sternum down to 6th or 7th rib; cartilages of all the true ribs; apon. of ext. oblique. *I.* ant. bicip. ridge of humerus.

The *costo-coracoid* membrane in relation with this muscle is pierced by the cephalic vein, thoracico-acromialis artery and vein, superior thoracic artery, and anterior thoracic nerve.

Pectoralis Minor—*O.* 3d, 4th, and 5th ribs and apon. covering intercostals. *I.* coracoid proc. of scapula.

Subclavius—*O.* cart. of 1st rib. *I.* under surf. of middle 3d of clavicle.

LATERAL THORACIC REGION.

Serratus Magnus—*O.* by 9 digit. from 8 upper ribs (2d having 2); apon. over intercost. spaces. *I.* post. bord. of scapula.

ACROMIAL REGION.

Deltoid—*O.* ant. bord. and upper surf. of clav.; outer marg. and upper surf. of acromion proc., and lower bord. of spine of scapula. *I.* outer side of shaft of humerus.

ANTERIOR SCAPULAR REGION.

Subscapularis—*O.* subscapular fossa. *I.* lesser tuberosity of humerus.

POSTERIOR SCAPULAR REGION.

Supraspinatus—*O.* supraspinous fossa. *I.*

highest facet on greater tuberosity of humerus.

Infraspinatus—*O.* infraspinous fossa. *I.* middle facet on greater tuberosity.

Teres Minor—*O.* axillary bord. of scapula. *I.* lowest facet on great tuberosity of humerus.

Teres Major—*O.* inf. ang. of scapula. *I.* post. bicip. ridge of humerus.

ANTERIOR HUMERAL REGION.

Coraco-brachialis—*O.* coracoid proc. of scapula. *I.* inner side of shaft of humerus.

Biceps—*O.* by 2 heads: long head from sup. bord. of glenoid cavity; short head from coracoid proc. *I.* tuberosity of radius.

Brachialis Anticus—*O.* shaft of humerus by 2 heads; intermuscular septa. *I.* coronoid process of ulna.

POSTERIOR HUMERAL REGION.

Triceps—*O.* by 3 heads: (1) inf. marg. of glenoid cavity; (2) ext. and post. bord. of humerus; (3) int. and post. bord. of humerus. *I.* olecranon process of ulna.

Subanconeus—*O.* humerus below olecranon fossa. *I.* post. lig. of elbow joint.

MUSCLES OF FORE-ARM AND HAND.

Palmaris Brevis (between the skin and the palmar fascia)—*O.* annular ligament

and palmar fascia. *I.* integuments on inner side of palm.

Pronator Radii Teres—*O.* ant. part of int. condyle; fascia of fore-arm; intermuscular septa; small slip, separated from the larger head by the median nerve, from coronoid process of ulna. *I.* outer and back part of radius, about its center.

Flexor Carpi Radialis—*O.* int. condyle and intermuscular septa. *I.* base of metacarpal bone of index finger.

Palmaris Longus—*O.* int. condyle and fascia of fore-arm. *I.* annular ligament and palmar aponeurosis, near root of thumb.

Flexor Carpi Ulnaris—*O.* int. condyle; inner side of olecranon; an aponeur. between these points, under which passes the ulnar nerve; inner edge of nearly whole length of ulna, and fascia of fore-arm. *I.* os pisiform and base of 5th metacarpal bone.

Flexor Digitorum Sublimis (*perforatus*)—*O.* inner condyle, int. lat. lig., coronoid process, and radius below tubercle. *I.* anterior part of 2d phalanx of each finger.

Flexor Digitorum Profundus (*perforans*)—*O.* upper three-fourths of ant. surf. of ulna by 2 heads, which embrace the insertion of the brachialis anticus; internal half of interosseous ligament. *I.* last phalanx of each finger.

Flexor Longus Pollicis—*O.* fore part of

radius below the tubercle, from interosseous membrane to within 2 inches of carpus, and from coronoid process. *I.* last phalanx of thumb.

Pronator Quadratus—*O.* inferior fifth of anterior surface of ulna. *I.* ant. part of inf. fourth of radius.

Supinator Radii Longus—*O.* external ridge of humerus to within 2 inches of outer condyle, and from intermuscular ligament. *I.* styloid process of radius.

Extensor Carpi Radialis Longior—*O.* ridge of humerus, between supinator longus and external condyle. *I.* back part of the carpal extremity of metacarpal bone of index finger.

Extensor Carpi Radialis Brevior—*O.* inferior and posterior part of external condyle, and ext. lat. lig. *I.* carpal extremity of 3d metacarpal bone.

Extensor Digitorum Communis—*O.* ext. condyle, fascia of fore-arm, and intermuscular septa. *I.* posterior aspect of all the phalanges of 4 fingers.

Extensor Carpi Ulnaris—*O.* ext. condyle, fascia, and septa, and middle third of ulna. *I.* carpal end of 5th metacarpal bone.

Anconeus—*O.* posterior and inferior part of ext. condyle and lat. ligament. *I.* ext. surf. of olecranon, and sup. fifth of post. surf. of ulna.

Extensor Minimi Digiti—*O.* ext. condyle. *I.* posterior part of phalanges of little finger.

Supinator Radii Brevis—*O.* ext. condyle, ext., lat., and coronary ligaments, and from a ridge on outer side of ulna, below lesser sigmoid cavity. *I.* upper third of ext. and ant. surf. of radius, from above its tubercle to the insertion of pronator radii teres.

Extensor Ossis Metacarpi Pollicis—*O.* middle of post. part of ulna, interosseous ligament, and post. surf. of radius. *I.* base of metacarpal bone of thumb.

Extensor Primi Internodii Pollicis—*O.* interosseous ligament, radius, and occasionally a small portion of the ulna. *I.* base of 1st phalanx.

Extensor Secundi Internodii Pollicis—*O.* post. surf. of ulna, above its center and from interosseous ligament. *I.* base of last phalanx.

Extensor Indicis—*O.* middle of post. surf. of ulna, and interosseous ligament. *I.* 2d and 3d phalanges, uniting with the tendon of the common extensor.

Abductor Pollicis—*O.* ant. surf. of annular ligament and scaphoid bone. *I.* outside of base of 1st phalanx, and by an expansion into both phalanges.

Opponens Pollicis—*O.* annular ligament and trapezium. *I.* ant. extremity of metacarpal bone of thumb.

Flexor Brevis Pollicis—*O. external head*, from inside of annular ligament and trapezium and sheath of the flexor carpi radialis. *I.* ext. sesamoid bone and base of 1st pha-

lanx of thumb. *Internal head*—*O.* from trapezoid, magnum, and base of metacarpal bone of middle finger. *I.* int. sesamoid bone and base of 1st phalanx.

Adductor Pollicis—*O.* three-fourths of anterior surface of the 3d metacarpal bone. *I.* inner side of base of 1st phalanx of thumb.

Abductor Indicis—*O.* metacarpal bone of fore finger and one-half of that of the thumb. *I.* outer side of base of 1st phalanx. The radial artery passes between its 2 heads.

Lumbricales—*O.* outer side of the tendons of flexor profundus, near the carpus, a little beyond annular ligament. *I.* middle of 1st phalanx into tendinous expansion covering the back of each finger.

Abductor Minimi Digiti—*O.* annular ligament and pisiform bone. *I.* ulna side of 1st phalanx.

Flexor Brevis Minimi Digiti—*O.* annular ligament and unciform bone. *I.* base of 1st phalanx of little finger.

Abductor Minimi Digiti—*O.* int. to last, and overlapped by it. *I.* all the metacarpal bones of little finger.

Interossei Palmares (3 in number)—*O.* sides of metacarpal bones. *I.* 1st phalanges and tendinous expansion covering the dorsum of each finger.

Interossei Dorsales (4 in number)—*O.* opposed sides of 2 metacarpal bones. *I.* base of 1st phalanx of each finger and posterior tendinous expansion.

The palmar interossei are adductors, the dorsal interossei are abductors.

ILIAC REGION.

Psoas Magnus—*O.* last dorsal and all the lumbar vertebræ. *I.* lesser trochanter of femur.

Psoas Parvus—*O.* last dors. and 1st lumb. vert. *I.* ilio-pectineal eminence.

Iliacus—*O.* iliac fossa, ilio-lumb. lig. and base of sacrum; capsule of hip joint. *I.* tendon of Psoas, and oblique line bet. lesser trochanter and linea aspera.

ANTERIOR FEMORAL REGION.

Tensor Vaginæ Femoris—*O.* ant. part of outer lip of crest of ilium, and *I.* fascia lata one-fourth down the thigh.

Sartorius—*O.* ant. sup. spin. proc. of ilium. *I.* upper part of inner surf. of shaft of tibia.

Quadriceps Extensor.

1. *Rectus*—*O.* by 2 tendons, ant. infer. spin. proc. of ilium and brim of acetabulum. *I.* patella.

2. *Vastus Externus*—*O.* outer lip of linea aspera throughout. *I.* patella.

3. *Vastus Internus*—*O.* inner lip of linea aspera. *I.* patella.

4. *Crureus*—*O.* and *I.* same as last muscle.

Subcrureus—*O.* ant. surf. of lower part

of shaft of femur. *I.* upper part of synovial pouch.

INTERNAL FEMORAL REGION.

Gracilis—*O.* ramus of pubes and ischium. *I.* upper part of inner surf. of shaft of tibia.

Pectineus—*O.* ilio-pectineal line. *I.* line leading from lesser trochanter to linea aspera.

Adductor Longus—*O.* front of pubes. *I.* middle third of linea aspera.

Adductor Brevis—*O.* descending ramus of pubes. *I.* upper part of linea aspera.

Adductor Magnus—*O.* ramus of pubes and ischium. *I.* linea aspera. This muscle has 4 openings—3 for perforating arteries, and 1 for profunda.

GLUTEAL REGION.

Gluteus Maximus—*O.* sup. curved line of ilium; sacrum and coccyx; sacro-sciatic and sacro-iliac ligaments. *I.* fascia lata and rough line between great trochanter and linea aspera.

Gluteus Medius—*O.* bet. sup. and mid. curved lines of ilium. *I.* post. surf. of great trochanter.

Gluteus Minimus—*O.* bet. mid. and inf. curved lines. *I.* ant. surf. of great trochanter.

Pyriformis—*O.* front of sacrum; margin of great sacro-sciatic foramen; great sacro-

sciatic ligament. *I.* upper border of great trochanter.

Obturator Internus—*O.* inner side of obturator foramen and obturator membrane. Leaves the pelvis by lesser sacro-sciatic foramen, and receives the gemelli *I.* upper border of great trochanter.

Gemellus Superior—*O.* spine of ischium. *I.* upper border of great trochanter.

Gemellus Inferior—*O.* tuberos. of ischium. *I.* upper border of great trochanter.

Quadratus Femoris—*O.* tuberos. of ischium. *I.* post. surf. of great trochanter.

Obturator Externus—*O.* margin of obturator foramen and membrane. *I.* digital fossa of femur.

POSTERIOR FEMORAL REGION.

Biceps—*O.* by 2 heads: (1) from tuberos. of ischium, (2) from outer lip of linea aspera. *I.* outer side of head of fibula, forming the outer hamstring.

Semitendinosus—*O.* from tuberos. of ischium. *I.* upper part of inner surf. of shaft of tibia.

Semimembranosus—*O.* tuberos. of ischium. *I.* inner tuberos. of tibia.

ANTERIOR TIBIO-FIBULAR REGION.

Tibialis Anticus—*O.* outer tuberos. and upper two-thirds of the ext. surf. of shaft of tibia; inteross. membrane; deep fascia;

intermuscular septum. Passes through the innermost compartment of ant. annular ligament, and *I.* into inner and under surf. of int. cuneiform and base of metatarsal bone of great toe.

Extensor Proprius Pollicis—*O.* ant. surf. of fibula and inteross. memb. *I.* base of last phalanx of great toe.

Extensor Longus Digitorum—*O.* outer tuberos. of tibia; upper three-fourths of ant. surf. of shaft of fibula; inteross. memb.; deep fascia and intermuscular septa; terminates in 3 tendons. *I.* 2d and 3d phalanges of 4 lesser toes—the innermost tendon divides into 2.

Peroneus Tertius—*O.* ant. surf. of lower third of fibula. *I.* base of 5th metatarsal bone.

POSTERIOR TIBIO-FIBULAR REGION.

Gastrocnemius—*O.* by 2 heads from ext. and int. condyles of femur. *I.* unites with Soleus to form Tendo Achillis.

Soleus—*O.* back part of head of fibula and post. surf. of shaft; oblique line of tibia. *I.* forms with Gastrocnemius *Tendo Achillis*, which is inserted in post. tuberosity of os calcis.

Popliteus—*O.* depression on outer side of ext. condyle of femur and post. lig. *I.* post. surf. of shaft of tibia.

Flexor Longus Pollicis—*O.* lower two-

thirds of int. shaft of fibula. *I.* last phalanx of great toe.

Flexor Longus Digitorum (perforans)—*O.* post. surf. of shaft of tibia. *I.* last phalanges of 4 lesser toes; passing through the tendons of Flex. Brev. Dig.

Tibialis Posticus—*O.* inteross. membrane; post. surf. of tibia; upper two-thirds of shaft of fibula. *I.* scaphoid and int. cuneiform bones.

FIBULAR REGION.

Peroneus Longus—*O.* upper two-thirds of outer surface of fibula, small portion of tuberosity of tibia, fascia of leg, and intermuscular septa. *I.* tendon passes through a groove in cuboid bone obliquely across the sole of the foot, to become attached to the tarsal end of metatarsal bone of great toe.

Peroneus Brevis—*O.* outer and back part of lower half of fibula and intermuscular septa. *I.* base of metatarsal bone of little toe.

DORSAL REGION OF FOOT.

Extensor Brevis Digitorum—*O.* outer side of os calcis astragalo-calcanean ligament, horizont. port. of ant. annular ligament. Terminates in 4 tendons. *I.* the innermost tendon in 1st phalanx of great toe; the other 3 in the outer sides of the long extensor of 2d, 3d, and 4th toes.

PLANTAR REGION OF FOOT.

First Layer.

Abductor Pollicis—*O.* lower and inner part of os calcis, internal annular ligament, plantar aponeurosis, and internal intermuscular septum. *I.* internal side of base of 1st phalanx of great toe; there is a sesamoid bone in the tendon.

Flexor Digitorum Brevis (perforatus)—*O.* inferior and internal part of os calcis, plantar aponeurosis, and intermuscular septa. *I.* 2d phalanges of 4 lesser toes.

Abductor Minimi Digiti—*O.* outer side of os calcis, ligament extending from os calcis to outer side of 5th metatarsal bone, plantar fascia, external intermuscular septum, and base of 5th metatarsal bone. *I.* outer side of base of 1st phalanx of little toe.

Second Layer.

Musculus Accessorius—*O.* inferior and internal part of os calcis. *I.* outer part of tendon of Flexor Digitorum Longus.

Lumbricales—*O.* tendons of Flexor Digitorum Longus. *I.* internal side of 1st phalanges of 4 lesser toes. Between the Flexor Brevis and Flexor Accessorius lie the external plantar vessels and nerve.

Third Layer.

Flexor Pollicis Brevis—*O.* by a pointed process from inner border of cuboid and

from external cuneiform bone. *I.* by 2 divisions into outer and inner border of base of 1st phalanx of great toe; the tendons contain sesamoid bones.

Adductor Pollicis—*O.* cuboid, base of 3d and 4th metatarsal bones, and sheath of Peroneus Longus. *I.* base of 1st phalanx of great toe.

Transversus Pedis—A narrow fasciculus stretched beneath the digital extremities of the metatarsal bones.

Flexor Brevis Minimi Digiti—*O.* 5th metatarsal bones and sheath of tendon of Peroneus Longus. *I.* inner side of base of 1st phalanx of little toe.

Fourth Layer.

Seven interossei muscles. Three on sole of foot, and 4 upon its dorsum.

Inferior or plantar.

1st—*O.* inner side of 3d metatarsal bone. *I.* base of 1st phalanx of the same toe.

2d—*O.* inner side of 4th metatarsal bone. *I.* inner side of 1st phalanx of the same toe.

3d—*O.* 5th metatarsal bone. *I.* inner side of base of 1st phalanx of little toe.

Superiores, vel dorsales; they arise by 2 heads from the contiguous surfaces of the metatarsal bones.

1st—*O.* internal side of 2d metatarsal bone and outer side of 1st. *I.* inner side of base of 1st phalanx of 2d toe.

2d—*O.* opposite side of 2d and 3d meta-

tarsal bones. *I.* outer side of 1st phalanx of 2d toe.

3d—*O.* opposite side of 3d and 4th metatarsal bones. *I.* outer side of 1st phalanx of middle toe.

4th—*O.* opposite sides of the 4th and 5th metatarsal bones. *I.* outer side of the 1st phalanx of 4th toe.

THE VASCULAR SYSTEM.

THE ARTERIES

are composed of 3 coats: (1) Internal or Serous; (2) Middle or Fibrous; (3) External or Cellular. They may all be traced through their several trunks back to

THE AORTA,

which commences at the left ventricle of the heart, and after ascending about 2 inches arches backward to the left side, and then descends within the thorax.

The ascending portion of the arch is about 2 in. long, and is in relation *in front* with pulmonary artery, right auric. appendix, pericardium, and remains of thymus gland; *on the right* with sup. cava and right auricle; *on the left* with pulmonary artery; and *behind* with right pulmonary vessels and root of right lung. This portion gives off the *right* and *left coronary* arteries.

The transverse portion begins at the upper bord. of 2d costo-sternal articulation of the right side in front, passes from right to left, and from before backward, to the left side of 2d dors. vert. behind. Its upper bord. is about 1 in. below the upper marg. of sternum.

Relations—*above*, left innom. vein, art. innom., left carot., left subclav. art.; *in front*, left pleura and lung, left pneumogast. nerve, left phrenic nerve, cordiac nerves; *behind*, trachea, cardiac plexus, esophagus, thoracic duct, left recurrent nerve; *below*, bifurcation of pulm. art., remains of ductus arterios., left recurrent nerve, left bronchus.

Branches—innominate, left carotid, and left subclavian.

Descending portion inclines downward on left side of body of 4th dors. vert., at the lower bord. of which it becomes thoracic.

Relations—*in front*, pleura and root of left lung; *right side*, esophagus and thoracic duct; *left side*, pleura; *behind*, left side of body of 4th dors. vert.

Branches—none.

Arteria Innominata,

or transverse port. of arch.

Relations—*in front*, sternum, sterno-hyoid, and sterno-thyroid, remains of thymus gland, left innominate and inf. thyr. veins, inf. cerv. card. br. from right pneumogastric; *right side*, right vena innominata, right pneumogastric, pleura; *left side*, remains of thymus gland and left carotid; *behind*, trachea.

Branches—common carotid and subclavian of right side.

COMMON CAROTID ARTERIES*

divide opposite the upper border of the thyroid cartilage into

1. External.
2. Internal.

THE EXTERNAL CAROTID

sends off 10 branches—viz.:

1. *Superior thyroid* sends off—1st, hyoidean branch; 2d, superficial branch; 3d laryngeal branch; and 4th, thyroidean branch.
2. *Lingual* sends off—1st, hyoidean branch; 2d, dorsalis linguæ; 3d, sublingual; and 4th, the ranine.
3. *Facial* sends off—1st, inferior palatine; 2d, tonsillar; 3d, glandular; 4th, submental; 5th, inferior labial; 6th, inferior coronary; 7th, masseteric; 8th, superior coronary; 9th, lateral nasal; and 10th, angular, anastomosing with the ophthalmic.
4. *Muscular.*
5. *Occipital* gives off princeps cervicis, inferior meningeal, and terminal branches, of which one enters the mastoid foramen; the others ramify in the scalp.
6. *Posterior auricular* gives off muscular, glandular, and stylo-mastoid.
7. *Ascending pharyngeal* gives off pharyngeal and meningeal branches.
8. *Transverse facial.*
9. *Superficial temporal* gives off—1st, an-

*The relation of these and several other large arteries will be given in REGIONAL ANATOMY.

terior auricular; 2d, capsular branches; 3d, middle temporal; 4th, posterior temporal; and 5th, anterior temporal.

10. *Internal maxillary* gives off—1st, tympanic, which enters the Glaserian fissure; 2d, meningea media, which enters the foramen spinosum; 3d, meningea parva; 4th, inferior maxillary or dental, which enters the dental canal; 5th, deep temporal; 6th, pterygoid; 7th, masseteric; 8th, buccal; 9th, alveolar; 10th, infraorbital; 11th, descending palatine; 12th, vidian; 13th, pterygo-palatine; 14th, spheno-palatine.

THE INTERNAL CAROTID

supplies no vessels in the neck, but, in its passage through the petrous portion of the temporal bone, gives off—

1. *The tympanic.*

2. *The arteriæ receptaculi*, or vessels to the cavernous sinus.

3. *The anterior meningeal.*

Opposite the anterior clinoid process it divides into—

4. *Ophthalmic artery* sends off—1st, lachrymal; 2d, centralis retinæ; 3d, supraorbital; 4th, ciliary branches (= ant., short, and long); 5th, muscular; 6th, posterior ethmoidal; 7th, anterior ethmoidal; 8th, palpebral; 9th, nasal; and 10th, frontal.

5. *Anterior cerebral* sends off—1st, the anterior communicans; 2d, the arteria corporis callosi.

6. *Middle cerebral.*
7. *Posterior communicans.*
8. *Anterior choroid.*

The anterior cerebral arteries are united by the anterior communicans, the posterior communicans passes back to join the posterior cerebral (a branch of the basilar), and in this manner is formed an arterial circle, called the Circle of Willis.

THE SUBCLAVIAN ARTERY

is divided into 3 portions: 1st, on the *right* side it extends from the arteria innominata to the inside of the scalenus anticus; 2d, the second portion lies *under* the scalenus anticus; 3d, the third portion extends from the scalenus anticus to the lower border of the 1st rib. On the *left* side, the left subclavian extends from the arch of the aorta to the inside of the scalenus anticus muscle; 2d, the second portion of the left subclavian, like that of the right side, lies *under* the scalenus anticus; 3d, the third portion of the left subclavian, also like that of the right, extends from the scalenus anticus to the lower border of the 1st rib. The *third* portion is usually ligated.

1. *Vertebral* gives off—1st, the arteriæ medullæ spinalis transversæ; 2d, the meningeal; 3d, the inferior cerebellar; 4th, anterior spinal; 5th, posterior spinal; 6th, muscular. The basilar artery, formed by the union of the 2 vertebral, gives off—

Transverse.
Anterior cerebellar.
Superior cerebellar.
Posterior cerebral.

The anastomosis, between the branches of the internal carotid and vertebral arteries, constitutes the *Circle of Willis.* It is formed in front by the anterior cerebral and anterior communicating; on each side by the trunk of the internal carotid, and the posterior communicating; behind by the posterior cerebral and point of the basilar.

2. *Thyroid axis* divides into—1st, inferior thyroid gives off laryngeal, tracheal, and esophageal branches, and cervicalis ascendens; 2d, suprascapular gives off a supra-acromial branch, and then passes into the supraspinous fossa of the scapula over the notch; 3d, transversalis colli gives off a superficial cervical branch, and terminates in the posterior scapular.

3. *Internal mammary* gives off—1st, comes nervi phrenici; 2d, mediastinal; 3d, pericardiac; 4th, sternal; 5th, anterior intercostal; 6th, perforating; 7th, musculophrenic; 8th, superior epigastric.

4. *Superior intercostal* gives off deep cervical and muscular.

THE AXILLARY ARTERY*

extends from first rib to the lower border

*See axillary space.

of the tendon of the latissimus dorsi, and sends off 7 branches:

1st Part. { *Superior thoracic.* / *Acromial thoracic.*
2d Part. { *Thoracica longa.* / *Thoracica alaris.*
3d Part. { *Subscapular.* / *Anterior circumflex.* / *Posterior circumflex.*

THE BRACHIAL ARTERY

extends from the lower border of the tendon of the latissimus dorsi to a finger's breadth below the bend of the elbow, and sends off 5 branches.

1. *Profunda superior* sends off—1st, an ascending branch; and 2d, the musculo-spiral branch. It accompanies the musculo-spiral nerve.
2. *Nutrient.*
3. *Profunda inferior* accompanies the ulnar nerve.
4. *Anastomotica magna.*
5. *Muscular.*

THE RADIAL ARTERY

sends off 12 branches:

1. *Recurrent radial.* It anastomoses with the profunda superior.
2. *Muscular.*
3. *Superficialis volæ*, anastomoses with the ulnar to form the superficial palmar arch.
4. *Anterior carpal.*

5. *Posterior carpal.*
6. *Metacarpal.*
7. *Dorsalis pollicis.*
8. *Dorsalis indicis.*
9. *Princeps pollicis.*
10. *Radialis indicis.*
11. *Perforating.*
12. *Interosseous.*

THE ULNAR ARTERY

sends off 8 branches:

1. *Anterior recurrent.*
2. *Posterior recurrent.*
3. *Interosseous* sends off the anterior interosseous and posterior interosseous.
4. *Muscular.*
5. *Anterior carpal.*
6. *Posterior carpal.*
7. *Arteria communicans.*
8. *Palmaris superficialis*, anastomoses with the superficialis volæ to form the superficial palmar arch. A long branch comes off from the ulnar or interosseous, called the comes nervi mediani; it is of uncertain size.

PALMAR ARCHES.

The deep palmar arch is formed by the palmaris profunda of the radial, uniting with the arteria communicans from the ulnar; it sends off 5 small branches to supply the interossei muscles.

The superficial palmar arch is formed by

the arteria palmaris of the ulnar, uniting with the superficialis volæ from the radial. It sends off 4 branches:

1. *Branches to ulnar edge of little finger.*
2. *Branch to cleft between little and ring fingers.*
3. *Branch to cleft between ring and middle fingers.*
4. *Branch to cleft between middle and index fingers.*

THE THORACIC AORTA

sends off 5 sets of branches:

1. *Pericardiac.*
2. *Mediastinal.*
3. *Bronchial.*
4. *Esophageal.*
5. *Intercostals:* each divides into—1st, the posterior branches; and 2d, the anterior branches.

ABDOMINAL AORTA.

Relations: In front—lesser omentum and stomach; branches of cœliac axis and solar plexus; splenic vein; pancreas; left renal vein; transverse duodenum; mesentery; aortic plexus. *Right side*—right crus of diaphragm; inferior vena cava; vena azygos; thoracic duct; right semilunar ganglion. *Left side*—sympathetic nerve; left semilunar ganglion. *Behind*—left lumbar veins; receptaculum chyli; thoracic duct; vertebral column.

Branches—9:

1. *Phrenic.*
2. *Cœliac axis.*
   - *Gastric.*
   - *Hepatic.*
     - *Pyloric.*
     - *Gastro-duodenalis.*
       - *Gastro-epiploica dextra.*
       - *Pancreatico-duodenalis.*
     - *Cystic.*
   - *Splenic.*
     - *Pancreaticæ parvæ.*
     - *Pancreatica magna.*
     - *Gastric (vasa brevia).*
     - *Gastro-epiploica sinistra.*
3. *Superior mesenteric.*
   - *Inferior pancreatico-duodenalis.*
   - *Vasa intestini tenuis.*
   - *Ileo-colic.*
   - *Colica dextra.*
   - *Colica media.*
4. *Suprarenal.*
5. *Renal.*
6. *Spermatic.*
7. *Inferior mesenteric.*
   - *Colica sinistra.*
   - *Sigmoid.*
   - *Superior hemorrhoidal.*
8. *Lumbar.*
9. *Sacra media.*

The abdominal aorta terminates in

THE COMMON ILIAC ARTERIES.

Relations: Right common iliac. In front—peritoneum, small intestines, sympathetic nerves, ureter. *Outer side*—vena cava, right common iliac vein, Psoas muscle. *Behind*—right and left common iliac veins.

Left common iliac: In front—peritoneum, sympathetic nerves, rectum, sup. hemor. artery, ureter. *Inner side*—left common iliac vein. *Outer side*—Psoas muscle. *Behind*—left common iliac vein. The common iliacs divide into *internal* and *external* iliacs.

INTERNAL ILIAC.

Relations: In front — peritoneum and ureter. *Outer side* — Psoas Magnus. *Behind* — internal iliac vein, lumbo-sacral nerve, Pyriformis muscle.

Branches, 12—*Anterior trunk:*

1. *Superior vesical.*
2. *Middle vesical.*
3. *Inferior vesical.*
4. *Middle hemorrhoidal.*
5. *Obturator.*
6. *Internal pudic.*
   - *Inf. or ext. hemorrhoidal.*
   - *Superficial perineal.*
   - *Transverse perineal.*
   - *Artery of the bulb.*
   - *Artery of corpus cavernosum.*
   - *Dorsal artery of penis.*

7. *Sciatic.* { *Coccygeal.* / *Comes nervi ischiadici.* / *Muscular.* }
8. *Uterine.* { *In female.* }
9. *Vaginal.* { *In female.* }

Posterior trunk:

1. *Gluteal.* { *Superficial.* / *Deep.* }
2. *Ilio-lumbar.*
3. *Lateral sacral.*

EXTERNAL ILIAC.

Relations: In front—peritoneum, spermatic vessels, genito-crural nerve, circumflex iliac vein, lymphatic vessels and glands. *Outer side*—Psoas Magnus, iliac fascia. *Inner side*—ext. iliac vein and vas deferens at femoral arch. *Behind*—external iliac vein and Psoas Magnus.

Branches—2:

1. *Epigastric.* { *Cremasteric.* / *Pubic.* / *Muscular.* }
2. *Circumflex iliac* (anastomoses with ilio-lumbar).

The continuation of the ext. iliac below Poupart's ligament is called

THE FEMORAL ARTERY.

(Relations given in Scarpa's triangle).

Branches—7:

1. *Superficial epigastric.*

2. *Superficial circumflex iliac.*
3. *Superficial external pudic.*
4. *Deep external pudic.*
5. *Profunda.* { *External circumflex.* / *Internal circumflex.* / *Three perforating.*
6. *Muscular.*
7. *Anastomotica magna.*

The continuation of the femoral from the opening in the adductor magnus is called

THE POPLITEAL ARTERY.

(Relations given in popliteal space).

Branches—7:

1. *Muscular.* { *Superior.* / *Inferior or sural.*
2. *Cutaneous.*
3. *Superior external articular.*
4. *Superior internal articular.*
5. *Azygos articular.*
6. *Inferior external articular.*
7. *Inferior internal articular.*

It divides into the anterior and posterior tibial.

ANTERIOR TIBIAL ARTERY.

Relations: In front—integument, superficial and deep fasciæ; tibialis anticus (overlaps it in upper part of leg.); Ext. Long. Dig., and Ext. Prop. Poll. overlap it slightly; anterior tibial nerve. *Inner side*—tibialis anticus; Ext. Prop. Poll. crosses it at lower part. *Outer side*—ant. tib. nerve; Ext. Long.

Dig. and Ext. Prop. Poll. *Behind*—interosseous membrane; tibia, ant. lig. of ankle joint.

Branches—4:

1. *Recurrent tibial.*
2. *Muscular.*
3. *Internal malleolar.*
4. *External malleolar.*

The continuation of the ant. tibial is called

THE DORSALIS PEDIS ARTERY.

Relations: In front—integument and fascia; innermost tendon of Ext. Brev. Dig. *Tibial side*—Ext. Prop. Poll. *Fibular side*—Ext. Long. Dig.; ant. tib. nerve. *Behind*—astragalus, scaphoid, int. cun. and their ligaments.

Branches—5:

1. *Tarsal.*
2. *Metatarsal.*
3. *Interosseous.*
4. *Dorsalis hallucis* (*pollicis*).
5. *Communicating.*

POSTERIOR TIBIAL ARTERY.

Relations: In front—tibialis posticus; Flex. Long. Dig.; tibia; ankle joint. *Inner side*—post. tib. nerve, upper third. *Outer side*—post. tib. nerve, lower two-thirds. *Behind*—gastrocnemius, soleus, deep fascia and integument.

Branches—5:

1. *Peroneal.*
   Anterior peroneal.
2. *Muscular.*
3. *Nutrient.*
4. *Communicating.*
5. *Internal calcanean.*

Divides beneath the origin of the adduct. poll. into 6 internal, and 7 external, plantar arteries.

THE PLANTAR ARCH

is formed by the external plantar and a communicating branch from dorsalis pedis.

Branches—3:

1. *Posterior perforating.*
2. *Digital.*
3. *Anterior perforating.*

THE PULMONARY ARTERY

will be described with the lungs.

THE VEINS

return the blood to the right auricle of the heart by 2 large trunks called the superior and inferior venæ cavæ.

THE SUPERIOR VENA CAVA

is formed by the right and left innominate veins.

THE VENÆ INNOMINATÆ

contain no valves, and are formed by the union of the internal jugular and subclavian veins of the corresponding side. *The right* receives the right vertebral vein (receiving the spinal veins) and lymphatic duct; right internal mammary inferior thyroid and superior intercostal veins. *The left* receives the left vertebral inferior thyroid, internal mammary and sup. intercostal, and generally thymic and pericardiac veins.

THE INTERNAL JUGULAR

contains 2 valves, and is formed by the *lateral* and *inferior petrosal sinuses* at the jugular foramen, and receives the facial, lingual, pharyngeal, superior, and middle thyroid, and sometimes the occipital.

THE SINUSES OF THE DURA MATER

are 15 in number:

1. *Superior longitudinal* receiving the sup. cerebral, parietal, and diploic veins.
2. *Inferior longitudinal* receiving veins from falx cerebri.
3. *Straight* receiving inf. long. sinus and *venæ galeni*, inf. med. cerebral and sup. cerebellar veins.
4. *Two occipital* receiving small veins around for. mag.
5. *Two lateral* receiving sup., long., straight, and occipital.

6. *Two cavernous* receiving ophthalmic which connects them with facial vein; inf. ant. cerebral veins.

7. *Circular* running around sella turcica, and communicating with cavernous.

8. *Transverse* connecting 2 inf. petrosal.

9. *Two superior petrosal* connecting cavern. and lat., and receiving a cerebral and cerebellar vein.

10. *Two inferior petrosal* receiving cavernous and transverse, and uniting with the lateral, to form the internal jugular.

THE SUBCLAVIAN VEIN

receives the external, anterior, and internal jugular veins, and a small branch from cephalic.

1. *The external jugular* is formed in the substance of the parotid gland by the posterior auricular and temporo-maxillary, temporal and internal maxillary. It receives post. ext. jugular, suprascapular transverse cervical, communicating branch from ant. jug., and a large one from internal jug.

2. *The anterior jugular* contains no valves, and receives laryngeal branches and communications with its fellow, ext. and int. jug.

At the outer margin of the 1st rib the subclavian vein becomes

THE AXILLARY VEIN,

which is formed by the continuation up-

ward of the basilic vein. It receives branches corresponding to those of the axillary artery, the venæ comites of the brachial, and the cephalic vein.

THE CEPHALIC VEIN

is formed by the junction of the radial and median cephalic.

The radial commences on the dors. surf. of the thumb, index finger, and radial side of the hand, by branches communicating with the vena salvatella—the vein of the little finger.

The median cephalic forms with *the median basilic*, the terminal branches of the *median vein*, which collects the blood from the palmar surf. of hand and mid. line of fore-arm communicating with ant. uln. and rad.

THE BASILIC VEIN

is formed by the ant. and post. ulnar, and receives the median basilic from median.

The basilic v. is continuous with the axillary.

The anterior ulnar begins on ant. surf. of wrist and ulnar side of hand.

The posterior ulnar commences on post. surf. of ulnar side of hand and from vein of little finger—*vena salvatella.*

THE INFERIOR VENA CAVA

is formed by the union of the 2 common

iliac veins. It receives the lumbar, spermatic, ovarian, renal, suprarenal, phrenic, and hepatic veins. It communicates with the sup. vena cava by the *azygos veins*, which are made up by the intercostal veins, receiving esophageal, mediastinal, vertebral, and bronchial veins. The right azygos enters the thorax through the aortic opening in the diaphragm, the left through the left crus.

THE COMMON ILIAC

veins are formed by the union of the internal and external iliac veins. They receive the ilio-lumbar and lateral sacral veins. The left receives in addition the middle sacral.

THE INTERNAL ILIAC

veins are formed by the venæ comites of the internal iliac artery and its branches (except umbilical). It has no valves. It receives the gluteal, sciatic, internal pudic, and obturator veins; the hemorrhoidal and vesico-prostatic plexuses in the male, and uterine and vaginal plexuses in the female.

The hemorrhoidal plexus is formed by the superior hemorrhoidal veins (branches of inf. mesenteric) middle and inf. hemorrhoidal, which go to int. iliac. The sup. hemorrhoidal has no valves. The intricate inosculation acts like valves to produce dilatation when regurgitation takes place.

THE EXTERNAL ILIAC VEIN

begins at the termination of the femoral, beneath the crural arch. It has no valves. It receives the epigastric and circumflex iliac veins.

THE FEMORAL VEIN

is the continuation of the popliteal; lies in the upper part of its course internal to the femoral artery lower down; it passes behind it, and still lower becomes external. It has 4 or 5 valves. It receives the internal saphenous vein, muscular branches, and profunda femoris.

The *internal saphenous* vein commences on the dorsum and inner side of the foot. It receives cutaneous branches, superficial epigastric, superficial external iliac, superficial external pudic. It communicates with the other veins in the leg and foot by numerous branches. It has from 2 to 6 valves.

THE POPLITEAL VEIN

is formed by the venæ comites of the ant. and post. tibial. It ascends to the tendinous opening in the adduct or magnus, where it becomes the femoral. It contains 4 valves. It receives the sural, articular and external saphenous veins.

The external or short saphenous vein receives the blood from the dorsum and outer side of the foot.

THE PORTAL VEIN

collects the blood from the viscera of digestion. It is made up of 4 veins: 1. *Inferior mesenteric*, which receives hemorrhoidal branches inosculating with those from internal iliac veins. 2. *Superior mesenteric.* 3. Splenic. 4. Gastric. Its circulation through the liver is given with the description of that organ.

THE CARDIAC VEINS

return the blood from the substance of the heart. They are (1) great cardiac, (2) posterior cardiac, (3) anterior cardiac, (4) venæ thebesii (opening directly into the right auricle). The coronary sinus receives these veins (except venæ theb.) and terminates in the right auricle.

THE PULMONARY VEINS

bring the blood back from the lungs, and are 4 in number. They carry arterial blood, have no valves, and open in the left auricle. In the lung the order of arrangement is from before backward, artery, bronchus, vein; at the root of the lung, vein, artery, bronchus.

THE LYMPHATICS

comprehend — 1st, vessels conveying the lymph and chyle into the veins; and 2d,

enlargements occurring in their course, called glands or ganglia.

The *lacteal or chyliferous vessels* commence on the villi of the mucous surface of the intestines, pass through the mesenteric glands backward toward the spine, where they terminate in the thoracic duct.

The *lymphatic vessels* are found throughout the body, and generally observe a deep and superficial arrangement.

Lymphatics of the Lower Extremities.—The superficial set accompany the external and internal saphenous veins; they communicate freely in their course with the deep lymphatic trunks which accompany the deep vessels. Those which accompany the external saphenous vein enter the glands in the popliteal space, whilst those accompanying the internal saphenous vein ascend to the groin and pass through the inguinal glands, forming connections with the superficial lymphatics of the abdomen, the perineum, and the genitals. The deep lymphatics of the hip and perineum are conducted by branches of the internal iliac vessels into the pelvis, and pass through the pelvic glands. From the inguinal and pelvic glands the lymphatics pass through the iliac vessels to the receptaculum chyli.

The thoracic duct commences by a dilatation called *receptaculum chyli*, on the body of the 2d lumbar vertebra; passing between the crura of the diaphragm, it gains

the posterior mediastinum, where it lies between the aorta and the vena azygos; at the 4th dors. vert. it crosses the spine obliquely to the left side, passing behind the esophagus and arch of the aorta, and placed behind the left pleura and between the left carotid and left subclavian arteries; it then goes to the left side of the neck as high as the 6th cervical vertebra, where, curving downward and outward, it opens close to the external angle formed by the left subclavian and jugular veins.

Lymphatics of the Upper Extremities.—The superficial set accompany the superficial veins, and pass through 2 or 3 glands situated at the inner condyle; joining the deep lymphatics which accompany the venæ comites, they go to the axilla, and pass through the axillary glands; following the course of the axillary vein, they pass beneath the clavicle, join the lymphatics of the neck, and terminate in the thoracic duct. The lymphatics of the right upper extremity and right side of the neck unite to form the *right or lesser thoracic duct*, which opens into the right vena innominata.

The lymphatics of the trunk consist of a deep and superficial set; in the chest the former are seated between the muscles and pleura, in the abdomen between the muscles and peritoneum, the superficial being subcutaneous. The viscera contained in

the chest and abdomen also have a superficial and deep layer of lymphatics, the deep being distributed through the peculiar tissue of each organ, the superficial running beneath the membranous envelope.

Lymphatics have been seen in the membranes, but not in the proper substance of the brain and spinal cord.

THE NERVOUS SYSTEM

consists of 2 sets of nerve and nerve centers, intimately connected together. They are (1) *cerebro-spinal*, and (2) *sympathetic* or *ganglionic*.

THE CEREBRO-SPINAL SYSTEM

is composed of the spinal cord, brain, and the nerves which they give off.

The membranes of the spinal cord are 3 in number:

1. *Dura mater* or *fibrous*, continuous with that which invests the brain, but differing from it in being smooth on the exterior, and in not forming the periosteum of the vertebræ, and in not sending processes into the spinal cord, nor has it any sinuses.

2. *Arachnoid*, consisting of a parietal and visceral layer, like the arachnoid of the brain with which it is continuous. The parietal layer is on the inner surface of the dura mater, to which it is firmly attached; the visceral layer is reflected loosely upon the cord, giving to the nerves loose sheaths, which are reflected upon themselves at the point where the nerves pierce the dura mater. Between the visceral layer and the

cord is a space, the *subarachnoid* communicating with the interior of the brain by an opening in the 4th ventricle. It lodges the subarachnoid fluid. The arachnoid has no vessels.

3. The *pia mater* incloses the spinal cord, giving prolongations upon the roots of the nerves. It is continuous with the pia mater of the brain, but is more fibrous and less vascular. It sends a process into the anterior median fissure of the cord, opposite to which is a fibrous band called *linea spendeus*, and at the 2d lumbar vertebra ends in the *filum terminale* or *central ligament* of the cord, which lies within the prolongation of the dura mater, to be attached with it to the coccyx.

The *ligamentum denticulatum* is found on each side of the cord, between the anterior and posterior roots of the nerves. It is formed by a series of 21 or 22 serrations, connected with the pia mater, and with the inner surface of the dura mater, midway between the apertures of exit for the nerves. It serves to sling the cord and secure it from shocks (Heath).

THE SPINAL CORD.

In speaking of the functions of the cord, Prof. Huxley has given the most concise and accurate description of its anatomy, of which we avail ourselves in this connection.

The spinal cord is a column of grayish-white soft substance, extending from the top of the spinal canal, where it is continuous with the brain, to about the 2d lumbar vertebra, where it tapers off to a point. A deep fissure, the *anterior fissure*, divides it in the middle line in front, nearly down to its center; and a similar fissure, the *posterior fissure*, also extends nearly to its center in the middle line behind. The pia mater extends into each of these fissures, and supports the vessels which supply the cord with its blood. In consequence of the presence of these tissues, only a narrow bridge of the substance of the cord connects its two halves, and this bridge is traversed throughout its entire length by a minute canal, the *central canal* of the cord.

Each half of the cord is divided longitudinally into 3 equal parts, by the lines of attachment of 2 parallel series of delicate bundles of nervous filaments, the *roots of the spinal nerves*. The roots of the nerves which arise along that line which is nearer the posterior surface of the cord are called *posterior roots;* those which arise along the other line are the *anterior roots*. A certain number of anterior and posterior roots, on the same level on each side of the cord, converge and form anterior and posterior bundles, and then the 2 bundles, anterior and posterior, coalesce into the *trunk of a spinal nerve;* but, before doing so, the pos-

terior bundle presents an enlargement—the *ganglion of the posterior root.*

A TRANSVERSE SECTION OF THE CORD shows that each half contains 2 substances—a *white substance* on the outside, and a *grayish-red substance* in the interior. And this gray substance is so disposed that, in transverse section, it looks something like a crescent, with one end bigger than the other, and with the concave side turned outward. The 2 ends of the crescent are called its *horns* or *cornua*, the one in front being the *anterior cornu;* the one turned backward the *posterior cornu.* The convex sides of the cornua of the 2 halves approach one another, and are joined by the bridge which contains the central canal.

Many of the nerve fibers of which the anterior roots are composed may be traced into the anterior cornu, while those of the posterior roots enter the posterior cornu.

The posterior roots are *sensory*, the anterior *motor.*

Columns of the Cord.—The fissures divide each half of the spinal cord into 4 columns—anterior, lateral, posterior, posterior median.

THE BRAIN AND ITS MEMBRANES.

The membranes of the brain are the same as those of the cord.

The *dura mater* lines the skull, and gives off 3 processes into the cavity of the skull.

1. Falx cerebri descending vertically in the longitudinal fissure, and attached to the crista galli, and connected behind with the upper surface of the tentorium.

2. Tentorium cerebelli separating the cerebellum from the cerebrum.

3. Falx cerebelli between the 2 lateral lobes of the cerebellum.

The *arachnoid* is a serous membrane which has been seen to consist of 2 layers—*parietal*, which lines the dura mater, and *visceral*, which is now to be examined.

The *visceral layer* is more or less united with the subjacent pia mater, but differs from it in passing from one convolution to another without dipping into the sulci. It passes into the great longitudinal fissure between the hemispheres of the cerebrum, and is traced from the anterior termination of this over the base of the cerebrum (the lobes of which it binds together) to the cerebellum and medulla oblongata, where it becomes continuous with the arachnoid of the spinal cord. It gives sheaths to the cranial nerves as far as the foramina of exit, where they are reflected to join the parietal layer of arachnoid.

Between the arachnoid and the pia mater is the *subarachnoid space*, which contains the cerebro-spinal fluid, and which, though ex-

isting all over the brain, is only to be seen in the following places:

The *anterior subarachnoid space* (diamond-shaped space) is immediately in front of the pons varolii, and is formed by the stretching of the arachnoid from one middle lobe of the cerebrum to the other, as far forward as the optic commissure.

The *posterior subarachnoid space* (4th ventricle) will be found beneath the cerebellum on lifting up the medulla oblongata. This communicates with the subarachnoid space of the spinal cord, and with the interior of the brain by means of an aperture into the 4th ventricle, which may now be seen by removing the layer of arachnoid.

The *pia mater* is a vascular membrane closely investing the brain and passing into the sulci between the convolutions, besides giving processes into the interior of the brain which will be subsequently examined. It becomes more tough and fibrous as it approaches the spinal cord, upon which its vascularity almost entirely disappears.

The brain is divided into 4 parts: the (3) cerebrum, (4) cerebellum, (2) pons varolii, and (1) medulla oblongata.

THE MEDULLA OBLONGATA

is the upper part of the spinal cord, and extends from the upper border of the atlas to the lower border of the pons, being about 1¼ in. in length. It is divided by an an-

terior and posterior fissure into 2 lateral halves, and these are again subdivided into 4 columns, named from before backward—anterior pyramid, lateral tract and olivary body, restiform body, and posterior pyramid.

The *anterior pyramids* are continuous with the anterior columns of the cord, and contain its motor fibers. They decussate across the median fissure at the lower part of the medulla.

The *lateral tract* is continuous with the lateral column of the cord. Below it is broad, and placed between the anterior pyramid and the restiform body; but above it is narrow, and encroached upon by the *olivary body*, an ovoid projection close to the anterior pyramid, and just below the pons.

The white fibers winding around the lower end of each body are called the *arciform fibers.*

The *restiform bodies* are continuous with the posterior columns of the cord. They are between the lateral tracts and posterior pyramids. They form the inferior peduncles of the cerebellum, and lateral boundaries of 4th ventricle.

The *posterior pyramids* are continuous with the posterior median columns of the cord.

The posterior surface of the medulla oblongata forms the floor of the 4th ventricle, and between the diverging post. pyr. re-

sembles the point of a pen, and is called *calamus scriptorius*. Continuous with the post. med. fissure of the cord is a canal terminating in a *cul-de-sac* called the ventricle of Arantius.

THE PONS VAROLII

connects the various segments of the encephalon. It is grooved along the median line for the basilar artery. It forms the middle peduncles of the cerebellum. It is composed of fibers and gray matter. It is sometimes called *tuber annulare*.

THE CEREBRUM

is divided into 2 lateral halves by the great longitudinal fissure which extends down to a transverse commissure of white matter, the *corpus callosum* connecting the 2 hemispheres. This fissure lodges the falx cerebri.

The *convolutions* are numerous eminences separated by depressions called *sulci*, lined by process of the pia mater. The convolutions contain gray matter externally and white matter internally. Those which are most clearly marked are—the convolution of the corpus callosum (gyrus fornicatus), convolution of the longitudinal fissure, supraorbital convolution, and convolutions of the outer surface of the hemisphere.

THE BASE OF THE BRAIN

is divided into 3 lobes—anterior, middle, and posterior.

From before backward the objects exposed are 13 in number.

1. The *longitudinal fissure* separates the anterior lobes of the cerebrum, and if these are drawn apart a white body will be seen at the bottom of the fissure, which is the

2. *Corpus callosum;* the anterior part, around which the anterior cerebral artery turns, being known as the *genu*, and the central portion continued into the lamina cinerea, as the *rostrum*. It has on its surface a raphe, bounded on each side by projections called nerves of Lancisi.

3. The *lamina cinerea* is a thin gray layer, continuous with the under surface of the corpus callosum, and prolonged to the margin of the optic commissure.

4. The *olfactory peduncle* and *bulb*—1st nerve.

5. The *fissure of Sylvius* runs outward between the anterior and middle lobes of the cerebrum. At the bottom of the fissure will be seen a few nearly straight convolutions (*gyri operti*) aggregated together, to which the name Island of Reil or central lobe has been applied.

6. The *locus perforatus anticus* is situated close behind the olfactory nerve and at the inner end of the fissure of Sylvius. It is composed of gray nervous matter, and is perforated by numerous small branches from the middle cerebral artery (going to the corpus striatum).

7. The *optic commissure* or *chiasma*—the point of communication between the 2 optic nerves.

8. The *tuber cinereum* is a gray body placed immediately behind the optic chiasma. Projecting from it (within it, rather) is the

9. *Infundibulum* (funnel), a tube connected with the pituitary body, which is generally left in the *sella turcica* upon the removal of the brain.

10. The *pituitary body* is solid in the adult, and consists of 2 lobes of a reddish color. The anterior lobe is the larger, and is oblong in shape; the posterior lobe is round.

11. The *corpora albicantia* or *mammillaria* are 2 white bodies resembling small peas, which are placed between the 2 crura cerebri. They are formed by the anterior crura of the *fornix*, which descend to the base of the brain and there make a sudden fold upon themselves, thus forming the bodies. Gray matter is found in the interior of each body.

12. The *locus perforatus posticus* (pons tarini) is placed in the angle between the 2 crura cerebri. It is composed of gray matter, and is perforated by numerous vessels (going to the thalamus opticus).

13. The *crura cerebri* are 2 large white bodies which appear at the anterior border of the pons varolii, and diverge to enter

the under surface of the cerebrum. They contain a mass of gray matter called *locus niger*. Winding round each crus are the optic tract and the 4th nerve, and between the 2 crura is the *interpeduncular space* containing the tuber cinereum, the corpora albicantia, and the locus perforatus posticus.

THE INTERIOR OF THE CEREBRUM.

In entering the hemispheres the peduncles of the hemispheres diverge, the fibers of each passing through 2 masses of gray matter or ganglia, called the *thalamus opticus* and *corpus striatum*, which project from the upper and inner side of each peduncle. Just above these the corpus callosum runs transversely from one hemisphere to the other, and forms the roof of a cavity or ventricle, included between its under surface and the upper surface of the ganglia, and parts which fill in the interpeduncular space. This is the general ventricular cavity of the cerebrum, and it is cut into 2 parts by a vertical septum, the *septum lucidum*, thus forming 2 ventricles, the 1st and 2d ventricles of the cerebrum, or the *lateral ventricles*.

Each *lateral ventricle* consists of a *central cavity* and 3 *cornua*, anterior, posterior, and descending. The *anterior* cornu turns outward in the anterior lobe of the cerebrum, and the *posterior* cornu turns inward in the

posterior lobe of the cerebrum, thus forming with the central portion a cavity shaped (on the right side) like the italic letter *f*. The ventricle is bounded superiorly by the corpus callosum which forms its *roof*, the *floor* being formed by the following parts from before backward: (1) corpus striatum, (2) tænia semicircularis, (3) thalamus (opticus), (4) choroid plexus, (5) corpus fimbriatum, (6) fornix.

The *corpus striatum* is a pyriform body with the greater end forward, and constitutes the *anterior ganglion of the cerebrum* (or *ganglion of motion*). The 2 corpora striata are separated posteriorly by the 2 thalami.

The *tænia semicircularis* is a narrow band of white matter, which connects the corpus striatum with the optic thalamus.

The *thalamus* (opticus) is described with 3d ventricle.

The *choroid plexus* is a vascular fringe lying upon the surface of the thalamus and continued into the descending cornu of the lateral ventricle. Each is connected with the other through the *foramen of Monro*, an opening beneath the fornix (behind its anterior pillars) in the middle line.

The *corpus fimbriatum* is the thin edge of the fornix.

The *fornix* is a thin white body beneath the corpus callosum in the middle line.

Anteriorly it is divided into 2 crura (or pillars), which pass to the base of the brain (forming the corpora albicantia). Posteriorly it is incorporated with the splenium of the corpus callosum, and is continuous with the hippocampus major. (It consists of antero-posterior commissural fibers). The fornix is separated from the corpus callosum in front by the septum lucidum.

The *fifth ventricle* lies between the 2 layers of the septum lucidum.

The *foramen of Monro* is the communication between the 2 lateral and the 3d ventricles.

The *hippocampus minor* is a projection from the inner wall of the posterior cornu of the lateral ventricle, corresponding to the *calcarine fissure*. It is white on the surface, but gray in the interior.

The *descending* or *middle cornu* takes a curved course downward in the middle lobe of the cerebrum and beneath the optic thalamus.

The *hippocampus major* is continuous with the fornix. Its anterior extremity is enlarged. Called *pes hippocampi* from its fancied resemblance to the foot of an animal.

At the anterior border of the hippocampus major is a thin band of white cerebral matter continuous with the corpus fimbriatum, but now called the *tenia hippocampi*.

The *fascia dentata* is the gray matter of

the convolution which forms the pes hippocampi.

The *choroid plexus* of the descending cornu is continuous with the choroid plexus of the lateral ventricle, and is connected with the pia mater through a slit immediately in front of the tenia hippocampi (transverse fissure of Bichât).

The *pes accessorius* or *eminentia collateralis* is a projection at the commencement of the descending cornu and between the hippocampus major and the hippocampus minor, corresponding to the *collateral fissure*.

The *velum interpositum* is a triangular process of pia mater carried into the interior of the brain through the great transverse fissure (of Bichât). The continuity of the pia mater may be traced upon the upper surface of the cerebellum and the under surface of the posterior lobe of the cerebrum, and it may be followed through the descending cornu of the lateral ventricle to the base of the brain, where it appears by the side of the crus cerebri. At each side of the velum interpositum are the choroid plexuses of the lateral ventricles, and in the center are 2 veins (*venæ galeni*) which open into the straight sinus of the dura mater.

The *great transverse fissure* or *fissure of Bichât* is the slit by which the pia mater enters the brain. It is opposite the interval between the cerebrum and the cerebel-

lum, and reaches forward in the brain beneath the fornix and corpus callosum, and above the great ganglia of the brain (corpora striata and optic thalami). The fissure is continued downward on each side in the descending cornu of the lateral ventricle, and reaches the base of the brain at the outer side of each crus cerebri.

The *third ventricle* is the space in the middle line between the 2 optic thalami. Its *roof* is formed by the fornix and velum interpositum, and its *floor* by the structures contained within the Circle of Willis at the base of the brain—viz.: the lamina cinerea, optic chiasma, tuber cinereum, corpora albicantia, and locus perforatus posticus (from before backward).

The *anterior* boundary of the ventricle is formed by the *anterior commissure*, a white band (between the 2 corpora striata) which may be seen between and in front of the 2 anterior pillars of the fornix; the *posterior* boundary is the *posterior commissure*, a slender white band (between the 2 thalami) which may be seen immediately in front of, and a little beneath, the pineal gland. Stretching across the ventricle between the 2 optic thalami is (a broad gray band) the *middle* or *soft commissure* which divides the ventricle into 2 portions, to which the names *foramen commune anterius* and *foramen commune posterius* are sometimes given.

The 3d ventricle communicates with the

2 lateral ventricles by the foramen Monro, and with the 4th ventricle by the *iter a tertio ad quartum ventriculum* or aqueduct of Sylvius, which passes beneath the posterior commissure, the pineal gland and the corpora quadrigemina. In the fœtus the 3d ventricle communicates in addition with the 5th ventricle, and also with the infundibulum (by the iter ad infundibulum, the opening of which is just under the anterior commissure).

The *thalamus opticus* is now seen to be a large white body placed posteriorly to the corpus striatum, and at the side of the 3d ventricle. It is the *ganglion of sensation*. It has been seen to form part of the floor of the lateral ventricle by its upper surface, on which is a slight prominence called the anterior tubercle.

The thalamus opticus forms the roof of the descending cornu of the lateral ventricle, and by drawing it upward on the side upon which the cornu has been opened, 2 projections on its under surface may be seen. These are the *corpora geniculata* (externum and internum), of which the outer one is the larger. By turning the brain on its side the optic tract may be readily traced to the under surface of the optic thalamus, to which it is attached, and will be found to divide into 2 parts, which are connected with the corpora geniculata, and pass on to the corpora quadrigemina.

The *pineal body* or *gland* (conarium) is a pink body of a conical shape, lying between the anterior pair of the corpora quadrigemina and above the posterior commissure of the 3d ventricle. Its anterior part or base is connected with the margins of the optic thalami by 2 slender *anterior peduncles* or *habenæ*, and is also connected with the subjacent bodies by slender *inferior peduncles*. The velum interpositum gives a special investment of pia mater to the gland. The pineal body contains a cavity in which are some particles of calcareous matter (acervulus).

The *corpora quadrigemina* are 4 white prominences placed immediately behind the 3d ventricle, and named *nates* and *testes*. Both sets of bodies are connected to the optic thalami by white bands, and the nates are also connected to the pineal gland, which lies upon their upper surface.

The 2 broad white bands passing from the cerebellum to the testes are the superior peduncles of the cerebellum (*processus a cerebello ad testes*), and between them is a thin layer of white matter, the *valve of Vieussens*, to which the 4th pair of nerves may be traced round the superior peduncles of the cerebellum.

The band of white matter passing transversely beneath the corpora quadrigemina on each side, and seen immediately in front

of the superior peduncles of the cerebellum, is the *fillet of the olivary body.*

The *anterior commissure* is a cylindrical white band which may be traced through the corpus striatum to the roof of the descending cornu of the lateral ventricle.

The *anterior pillar of the fornix* descends in front of the 3d ventricle and reaches the base of the brain, where it makes a fold to form the superficial white substance of the corpus albicans of one side, and then ascends to be lost in the gray matter of the optic thalamus.

THE CEREBELLUM,

or small brain, lies beneath the posterior lobes of the cerebrum, and in the skull is separated from them by the tentorium cerebelli. It is of a darker color than the cerebrum, and its surface is divided into laminæ instead of convolutions, and these are separated by shallow sulci. The cerebellum is divisible into 2 lateral halves united by a commissure, and the *horizontal fissure* divides the organ into an upper and a lower part.

The upper surface is flat except in the median line, where there is a slight ridge forming the commissure, and called the *superior vermiform process.* The upper part of each hemisphere is divided into an anterior and a posterior lobe by an indistinct fissure.

The *anterior lobe* is the larger and of a square shape, reaching as far back as the posterior extremity of the vermiform process.

The *posterior lobe* is the small portion behind the level of the vermiform process, and reaches to the horizontal fissure.

The cerebellum is connected to the cerebrum and spinal cord by 3 peduncles or crura, of which the superior one can now be seen.

The *superior peduncle* (*processus a cerebello ad testes*) is a broad, flattened white band, which is connected below with the inferior vermiform process and passes forward to the corpora quadrigemina, the 2 peduncles of opposite sides converging at the posterior border of the testes. The 2 processes are prolonged beneath the corpora quadrigemina to the optic thalamus, their fibers decussating in their passage.

The *valve of Vieussens* is the thin layer of gray nervous matter stretched between the 2 superior peduncles of the cerebellum and connected with the anterior extremity of the inferior vermiform process.

The *middle peduncle* (*processus a cerebello ad pontem*), the largest of the 3 peduncles, has been already seen at the base of the brain.

The *inferior peduncle* (*processus a cerebello ad medullam*) forms part of the restiform body of the medulla.

The *inferior surface* of the cerebellum is divided into 2 hemispheres by a deep fissure, the *vallecula*, at the bottom of which is the *inferior vermiform process.*

Each hemisphere is divided into lobes. Beginning behind is the *posterior lobe*, next the *slender lobe*, and in front of that the *biventral* or *digastric lobe.*

The *amygdala* or *tonsil* is a prominent lobe, close to the vallecula, which it partially conceals.

The *flocculus* is a small lobe immediately in front of the biventral lobe, which lies beneath the crus cerebelli, and is hence called the sub-peduncular lobe.

The *inferior vermiform process* is divided into the *nodule*, which projects into the 4th ventricle; the *uvula*, from the fact of its lying between the 2 tonsils; behind this the *pyramid*, and posterior to this again are a few transverse commissural fibers.

The *fourth ventricle* is situated at the back of the pons varolii and medulla oblongata, those bodies forming its *floor.* The *roof* is formed by the valve of Vieussens and the inferior vermiform process of the cerebellum; the *sides* by the 2 superior peduncles of the cerebellum (processus ad testes) above, and below by the restiform body. The cavity of the ventricle is lozenge-shaped, and it communicates above with the 3d ventricle by the aqueduct of Sylvius (*iter a tertio ad quartum ventricu-*

lum) which passes beneath the corpora quadrigemina. Below, the 4th ventricle is closed by a reflection of pia mater, in which there is usually an opening establishing a communication between the ventricles of the brain and the subarachnoid space of the spinal cord. Connected with this process of pia mater is the *choroid plexus of the 4th ventricle*, which extends for some distance into the cavity.

In the floor of the ventricle is a median groove, which, when traced downward, will be found to end in a small hole, the commencement of the central canal of the spinal cord (*canal of Stilling*). On each side of this groove is a convex body, the *fasciculus teres*, which is white at the upper part of the ventricle, but covered below by gray matter, and is the continuation of the fibers of the lateral tract and restiform body of the medulla.

There are 4 gangliform projections or nuclei on each side of the median groove in the floor of the ventricle. The upper one is for the 6th and facial nerves, and immediately below are some white lines (*lineæ transversæ*), which run transversely from the median fissure, and are connected with the auditory nerve. The lower nuclei are for the auditory, the 8th, and the 9th nerves.

By slicing vertically either hemisphere of the cerebellum, the appearance known as

the *arbor vitæ* will be seen. This is due to the peculiar arrangement of white cerebral matter within the gray matter of the external laminæ; and by careful slicing, an irregular gray body (*corpus dentatum*) will be seen in the center of the white matter of each hemisphere. By making a transverse section of the medulla oblongata, a small *corpus dentatum* will also be seen in the olivary body of each side.

A section through the cerebrum at the level of corp. call. reveals the *centrum ovale minus* on the superior part, and *centrum ovale majus* on the inferior.

THE NERVES

are round cords, made up of a sheath or neurilemma, a central axis cylinder, and an intervening white substance called the white substance of Schwann. They come off from the cerebro-spinal axis.

THE CRANIAL NERVES

are arranged in pairs, and are named in the order in which they come out from the cavity. They are

1st. Olfactory.
2d. Optic.
3d. Motor oculi.
4th. Patheticus.
5th. Trifacial.
6th. Abducens.

7th. { Facial = portio dura.
Auditory = portio mollis.

8th. { Glosso-pharyngeal.
Pneumogastric.
Spinal accessory.

9th. Hypoglossal.

I.—THE OLFACTORY PEDUNCLE

has 3 roots.

The *external* (white) passes across the fissure of Sylvius to the middle lobe, into the corpus striatum.

The *middle* (gray) goes to the gray matter in the anterior lobe.

The *internal* (white) goes to the inner side of the anterior lobe.

It passes through the cribriform plate of the ethmoid to the mucous membrane of the nose. It has no neurilemma.

II.—THE OPTIC NERVE

passes from the optic commissure to the eyeball, where it spreads out to form the retina. The commissure connects by a peculiar arrangement of fibers the 2 hemispheres and the 2 eyes, each with the others.

The optic tract is a flattened band, connecting the optic commissure with the brain. It disappears around the crus cerebri and beneath the middle lobe, and is traced to the corpora geniculata, to the optic thalamus, and to the corpora quadrigemina. This

nerve leaves the cranium by the optic foramen.

III.—THE MOTOR OCULI

comes off from the inner surface of the crus in front of the pons. It is traced to the gray substance of the crura (locus niger) and the floor of the 4th ventricle. It leaves the cranium by the sphenoidal fissure, and supplies all the muscles of the eyeball, except the Sup. Oblique and Ext. Rect.

IV.—THE PATHETICUS

is the smallest cranial nerve. It comes from the valve of Vieussens, and winds around the crus cerebri. It supplies the Superior Oblique.

V.—THE TRIFACIAL

is the largest cranial nerve, and consists of 2 portions—motor and sensory, of which the motor is the smaller and the anterior. It arises from the side of the pons, and may be traced to the floor of the 4th ventricle. At the apex of the petrous portion of the temporal bone it has developed upon the sensory root a large semilunar ganglion, called *Casserian ganglion.* The motor root passes beneath this. It sends off from this ganglion 3 large branches, which are distributed according to the following table:

1. Ophthalmic.
Exit sphenoidal fissure.
- Lachrymal.
- Frontal.
  - Supratrochlear.
  - Supraorbital.
  - Muscular.
  - Cutaneous.
  - Pericranial.
- Nasal.
  - Ganglionic.
  - Long ciliary.
  - Infratrochlear.

2. Superior maxillary.
Exit foramen rotundum.
- In spheno-maxillary fossa.
  - Orbital.
  - Spheno-palatine.
  - Posterior dental.
- Infraorbital canal.....
  - Anterior dental.
- On the face.
  - Palpebral.
  - Nasal.
  - Labial.

3. Inferior maxillary.
Exit foramen ovale.
- Anterior root. (Motor.)
  - Masseteric.
  - Deep temporal.
  - Buccal.
  - Pterygoid.
- Posterior root. (Sensory and motor.)
  - Auriculo-temporal.
  - Gustatory or lingual.
  - Inferior dental.
    - Mylo-hyoid.
    - Dental.

VI.—THE SIXTH, ABDUCENS,

arises from the ant. pyr. of the medulla, close to the post. bord. of the pons. It may be traced to a gray nucleus in the 4th ventricle.

It leaves the cranium by the sphenoidal fissure, and is distributed to the External Rectus muscle.

VII.—THE SEVENTH PAIR

consist of 2 portions—*portio dura* or *facial*, and *portio mollis* or *auditory*.

Between the two is the *pars intermedia*, a minute nerve which joins the facial.

The *portio dura* or *facial* nerve arises from the lateral tract, and slightly from the pons. It may be traced to the floor of the 4th ventricle. It enters the meatus auditorius internus, and emerges from the cranium by the stylo-mastoid foramen.

It has developed upon it in the hiatus Fallopii a reddish swelling called *intumescentia ganglioformis*. On account of its numerous communications it is called *pes anserinus*. The following table expresses its distribution:

Within aqueductus Fallopii—

{ Tympanic.
Chorda tympani (exit canal of Huguier).

At its exit from stylo-mastoid foramen—
- Posterior auricular.
- Digastric.
- Stylo-hyoid.

On the face—
- Temporo-facial.
  - Temporal.
  - Malar.
  - Infraorbital.
- Cervico-facial.
  - Buccal.
  - Supramaxillary.
  - Inframaxillary.

Communications.

In the intern. aud. meatus—
- With the auditory nerve.

In the aqueductus Fallopii—
- With Meckel's ganglion by large petrosal.
- With optic ganglion by small petrosal.
- With sympathetic on middle meningeal by external petrosal.

At its exit from stylo-mastoid foramen—
- With the pneumogastric.
- With the glosso-pharyngeal.
- With the carotid plexus.
- With the auricularis magnus.
- With the auriculo-temporal.
- With the 3 divisions of the 5th.

The *portio mollis* or *auditory* nerve is soft, and has no neurilemma. It arises

from the floor of the 4th ventricle (auditory nucleus) and winds around the restiform body to join the facial, with which it enters the meat. aud. int., and is distributed to the cochlea, vestibule and semicircular canals.

VIII.—THE EIGHTH PAIR

consist of 3 nerves—*glosso-pharyngeal*, *pneumogastric*, and *spinal accessory*.

They may be traced to special nuclei in the 4th ventricle.

The *glosso-pharyngeal* is the nerve of sensation to the mucous membrane of the pharynx fauces and tonsil, of motion to the pharyngeal muscles, and a special nerve of taste in all the parts of the tongue to which it is distributed. In its exit from the cranium through the *jugular foramen* (for. lac. post.) it presents 2 gangliform enlargements:

1. Superior or jugular ganglion.
2. Inferior or petrous ganglion.

Communicating branches—

- Pneumogastric.
- Sympathetic.
- Facial.
- Tympanic. (Jacobson's nerve.)

The branches of the glosso-pharyngeal are (1) carotid, (2) pharyngeal, (3) muscular, (4) tonsillar, and (5) lingual.

The *spinal accessory nerve* consists of 2

parts, one accessory to the pneumogastric, the other the spinal portion.

The upper or accessory part arises by fine filaments from the whole length of the medulla below the pneumogastric. It joins in the jugular foramen with the upper ganglion of the pneumogastric, and gives branches to the pharyng. and laryng. branches of that nerve.

The spinal portion arises by fibrillæ from the side of the spinal cord as low as the 6th cerv. nerve, ascends between the ligamentum denticulatum and the post. roots of the cerv. nerves to enter the foramen magnum, and passes to the jugular foramen to join the accessory portion in the same sheath with the pneumogastric. It pierces the Sterno-mastoid muscle, and passes on to be distributed to the Trapezius, receiving communicating branches from the cervical nerves.

The *pneumogastric nerve* arises by several filaments from the lateral tract below the glosso-pharyngeal. It is both motor and sensitive.

It has 2 ganglia developed upon it, one in the jugular foramen—the ganglion jugulare, or ganglion of the root—the other after its exit, the ganglion inferius, or ganglion of the trunk.

The ganglion of the root receives filaments from the spinal accessory, from petrous gang. of glosso-pharyngeal, from

facial through the auricular branch, from sympathetic by sup. cerv. gang.

The ganglion of the trunk is connected with the hypoglossal, sup. cerv. gang. of sympathetic, and loop bet. 1st and 2d cerv. nerves.

The pneumogastric gives off branches as follows:

In the jugular fossa—
- Auricular (Arnold's).

In the neck—
- Pharyngeal.
- Superior laryngeal to muc. mem. and Cric. Thy.
- Recurrent or inf. laryngeal to all muscles of larynx except Cric. Thy.
- Cervical cardiac.

In the thorax—
- Thoracic cardiac.
- Anterior pulmonary.
- Posterior pulmonary.
- Esophageal.

In the abdomen—
- Gastric.

IX.—THE NINTH OR HYPOGLOSSAL NERVE arises from the groove bet. the ant. pyr. and olivary body, and may be traced to floor of 4th ventricle. It is the motor nerve of the tongue, and leaves the cranium by ant. condyloid for.

Its communicating branches are (1) pneumogastric, (2) sympathetic, (3) 1st and 2d cervical, (4) gustatory.

Its branches of distribution are (1) descendens noni, (2) thyro-hyoid, (3) muscular.

THE SPINAL NERVES

are arranged in 31 pairs, as follows:

Eight cervical.
Twelve dorsal.
Five lumbar.
Five sacral.
One coccygeal.

THE CERVICAL NERVES

divide after their exit from the intervertebral foramina into anterior and posterior branches. The ant. branches of the 4 upper form the *cervical plexus*, and the ant. branches of the 4 lower cerv. 1st dors. form the *brachial plexus*.

The cervical plexus (union of ant. br. from 4 upper cerv.) is distributed as follows:

Superficial—

- Ascending.
  - Superficialis colli.
  - Auricularis magnus.
  - Occipitalis minor.
- Descending. (Supraclavicular.)
  - Sternal.
  - Clavicular.
  - Acromial.

Deep—

- Internal.
  - Communicating.
  - Muscular.
  - Communicans noni.
  - Phrenic descends on scalen. ant. to diaph.
- External.
  - Communicating.
  - Muscular.

The *posterior branches*, except the first 2, divide into external and internal branches.

The post. br. of 1st is called the *sub-occipital*, and that of the 2d the *great occipital*.

The *brachial plexus* is formed as follows:

The 5th, 6th, and 7th unite to form one cord, and the 8th and 1st dors. to form a second. Each cord bifurcates, and by the junction of the 2 middle branches they form 3. Each of these bifurcates to form 5 (2 br. uniting).

Outer cord—

- External anterior thoracic.
- External cutaneous.
- Outer head of median.

Inner cord—

- Inner head of median.
- Ulnar.
- Internal cutaneous.
- Lesser internal cutaneous.
- Internal anterior thoracic.

Posterior cord—

- Musculo-spiral.
- Circumflex.
- Three subscapular.

The branches above the clavicle are (1) communicating, (2) muscular, (3) posterior thoracic, (4) suprascapular.

The branches below the clavicle are as follows:

To chest—

- Anterior thoracic.

To shoulder—

- Subscapular.
- Circumflex.

To arm, fore-arm, and hand—

- Musculo-cutaneous = ext. cut.
- Internal cutaneous.
- Lesser internal cutaneous = nerve of Wrisberg.
- Median.
- Ulnar.
- Musculo-spiral.

The *musculo-cutaneous* pierces the coraco-brachialis muscle, and becomes cutaneous after giving off muscular branches, and then divides into ant. and post.

The *internal cutaneous* supplies the skin, and divides into ant. and post.

The *median nerve* gives off in the fore-arm ant. interosseous, palmar cutaneous, and branches to all the muscles except

Flex. Carp. Uln., and inner half of Flex. Prof. Dig.; in the hand it supplies the thumb, 1st and middle fingers, and outer half of ring finger.

The *ulnar nerve* supplies the Flex. Carp. Uln., bet. the heads of which it enters the fore-arm at the elbow and inner half of Flex. Prof. Dig. in the fore-arm, and in the hand the little finger and inner half of ring finger.

The *musculo-spiral* gives off muscular, cutaneous, radial, and posterior interosseous.

The radial supplies with the median, the thumb, 1st and 2d fingers, and outer half of 3d.

THE DORSAL NERVES

are 12 in number on each side, divide into *anterior* or *intercostal*, and *posterior* or *dorsal*.

THE LUMBAR NERVES

are 5 in number on each side, divide into anterior and posterior branches.

The ant. branches of the 4 upper lumbar nerves unite to form the *lumbar plexus*. Its branches are

Ilio-hypogastric.
Ilio-inguinal.
Genito-crural.
External cutaneous.
Obturator.
Accessory obturator.
Anterior crural.

The *anterior crural* gives off—*anteriorly*, middle cutaneous, internal cutaneous, and long saphenous; *posteriorly*, muscular and articular. It supplies the muscles on the front of the thigh, except Tens. Vag. Fem.

THE SACRAL AND COCCYGEAL NERVES are 5 in number on each side. They divide into anterior and posterior. The coccygeal goes to tip of coccyx, and ends in the integument.

The *sacral plexus* is formed by the upper 4 sacral nerves and the lumbo-sacral cord derived from the 4th and 5th lumbar nerves. Its branches are (1) muscular, (2) superior gluteal (supplying also Tens. Vag. Fem.), (3) pudic, (4) small sciatic, and (5) great sciatic.

The *pudic* gives off *inf. hemorrhoidal*, and divides into *perineal* and *dorsal nerve* of *the penis*.

The small sciatic gives off *inf. gluteal* to glut. max. and cutaneous branches.

The great sciatic—the largest cord in the body—passes out of the pelvis by gr. sac. sci. for. below pyriformis, descends bet. gr. troch. and tub. of isch. to lower third of thigh, and divides into internal and external popliteal nerves, giving off in its course articular and muscular branches.

The internal popliteal becomes, beneath the arch of the soleus, the *posterior tibial*. It gives off articular, muscular, and cu-

taneous branches, and the ext. or short saphenous.

The post. tibial gives off muscular and plantar cutaneous, and divides into external and internal plantar nerves, which end in digital branches arranged like those of the hand.

The *external popliteal* or *peroneal nerve* gives off articular and cutaneous branches, and divides into anterior tibial and musculo-cutaneous nerves.

The anterior tibial gives off muscular, tarsal, and internal branches, supplying adjacent sides of great and 2d toes.

The musculo-cutaneous supplies the muscles on the fibular side of the leg, and the integument of the dorsum of foot. It divides into 2 branches, external and internal.

THE SYMPATHETIC NERVOUS SYSTEM

is sometimes called *ganglionic*, because it is made up of a series of ganglia connected by cords.

THE CEPHALIC PORTION

consists of 4 ganglia: (1) *ophthalmic*, (2) *spheno-palatine* or *Meckel's*, (3) *otic* or *Arnold's*, (4) *submaxillary*.

THE OPHTHALMIC, LENTICULAR,

or ciliary, ganglion is about the size of a

pin's head, situated bet. the optic nerve and Ext. Rect. muscle. It has 3 roots: (1) sensory or long—from nasal br. of 5th; (2) motor or short—from inf. div. of 3d; (3) sympathetic—from cavernous plexus. The *short ciliary* branches of this ganglion supply the Iris and Ciliary muscle.

THE SPHENO-PALATINE GANGLION (MECKEL'S)

is situated in the spheno-maxillary fossa, close to spheno-palatine foramen. It has 3 roots: (1) motor—from facial by *Vidian* nerve; (2) sensory—from sup. max.; (3) sympathetic—from carotid plexus. Its branches are as follows:

Ascending—2 or 3 filaments to the periosteum of the orbit through spheno-maxillary fissure.

Descending—3 to palate, ant. or great, mid. or ext., and post. or small palatine nerves, the latter to the 2 elevators Lev. Pal. and Azyg. Uv.

Internal—to nose through spheno-palatine foramen, superior nasal (anterior), and naso-palatine (Cotunnius).

Posterior—(1) *Vidian*, running through Vidian canal in pteryg. proc., and dividing into *superficial* or *large petrosal*, passing through for. lac. med. and hiat. Fallopii to facial, and *carotid* to carotid plexus; (2) pharyngeal or pterygo-palatine passing

through pterygo-palatine to the mucous membrane of the pharynx.

THE OTIC GANGLION (ARNOLD'S)

is situated below the foramen ovale. It has 3 roots: motor—from inf. max.; sensory—from auriculo-temporal; and sympathetic—from middle meningeal. It gives off branches to the 2 Tensors (as Meckel's to the 2 elevators), Tens. Tymp. and Tens. Pal.

THE SUBMAXILLARY GANGLION

lies below the lingual nerve, by post. bord. of Mylo-hyoid. It has 3 roots: motor—from 7th by chorda tympani; sensory—from lingual; sympathetic—from facial plexus.

THE CERVICAL GANGLIA

are 3 in number—superior, middle, and inferior.

The *superior ganglion* is fusiform in shape, lying behind the sheath of the int. carotid and int. jug., opposite 2d and 3d cerv. vert. It gives off sup. inf., ext. int., and ant. branches. The superior branch divides into 2:

Outer forming carotid plexus.

Inner forming cavernous plexus.

The *carotid plexus* communicates with the Casserian ganglion, 6th nerve, and spheno-palatine ganglion, and is distributed to carotid artery and dura mater.

The *cavernous plexus* in cavernous sinus communicates with 3d, 4th, 5th, and 6th nerves, ophthalmic ganglion, and is distributed to the wall of the int. carotid.

The other branches of the sup. cerv. ganglion are distributed as their names import, and communicate with all the cranial and spinal nerves that lie in their course.

The *middle cervical ganglion*, opposite 5th cerv. vert., gives off the following branches: superior, inferior, external, internal (=thyroid and middle cardiac), and thyroid.

The *inferior cervical ganglion*, bet. base of trans. proc. of 7th cerv. vert. and neck of 1st rib, gives off superior, inferior, and external branches.

THE CARDIAC NERVES

are 3 in number on each side—superior, middle, and inferior, one being derived from each of the cervical ganglia. Plexuses are derived from these, receiving names according to the position which they occupy on the heart.

THE THORACIC PART OF THE SYMPATHETIC

consists of ganglia corresponding in number to the vertebræ.

The external branches communicate with each of the dorsal and spinal nerves.

The internal branches from the 6 upper ganglia supply the thoracic aorta. The internal from the 6 lower give filaments to

the aorta, and unite to form the 3 splanchnic nerves — greater, lesser, and renal splanchnic nerves distributed to the abdominal organs.

The *solar* or *epigastric* plexus receives the splanchnic nerves, and supplies all the viscera of the abdomen. It is made up of 2 *ganglia*—the *semilunar*, the largest in the body. From the solar plexus are derived the following plexuses, their distribution being indicated by their names: phrenic, celiac, gastric, hepatic, splenic, suprarenal, renal, superior mesenteric, spermatic, inferior mesenteric.

THE LUMBAR PORTION

consists of 4 ganglia, and gives off sup., inf. int. and ext. branches, and forming also plexuses.

THE PELVIC PORTION

consists of 4 ganglia, giving off numerous branches, and the *hypogastric* plexus supplying the pelvic viscera, and dividing into inferior hypogastric or pelvic plexuses. In front of the coccyx the termination of the pelvic sympathetic is called *ganglion impar*.

THE ORGANS OF SENSE

are 5 in number—viz.: those of touch, taste, smell, hearing, and sight.

THE SKIN

is the principal seat of the sense of *touch*. It consists of 2 layers, *epidermis* or *cuticle*, and *derma* or *cutis vera*. The epidermis is an epithelial structure. Its deeper and softer layers are called the *rete mucosum*. The *derma* consists of 2 layers, the *deep layer* or *corium*, and *superficial* or *papillary*.

THE TONGUE

is the organ of *taste*. Its base is connected with the hyoid bone by muscles, with the epiglottis by 3 folds of mucous membrane forming the glosso-epiglottic ligaments. The under surface is connected with the inf. maxillary by Genio Hyo-glossi, and in front a distinct fold of membrane forms the *frenum linguæ*. The mucous membrane consists of structures analogous to those of the skin.

The dorsum is marked in the median line by a tendinous raphe, and by 3 kinds of papillæ: (1) *papillæ maximæ* or *circumvallate*, arranged in the form of a V inverted; (2)

papillæ mediæ or *fungiform;* (3) *papillæ minimæ* or *filiform.*

The tongue is moved by—1. *Extrinsic muscles:* Hyo-gloss., Genio Hyo-gloss., Stylo-gloss., Palato-gloss., and part of Sup. Constrictor. 2. *Intrinsic muscles:* Sup. Longitudinal fibers, Inf. Longitudinal fibers (Lingualis), and Transverse.

The arteries of the tongue are derived from ling., fac., and ascend. pharyng.

The nerves of the tongue are 3 to each half; the gustatory branch of 5th to papillæ at fore part and sides of tongue (common sensation and taste); lingual branch of Glosso-pharyngeal to muc. memb. at base and sides of tongue and papillæ circumvallatæ (com. sens. and taste); hypoglossal nerve to muscular substance (motor).

THE ORGAN OF SMELL

consists of 2 parts—the nose and the nasal fossæ.

The *nose* is a frame-work of bones and cartilages.

The *bony frame-work* consists of the nasal bones and the nasal processes of the sup. maxillary.

The *cartilaginous frame-work* consists of 5 pieces—2 upper, 2 lower lateral, and cartilage of the septum or triangular cartilage.

The *nasal fossæ* have already been described. (See p. 30.) They are lined by

mucous membrane called *Schneiderian*, which is continuous with the conjunctiva by nasal duct and lach. canals; with lining memb. of tympanum and mastoid cells through Eustachian tube; with the antrum, frontal, ethmoid, and sphenoidal sinuses by the openings in the meatuses. On the portion to which the olfactory nerve is distributed the epithelium is tessellated. It is ciliated below, except near the aperture of the nares.

The *nerves* are:

Olfactory (special sense) distributed to upper third of septum, and surf. of sup. and mid. spongy bones.

Nasal br. of ophthalmic, filaments to upper and ant. part of septum.

Filaments from *ant. dent.* of *sup. max.* to inf. meatus and inf. turb. bone.

Vidian to upper and back part of septum.

Nas. branches of spheno-palatine ganglion distributed like the Vidian.

Naso-palatine to middle of septum.

Ant. palatine to mid. and inf. spongy bones.

The *arteries* are ant. and post., eth., spheno-pal., and alveolar.

THE EYE

is the organ of vision. The globe of the eye is composed of *tunics* and *humors*.

The *tunics* are 3 in number.

1. *Sclerotic* (or hard coat) and *cornea*.

The sclerotic forms five-sixths of the globe, the cornea the remaining one-sixth. It is pierced behind by the optic nerve, and the membrane through which the filaments pass is called the *lamina cribrosa*. The inner surface of the sclerotic is brown, marked by grooves in which are lodged the ciliary nerves, connected by a fine cellular tissue, the lamina fusca. The *cornea* is the transparent continuation of the sclerotic in front. It has 5 layers: a thick central fibrous structure, the cornea proper, in front of this the anterior elastic lamina, covered by the conjunctiva; behind the posterior elastic lamina, covered by the lining membrane of the anterior chamber of the eyeball.

The nerves are numerous in the cornea, but there are no arteries.

2. *Choroid* and *iris*. The 2d coat is formed by the choroid behind, and iris and ciliary processes in front. The choroid is highly vascular. It has 3 layers: external or *venæ vorticosæ*, middle or tunica Ruyschiana, and internal or pigmentary layer. The ciliary processes are formed by the plaiting inward of the choroid. The *iris* is the colored portion of the eye about the pupil. It has muscular fibers; *circular* = contractor of the pupil, *radiating* = dilator of the pupil.

3. *Retina*, composed of 3 layers: external or columnar layer (Jacob's membrane); middle or granular layer; internal or nervous layer. The arteria centralis retinæ

pierces the optic nerve, and goes to the nervous layer.

The *humors* of the eye are also 3 in number.

1. The *aqueous humor* fills the ant. and post. chambers of the eyeball. The ant. chamber is the space bounded in front by the cornea, behind by the front of the iris and ciliary ligament. The post. chamber is bounded in front by the iris, behind by the capsule of the lens and its suspensory ligament, and ciliary processes. The 2 chambers communicate through the pupil.

2. The *vitreous body* forms about four-fifths of the entire globe. It is hollowed out for the reception of the crystalline lens. The contents are inclosed in a thin membrane—the *hyaloid.*

3. The *crystalline lens* and its capsule are held in place by the *suspensory ligament.*

The *canal of Petit* is the space included between the suspensory ligament in front, and the hyaloid membrane behind the base being formed by the capsule of the lens.

THE APPENDAGES OF THE EYE

include the eyebrows, eyelids, conjunctiva, lachrymal gland, lachrymal sac, and nasal duct. The angles of junction of the upper and lower lids are called *canthi*—external and internal.

The *tarsal* cartilages are 2 thin elongated plates of fibro-cartilage, about an inch in

length. The *Meibomian glands* are between the tarsal cartilages and conjunctiva. The *conjunctiva* is the mucous membrane of the eye. It lines the inner surface of the eyelids, and is reflected over the sclerotic and cornea. The lachrymal gland is lodged in a depression at the outer angle of the orbit on the inner side of the ext. ang. proc. of frontal bone.

The lachrymal canals commence at minute orifices, *puncta lachrymalia;* they lead into the canaliculi, which terminate in the lachrymal sac, at the internal angle of the orbit. The nasal duct leads from this down into the inf. meatus of the nose.

THE EAR

is the organ of hearing. It consists of 3 portions—external, middle, and internal.

The *external ear* has an expanded portion called the *pinna*, the prominent margin of which is called the *helix.* The ridge next to this, divided above, is called the *anti-helix.* The lower and front part incloses a cavity, the *concha*, below which lie opposite to each other the *tragus* and *anti-tragus.* The depending soft part is called the *lobule.* The structure of the ext. ear is cartilaginous, except the lobule, which is connective tissue and fat. The entrance to the ear is called the *meatus auditorius externus*, $1\frac{1}{4}$ in. long (cartilaginous $\frac{1}{2}$ in., osseous $\frac{3}{4}$ in.), directed forward and inward. Near its ori-

fice are the *ceruminous glands*, secreting the wax. At the bottom of the meatus is the membrana tympani.

The *middle ear* or tympanum is a drum containing air, bounded *ext.* by *memb. tymp.* and meatus; *int.* by outer surf. of int. ear. Its roof and floor are formed by the connecting laminæ between the squamous and petrous portions of the temporal bone. The floor corresponds to the jugular fossa.

The *outer* wall of the chamber is formed by the membrani tympani, which is placed obliquely at the end of the meatus; the *inner* wall corresponds to the outer wall of the *vestibule; in front* is the opening of the Eustachian tube with the special tube for the Tensor Tympani muscle formed by the processus cochleariformis; *behind* is the opening into the mastoid cells. The *roof* of the chamber is a thin portion of bone separating it from the cavity of the cranium; the *floor* is a thicker portion corresponding to the jugular fossa.

The inner wall is the most important, and presents the following points for examination: (1) the *fenestra ovalis*, in which the base of the stapes articulates; below this (2) the *fenestra rotunda*, an opening into the cochlea; anterior to these a slight eminence grooved by nerves, (3) the *promontory* with Jacobson's nerve; and, posterior to the fenestra ovalis and fenestra rotunda, and close to the opening of the

mastoid cells, (4) the *pyramid*, a conical projection of bone pierced at the top by a small hole through which the *Stapedius* muscle works.

The *aqueduct of Fallopius*, or canal for the facial nerve, extends from the bottom of the meatus auditorius internus to the stylo-mastoid foramen. In the upper part of the canal is the *intumescentia ganglioformis*, an enlargement of the facial nerve at the point where it is joined by the great petrosal nerve through the hiatus Fallopii. The facial nerve in this part of its course gives off a minute branch to the Stapedius muscle and the chorda tympani.

The *chorda tympani* enters the tympanum close to the pyramid, and passes forward, between the handle of the malleus and the long process of the incus, to an opening close to the Glasserian fissure (the canal of Huguier), by which it leaves the temporal bone to join the gustatory nerve.

The *ossicula auditus* are the malleus, incus, and stapes.

The *malleus* (hammer) consists of a head, neck, handle (manubrium), and 2 processes, processus gracilis and processus brevis. The head articulates with the incus; the manubrium is inserted between the mucous and fibrous layers of the membrana tympani; the processus gracilis is inserted into the Glasserian fissure; the processus brevis gives attachment to the Tensor Tympani muscle.

The *incus* (anvil) consists of a body and 2 processes. The body articulates with the head of the malleus; the short process is attached to the margin of the orifice of the mastoid cells; the long process is nearly parallel to the handle of the malleus, and has at its extremity a small nodule of bone, the *os orbiculare*, which in the fœtus is separate, but becomes united in adult life, and articulates with the stapes.

The *stapes* (stirrup) is articulated by its head with the long process of the incus and at right angles to it. The base (at which the 2 crura unite) is attached to the fenestra ovalis; the neck gives attachment to the small Stapedius muscle.

The *muscles* of the tympanum are 3 in number—viz.: the Tensor Tympani, Laxator Tympani, and Stapedius; but some anatomists add a 4th, the Laxator Tympani Minor.

The *Tensor Tympani arises* from the under surface of the apex of the petrous portion of the temporal bone and from the Eustachian tube, and runs backward in a distinct canal formed by the processus cochleariformis, to be *inserted* into the root of the handle and the processus brevis of the malleus. It is *supplied* by a branch from the otic ganglion.

The *Laxator Tympani arises* from the under surface of the spine of the sphenoid bone and from the Eustachian tube, and

entering the tympanum through the Glasserian fissure is *inserted* into the neck of the malleus. It is *supplied* by a branch from the chorda tympani.

The *Stapedius arises* from the interior of the pyramid, and emerges from its apex to be *inserted* into the neck of the stapes. It is *supplied* by a branch of the facial nerve.

The *Laxator Tympani Minor arises* from the upper margin of the meatus externus, and is *inserted* into the handle and processus brevis of the malleus.

The *internal ear* or *labyrinth* contains—

1. The *vestibule*, placed behind the cochlea and before the semicircular canals. It is a small oval cavity lined by a membrane common to the labyrinth, contains a watery fluid, and presents the following openings—viz.: the foramen ovale, the 5 orifices of the semicircular canals, the orifice of the scala vestibuli of the cochlea, and the orifice of the aqueduct of the vestibule.

2. The *semicircular canals*, placed behind the vestibule, are 3 in number, 2 vertical and 1 horizontal; of the former, one is superior, and the other posterior. The openings of these canals are only 5 in number, in consequence of one opening of the vertical canals being common to both.

3. The *cochlea*, of conical form, the base toward the internal meatus, the apex toward the carotid canal, is composed of a bony tube which makes 2 turns and a half

round a central pillar called *the modiolus.* This tube is divided longitudinally by a thin plate, half bony, half membranous, called *lamina spiralis*, into 2 cavities; the 2 tubes thus formed are called the scalæ of the cochlea, they both unite at the apex in a cavity called *infundibulum*, and at the base of the cochlea they separate, one called *scala vestibuli*, which opens into the vestibule, the other called *scala tympani*, which opens into the tympanum by the fenestra rotunda. From the scala tympani proceeds a narrow bony canal called *the aqueduct of the cochlea*, which terminates in a slit-like opening in the inferior border of the petrous bone.

4. The *auditory nerve* gains the internal ear by the minute foramina at the base of the meatus auditorius internus, and divides into 2 branches, vestibular and cochlear.

The *vestibular* divides into 3 branches—sup., mid., and inf.

The *cochlear* divides into numerous filaments at the base of the modiolus, and then ascends along its canals, and bends outward between the plates of the bony lamina spiralis.

THE ORGANS OF DIGESTION

are as follows:

Alimentary Canal.

Mouth.
Pharynx.
Esophagus.
Stomach.
Small intestine. { Duodenum. Jejunum. Ileum.
Large intestine. { Cæcum. Colon. Rectum.

Accessory Organs.

Teeth.
Salivary glands. { Parotid. Submaxillary. Sublingual.
Liver.
Pancreas.
Spleen.

THE MOUTH

is placed at the entrance of the alimentary canal. The orifice is surrounded by 2 fleshy folds—the lips connected by *frœna* to the *gums*, which are composed of fibrous tissue

surrounding the necks of the teeth. The labial and buccal glands lie between the mucous membrane and subjacent muscles.

THE TEETH

appear in 2 sets. The 1st set appear in childhood, and are called *temporary*, *deciduous*, or *milk teeth*. The 2d set continue until old age, and are called *permanent*. Each tooth consists of a crown—above the gum, a fang or root imbedded in the alveolar process, and the neck between the two. The *temporary* teeth are 20 in number, 4 incisors, 2 canine, and 4 molars in each jaw. The *permanent* teeth are 32 in number, 4 incisors, 2 central and 2 lateral, 2 canine, 4 bicuspids, and 6 molars in each jaw. The incisors and canine have single fangs and single cusps. The bicuspids have 2 cusps, and sometimes 2 fangs. The upper molars have 3 fangs in the upper jaw, and 2 in the lower. The 3d molar tooth is called the wisdom tooth. The molars generally have 3 cusps. A section of a tooth shows externally around the crown hard *enamel*, consisting of a congeries of hexagonal rods; around the root *crusta petrosa* or *cement;* beneath these is the ivory or dentine, the larger portion of the tooth, consisting of *tubuli* arranged parallel with each other, opening at their inner ends into the *pulp cavity*. They contain slender prolongations of the pulp tissue, a soft vascular and sen-

sitive substance supplied with vessels and nerves entering the cavity through the small openings at the point of each fang.

The periods of eruption are:

Temporary Teeth.

Central incisors, 7th month.
Lateral incisors, 7th to 10th month.
Anterior molars, 12th to 14th month.
Canine, 14th to 20th month.
Posterior molars, 18th to 36th month.

Permanent Teeth.

First molars, 6½ years.
Two middle incisors, 7th year.
Two lateral incisors, 8th year.
First bicuspid, 9th year.
Second bicuspid, 10th year.
Canine, 11th to 12th year.
Second molars, 12th to 13th year.
Wisdom teeth, 17th to 21st year.

THE PALATE

forms the roof of the mouth. It consists of 2 portions—the hard palate in front, and the soft behind.

The *hard palate* is continuous with the soft palate. Its mucous membrane is adherent to the maxillary periosteum, and has beneath it glands which open on its surface.

The *soft palate* or *velum pendulum palati*

intervenes between the nose and the mouth, and consists of a fibrous membrane which is attached to the palate bones, and strengthened by expansions from the several muscles of the palate. It is covered by mucous membrane, ciliated on the upper but not on the lower surface. The center of its free border is prolonged into the uvula, and on each side are the pillars of the fauces—the anterior formed by the Palato-glossus muscle with the mucous membrane, and the posterior by the Palato-pharyngeus.

The muscles of the soft palate are 5 on each side: Lev. Pal., Tens. Pal., Palato-glossus, Palato-pharyngeus, and Azygos Uvulæ.

The *amygdalæ* or *tonsils* lie between the Palato-glossus and Palato-pharyngeus muscles. It consists of a number of mucous follicles, which open on the internal surface. Externally the tonsil is in relation with the sup. constrictor, the int. carotid, and ascending pharyngeal.

THE SALIVARY GLANDS

connected with the mouth are the *parotid*, *submaxillary*, and *sublingual*.

The *parotid gland* is the largest of the salivary glands, and is placed between the ear and the lower jaw, its superficial part overlapping the Masseter muscle, and being called the *socia parotidis*. It reaches as

high as the Zygoma and as far back as the mastoid process, and below it is separated from the submaxillary gland by the stylo-maxillary ligament, its deep surface resting against the styloid process and the muscles attached to it. The duct of Steno (ductus Stenonis) arises from the anterior part below the socia parotidis, and passes transversely across the Masseter about a finger's breadth below the Zygoma, to open into the mouth through the Buccinator muscle opposite the 2d molar tooth of the upper jaw. Immediately below the duct is a large branch of the facial nerve, and above it the transverse facial artery. The gland is traversed by the external carotid artery, which gives off its 2 terminal branches (temporal and internal maxillary) in its substance; by the external jugular vein; and by the facial and auriculo-temporal nerves, from both of which it receives branches. The structure of the parotid is that of a simple lobulated gland like the other salivary glands.

It receives *parotid branches* from the temporal artery and nervous filaments from the auriculo-temporal nerve.

The *submaxillary gland* consists of 2 portions—one, the larger, placed superficially on the mylo-hyoid in the submaxillary triangle, and the other winding round the posterior margin of the mylo-hyoid to rest on the hyo-glossus. From this deep portion the duct (Wharton's) arises, and lies at

first between the lingual and hypoglossal nerves, but at the anterior part of the hyo-glossus ascends beneath the lingual nerve at a higher level. It crosses again over the lingual nerve at the side of the tongue, and to open into the mouth close to the frænum linguæ.

The *sublingual gland* is beneath the mucous membrane by the side of the tongue, and lies on the genio hyo-glossus close to Wharton's duct, into which several of its ducts (ductus Riviniani) open, the others opening into the mouth in a crescent near the frænum.

THE PHARYNX

is a conical musculo-membranous bag extending by its base from the posterior part of the mylo-hyoid ridge and base of the skull to the posterior aspect of the cricoid cartilage, where it terminates in the esophagus. It is connected by its posterior wall to the vertebræ by loose cellular tissue, and interiorly it corresponds to the mouth and larynx.

It has the following 7 openings: superiorly, the posterior nares; externally, the Eustachian tubes; inferior to these is the opening of the mouth into the pharynx, or the isthmus faucium; posterior and inferior to the tongue is the superior opening of the larynx, and, lastly, the opening of the pharynx into the esophagus.

THE ESOPHAGUS

extends from the pharynx to the stomach; it is placed above, between the vertebræ and the trachea, inclines inferiorly to the left side, and passes behind its left bifurcation to reach the posterior mediastinum. In the mediastinum it descends forward, above the thoracic aorta, passes through the esophageal opening of the diaphragm, to terminate in the stomach. The mucous membrane of the mouth, pharynx, and esophagus is covered by epithelium.

THE ABDOMEN

is the largest cavity in the body. It is divided into 9 regions, with the contents of each as expressed in the following table:

TABLE OF ABDOMINAL CONTENTS.

Right Hypochondriac Region.	*Epigastric Region.*	*Left Hypochondriac Region.*
Right lobe of liver and gall-bladder, 1st part of duodenum, hepatic flexure of colon, pancreas, right suprarenal capsule, and part of right kidney.	Stomach (center and pylorus), left lobe of liver, lobus Spigelii, pancreas.	Stomach (cardiac end), spleen and tail of pancreas, splenic flexure of colon, left suprarenal capsule, and part of left kidney.
Right Lumbar Region.	*Umbilical Region.*	*Left Lumbar Region.*
Ascending colon, small intestine, right kidney.	Great omentum, transverse colon, 3d portion of duodenum, convolutions of jejunum and ileum.	Descending colon, small intestine, left kidney.
Right Iliac Region.	*Hypogastric Region.*	*Left Iliac Region.*
Cæcum, ureter.	Small intestines, apex of bladder in distension and in children. Pregnant uterus.	Sigmoid colon, ureter.

THE PERITONEUM

is the short serous sac investing the intestines.

Beginning at the umbilicus the membrane lines the abdominal wall, and reaches the diaphragm; from this reflected on the upper surface of the liver, round its anterior margin, and on the under surface of the organ as far back as the transverse fissure. It then passes down to the stomach, forming the anterior layer of the *gastro-hepatic* or *lesser omentum*, covers the anterior surface of the stomach, and is prolonged downward over the intestines to form the anterior layer of the *great omentum* or *epiploon*. By turning up the great omentum, the peritoneum will be seen to be reflected upon itself to form the posterior layer of the great omentum, which is continued upward until it meets with the transverse colon, under which it is prolonged to the spine, forming the under layer of the *transverse meso-colon*. It is now carried over the mesenteric vessels to the small intestine and back to the spine, thus forming the 2 layers of the *mesentery;* and it can then be seen to pass over the abdominal aorta into the pelvis, where it invests the rectum (*meso-rectum*) and passes from that intestine to the bladder, forming in the male the *recto-vesical pouch*. In the female the peritoneum is reflected from the rectum to the upper part of the vagina, forming the

recto-vaginal pouch (or *cul-de-sac of Douglas*), then over the uterus and between the uterus and bladder, forming the *utero-vesical pouch*. It is lastly carried over the bladder to the lower part of the abdominal wall and so to the umbilicus.

What is called the *greater bag* of the peritoneum has now been traced, but there is another pouch called the *lesser bag* placed behind it, and continuous with it through a hole or tube, the *foramen of Winslow*. This will be found by passing the finger carefully round the right border of the lesser omentum and immediately below the liver, when its point may be seen through the semi-transparent *double* fold of the lesser omentum. To see the cavity of the lesser bag, an incision must be carefully made through the great omentum, when, if the parts are healthy, the bag will be readily opened and the finger passed through the foramen of Winslow will be clearly seen.

Tracing it from the foramen, the membrane of the lesser bag will be found to form the posterior layer of the lesser omentum, then to cover the posterior surface of the stomach and to be prolonged downward to form the 2 internal layers of the great omentum, after which it passes up over the pancreas to the under surface of the liver behind the transverse fissure.

The *foramen of Winslow* is simply a constriction of the peritoneum dividing it into

2 parts, and produced by the passage of the hepatic artery forward and upward to the liver. When the finger is in the foramen it will feel the following boundaries: *in front*, the lesser omentum, containing the hepatic artery, bile duct, and portal vein; *behind*, the right crus of the diaphragm and the inferior vena cava; *below*, the hepatic artery (as it passes forward from the aorta); *above*, the lobulus Spigelii of the liver.

It is sometimes preferred to trace the 2 sacs of the peritoneum together, which can be readily done in the following way: Beginning at the liver, one layer covers the front and the other the back of the under surface of the organ, and the 2 meet at the transverse fissure to form the lesser omentum. They then separate to inclose the stomach, uniting at its lower border to form the anterior 2 layers of the great omentum; being reflected upon themselves they next form the posterior 2 layers, which separate to inclose the transverse colon, forming the meso-colon, as they are prolonged to the spine. The 2 layers now leave one another, and the upper one (lesser bag) is prolonged over the pancreas to the under surface of the liver, where it commenced. The under layer (greater bag) forms the mesentery around the small intestines, the recto-vesical pouch between the bladder and rectum, and passes over the abdominal wall to the diaphragm, from which it is reflected on

to the liver, where the description commenced.

Besides tracing the peritoneum vertically as has been shown, it should be traced horizontally as follows: Below the level of the transverse colon the circle will be found to be exceedingly simple. Beginning at the median line of the abdominal wall, the peritoneum may be traced to the right iliac region, where it will be found to cover the front of the cæcum and ascending colon (forming the *meso-cæcum* and *ascending meso-colon*); it then forms the *mesentery* around the small intestine, any portion of which will serve to show it; and lastly, covering the sigmoid flexure of the colon (*sigmoid meso-colon*), it is brought round again to the abdominal wall.

A fold attaching the top of the descending colon to the under surface of the diaphragm (*costo-colic*, Jenner) should be noticed, since it passes below the spleen and influences the movements of that organ.

Above the colon the arrangement is a little complicated by the existence of 2 sacs, the continuity of which, however, may be traced thus: Beginning at the median line of the abdominal wall the peritoneum may be traced into the right hypochondrium and over the right kidney; it then passes through the loop of the hepatic artery (foramen Winslowii), and across the

body in front of the pancreas, then to the posterior surface of the stomach and back to the foramen again, where it forms the posterior layer of the lesser omentum. Reflected at this point upon itself, the membrane will be seen to form the anterior layer of the lesser omentum and to be continued over the front of the stomach; thence to the spleen, which it incloses (forming the *gastro-splenic omentum*), and so to the left hypochondrium and round the abdominal wall. The continuity of the greater with the lesser bag is thus evident, and the foramen of Winslow is seen to be merely the narrowed tube of communication between the 2 cavities.

Besides the folds of peritoneum which have been named in tracing the membrane, there are others which form certain ligaments of the liver and bladder, and of the uterus in the female.

Passing from the umbilicus to the liver, the obliterated umbilical vein or *round ligament* is seen, and around it is reflected a double fold of peritoneum, the *suspensory* or *falciform ligament* of the liver. This is prolonged on each side over the diaphragm, and on the upper surface of the liver, where it forms the upper layer of the *coronary ligament;* the under layer being formed partly by the lesser bag of the peritoneum, and the triangular surface between the two being attached by firm areolar tissue to the

diaphragm. The doubled edges of the upper layer of the coronary ligament on each side are called the right and left *lateral ligaments.*

The *false ligaments* of the bladder are formed by the peritoneum; they are 5 in number—2 posterior, 2 lateral, and 1 superior. The *posterior* false ligaments are the margins of the recto-vesical pouch, and are formed by the membrane being reflected over the obliterated hypogastric arteries. The *lateral* false ligaments are the pieces of peritoneum reaching from the bladder to the sides of the pelvis, and the *superior* is that passing over the obliterated hypogastric arteries and urachus to the umbilicus.

THE STOMACH

presents a lesser and a greater curvature at its upper and lower borders, and a greater and a lesser end. The great end is the dilatation on the left side of the body near the entrance of the esophagus, and is called the cardiac or splenic end, or is sometimes known as the fundus. The small end terminates in the duodenum, and is called the pyloric end.

The coats of the stomach are 4—peritoneal, muscular (comprising longitudinal, circular, and oblique fibers), areolar, and mucous.

The mucous membrane is arranged in

longitudinal folds or ridges called *rugæ*, which disappear when the viscus is distended.

The *pylorus* or *pyloric valve* consists of a set of strong circular fibers at its duodenal end, acting as a sphincter muscle.

The mucous membrane is divided into a series of shallow cavities hexagonal in form (stomach cells), at the bottom of which 2 or more tubes (gastric follicles containing the peptic glands) open. These latter secrete the gastric juice, and are imbedded in the submucous areolar layer. The epithelium is columnar.

THE SMALL INTESTINES

extend from the pylorus to the ileo-cœcal valve, averaging 20 feet in length. They have 4 coats—viz.: peritoneal, muscular (longitudinal and circular), areolar, and mucous. Thus the first part of the duodenum is completely invested except in front. The longitudinal muscular fibers are external, and the circular internal. The mucous membrane has the following characteristics throughout: Valvulæ conniventes, villi, Lieberkühn's follicles, solitary glands, and a columnar epithelium; but the duodenum and ileum have special structures in addition.

The *duodenum* presents the opening of the bile and pancreatic ducts, which is marked by a papilla situated at the back

of the vertical portion of the intestine, and about or below its middle. The duodenum is from 8 to 10 inches long, and has a special structure (Brunner's glands) in addition to the ordinary characteristics of the small intestine.

Valvulæ conniventes are transverse folds of mucous membrane, which will be seen to commence a little beyond the pylorus, and to increase in size at the lower part of the duodenum.

Villi are minute projections from the surface of the mucous membrane, each containing a little capillary loop and a lacteal vessel, and being covered with columnar epithelium.

Lieberkühn's follicles are minute tubes which are placed between the villi; they dip into the submucous areolar tissue, and are lined with columnar epithelium.

Solitary glands are minute white bodies consisting of closed vesicles containing milky fluid and covered with villi. In typhoid fever they are enlarged and ulcerated.

The *jejunum* includes about two-fifths of the remaining small intestine, and is remarkable for the large size of the valvulæ conniventes and the number of solitary glands.

In the *ileum* the valvulæ conniventes will be found to diminish rapidly in size and to be wanting at the lower part.

Peyer's patches, the special characteristic of this part of the intestine, are formed of a collection of the solitary glands.

THE LARGE INTESTINE

is divided into cæcum, colon, and rectum, and is between 5 and 6 feet in length, and is remarkable for the pouched appearance consequent upon its longitudinal muscular fibers being shorter than the intestine itself. These longitudinal fibers are arranged in 3 distinct bands, 2 of which can be seen through the peritoneum, and the 3d between the layers of the meso-colon. (In the rectum, which is not pouched, these fibers spread over the whole gut as in the small intestine.) The *appendices epiploicæ* are small processes containing fat attached along the free border of the intestine, which will be found to vary considerably in size in different subjects.

The *cæcum* is distinguished by its rounded shape and by the opening of the ileum into it. It has attached to its lower and back part the *appendix vermiformis*, which is a little tubular prolongation terminating in a blind extremity.

The *ileo-cæcal valve* is formed by a prolongation of a piece of ileum through the wall of the cæcum, to which it is firmly attached.

The mucous membrane of the large intestine has no villi nor Peyer's patches.

Tubular glands resembling the follicles of Lieberkühn, and solitary glands or closed follicles imbedded in the submucous tissue, and having over them small depressions on the mucous surface, are found throughout the large intestine.

The *colon* is divided into right or *ascending* colon, the middle or *transverse*, the left or *descending*, and the *sigmoid flexure*.

The *rectum* extends from the sigmoid flexure of the colon to the anus; its upper third is wholly covered by peritoneum, its middle third only upon its anterior aspect and sides, and its inferior third has no peritoneal covering. In the male the antero-inferior aspect of the rectum is connected to the inferior surface of the bladder, the vesiculæ seminales, and the prostate gland, and in the female to the uterus and vagina. The rectum has the longitudinal fibers scattered over its whole surface, and is not sacculated like the other parts of the large intestine.

THE LIVER

presents 5 lobes, 5 fissures, and 5 ligaments. It measures 12 in. transversely, 6 in. from before backward, and 3 in. in thickness. On its upper surface it is divided into 2 unequal portions by the *falciform* or suspensory ligament. Tracing this back, the layers diverge to form the upper layer of the *coronary* ligament and the 2

lateral ligaments. The *fifth* or *round* ligament is the obliterated umbilical vein. Five fissures and 5 lobes are seen on the under surface of the liver.

1. *Longitudinal* forming (1) *right* and (2) *left* lobes, and occupied by round ligament.
2. Fissure for *ductus venosus.*
3. Transverse fissure giving passage to hepatic duct, hepatic artery, and portal vein, in that order from before backward.
4. Fissure for gall-bladder.
5. Fissure for *vena cava.*

The right and left lobes are formed by long. fissure. The *lobus quadratus* is bounded by the long. and trans. fissures and the gall-bladder. The *lobus Spigelii* lies between the *vena cava* and *ductus venosus.* The *lobus caudatus* connects the lobus Spigelii with the right lobe.

The *gall-bladder* is the reservoir for the bile. It ends in the cystic duct which joins the hepatic duct to form the *ductus communis choledochus.*

The liver is composed of lobules held together by loose areolar tissue of the ramifications of the portal vein, hepatic duct, artery, and veins, lymphatics, and nerves. The portal circulation is as follows: The portal vein enters the transverse fissure, divides into vaginal branches which subdivide into the *interlobular* veins *between* the lobules. These pierce the lobule to form the *intralobular* plexus *within* the lob-

ule. These unite at the base to form the *sublobular*, which then unite to form the *hepatic* veins, uniting thus with the blood returned from the substance of the liver to empty into the vena cava inferior.

The capsule of Glisson is the areolar tissue which accompanies the vessels in their course through the portal canals.

THE PANCREAS

is about 7 inches long. The larger end, where it touches the bowel, is called the head, the central portion the body, and the small extremity the tail. Its average weight is 3 ounces. Its duct (Wirsung's) passes into the duodenum. The pancreas consists of lobules of a yellowish color held together by loose fibrous tissue, a small duct passing from each lobule into the main trunk.

THE SPLEEN

is a purple organ, oval in form, has a convex and a concave surface, with an anterior border which is sharp and slightly notched, and a posterior border which is thicker. On the concave surface is a vertical fissure, the *hilum*, into which the splenic vessels enter. Beneath the peritoneal coat which invests the organ is found a fibrous coat, which is also continued into the splenic substance, forming the *trabeculæ* in which the splenic *pulp* is contained. In this pulp,

which consists principally of blood-vessels, are found the *Malpighian corpuscles*, special to the spleen. They are small vesicular bodies containing white semi-fluid matter attached to the minute divisions of the splenic artery.

ORGANS OF VOICE AND RESPIRATION.

THE LARYNX

is a triangular box, made up of cartilages, ligaments, muscles, mucous membrane, vessels, and nerves.

There are 9 cartilages entering into its formation: thyroid, cricoid, epiglottis, 2 arytenoid, 2 cornicula laryngis, 2 cuneiform.

The *thyroid cartilage* has 2 alæ united in front to form the *pomum Adami*, 4 cornua, 2 sup. and 2 inf. It gives attachment to the Stylo-phar., Palato-phar., Thyro-hyoid, Sterno-thyroid, and Inferior Constrictor, besides others of the intrinsic muscles of the larynx.

The *cricoid cartilage* gives attachment to inf. cons. fibers of esophagus, intrins. muscles, and ligaments of the larynx.

The *cuneiform cartilages* are included in the aryteno-epiglottidean mucous fold.

The *epiglottis* closes the opening of the larynx.

The *arytenoid cartilages* are situated at the back of the larynx, at the upper border of the cricoid cart.

The *cornicula laryngis* are connected with the apices of the arytenoid cartilages.

The ligaments of the larynx are 6 in number: thyro-hyoid, crico-thyroid membrane, crico-tracheal, capsular, thyro-epiglottidean and hyo-epiglottidean folds covered by mucous membrane—their names indicating their situation.

The *intrinsic muscles* of the larynx are 8 in number.

Five belong to the *rima glottidis* and *chordæ vocales*—Crico-thyroid, Crico-arytenoideus Posticus and Lateralis, Arytenoideus and Thyro-arytenoideus.

Three belong to the epiglottis—Thyro-epiglottidean, Aryteno-epiglottidean, sup. and inf.

The vocal chords or thyro-arytenoid ligaments are 4 in number—2 sup. or *false* chords, and 2 inf. or *true* chords.

The interval between the 2 true chords is called the *rima glottidis.*

The arteries of the larynx are derived from the superior and inferior thyroid.

The nerves are the superior and inferior or recurrent laryngeal from the pneumogastric.

The superior supplies the Crico-thyroid muscle and the mucous membrane, the inferior supplies all the muscles except the Crico-thyroid.

The mucous membrane is columnar ciliated below the sup. voc. chord; above the

cilia exist only in front and as high as the middle of the epiglottis, and beyond this it is squamous.

THE TRACHEA

is about 4½ inches in length, and is convex in front, but flattened posteriorly, being composed of a series of cartilages, the extremities of which are connected behind by fibrous and muscular tissue. There are from 16 to 20 cartilages, each measuring about 2 lines in depth, decreasing in depth from above downward. The last cartilage is cut obliquely on each side, so as to be adapted to the commencement of the bronchi. The cartilages are connected together by fibrous tissue, and the 1st is similarly connected to the cricoid cartilage.

Opposite the 5th dorsal vertebra it bifurcates into the bronchi.

The *right bronchus* is larger than the left, and is posterior and superior to the pulmonary vessels in the root of the lung. It is about 1 inch long, and takes a more horizontal course than the left. The vena azygos major hooks round the right bronchus to open into the vena cava.

The *left bronchus* is nearly twice as long as the right, and takes an oblique course beneath the arch of the aorta, crossing the esophagus and the descending aorta, and lying posterior to, but visible between, the pulmonary artery and veins.

THE THYROID BODY

consists of 2 symmetrical conical *lobes*, placed on each side of the upper part of the trachea, and united opposite the 2d and 3d rings of the trachea by the *isthmus*.

THE PLEURÆ

are 2 shut sacs of serous membrane lining the thorax and covering the lung. If one of the lungs is drawn forward, its pleura can be readily traced over the inner surface of the sternum and ribs (costal or parietal layer) on to the back of the lung; thence over the lung (pulmonary or visceral layer) to the front of the root of the lung, by which it is directed to the pericardium and carried forward to the sternum a little to one side of the median line. When the lung is drawn forward, below its root will be found a fold of pleura connecting the lower lobe with the side of the pericardium, which is called the *ligamentum latum pulmonis*. The pleura will be seen to be reflected on the upper surface of the diaphragm below, and to be prolonged in a conical form above the 1st rib, where it may be felt in relation with the subclavian artery. The diaphragm rises higher on the right side than on the left, owing to the presence of the liver, and the heart has a direction to the left; hence the right bag of the pleura is the wider, whilst

the left is the longer of the two, and the lungs correspond in shape.

THE MEDIASTINA

are the spaces between the pleuræ, and are 3 in number—anterior, middle, and posterior.

The *anterior mediastinum* is the small space bounded by the sternum in front, the pericardium behind, and the pleuræ at the sides, and is placed a little to the left of the median line. It contains (1) the Triangularis Sterni muscle, (2) the origins of the Sterno-hyoid and Thyroid muscles, (3) the remains of the thymus gland (a ductless gland largely developed in the fœtus), (4) the *left* internal mammary vessel, some cellular tissue, and a few lymphatics.

The *middle mediastinum* is the space between the 2 lungs, and contains (1) the heart and large vessels, (2) the pericardium, (3) the roots of the lungs, and (4) the phrenic nerves.

The *posterior mediastinum* is behind the pericardium. It contains (1) the thoracic aorta, (2) the trachea, (3) the esophagus, with the 2 pneumogastric nerves, (4) the vena azygos major, (5) the thoracic duct, (6) the greater splanchnic nerves at the lower part of the space, with some cellular tissue and lymphatics.

THE LUNGS

are 2 in number, divided each into 2 lobes,

and separated from each other by the heart and other contents of the mediastinum. The right lung is the larger, but shorter than the left.

On tracing the bronchi they will be found to divide again and again, the cartilaginous rings becoming merely plates, and at length disappearing, and the air-tubes thus becoming eventually membranous. The minute *bronchial tubes* terminate in *intercellular passages*, in which the mucous membrane is covered with squamous epithelium. Opening out of the intercellular passages are the *air-cells* or alveoli, the septa between which are formed by reduplications of the lining membrane.

The air-cells collected around the extremity of each minute bronchial tube form a *lobule*, and these aggregated together form the substance of the lung, but the air-cells of one lobule have no connection with those of another.

The *roots of the lungs* are each formed by a pulmonary artery, 2 pulmonary veins, and a bronchus, bound together by cellular tissue; together with the small bronchial vessels, the pulmonary plexus of the pneumogastric nerve, and some lymphatics. The order of the vessels from before backward on both sides of the body is the same—viz.: veins, artery, and bronchus; from above downward on the right side the order is the reverse—viz.: bronchus, artery, veins,

but on the left side it is artery, bronchus, veins. The reason of this difference is that the left bronchus passes beneath the arch of the aorta, and therefore becomes lower than the pulmonary artery on that side. The right pulmonary vessels pass beneath the arch of the aorta.

Organs of Circulation.

The Heart

is a conical organ situated in the middle mediastinum, and resting on the diaphragm. The base corresponds to the interval between the 6th and 9th dorsal vertebræ, and the apex beats between the 5th and 6th ribs, and the larger portion of the organ being to the left of the median line. The surface markings are the upper border of the 3d costal cartilage for the base of the heart, and a spot 2 inches below the nipple and 1 to the sternal side for the apex.

The heart is a double organ, composed of 2 auricles and 2 ventricles.

Each auricle has an appendix.

The anterior surface of the heart is convex, and is formed almost entirely by the right ventricle and auricular appendage, but the irregular border of the left auricular appendage appears to the left of the pulmonary artery. The posterior surface of the heart is flattened, and is formed by part of the right auricle and the left auricle and ventricle, which last forms the apex of the heart. Each surface of the heart is grooved vertically and horizontally, marking the divisions between the auricles and

ventricles. The anterior ventricular groove is near the left border of the heart, whilst the posterior ventricular groove is to the right, and they thus indicate the oblique position of the septum. In these grooves will be seen the coronary vessels. The *endocardium* or lining membrane of the heart is continuous with the lining membrane of the veins and arteries.

The right side of the heart is the venous side, and the left the arterial.

Right auricle.—The main cavity of the auricle is smooth internally, but in the appendix are the *musculi pectinati*, or muscular bands "resembling a comb."

The large openings into the right auricle are (1) the *superior vena cava*, which enters at the upper and anterior part; (2) the *inferior vena cava*, which enters at the lower and back part; and (3) the *coronary sinus*, which enters close above the *auriculo-ventricular* opening.

The *foramina Thebesii* are numerous small openings which are found in the wall of the auricle, and return blood from the muscular tissue of the heart.

The *tubercle of Lower* is a projection which is occasionally found in the wall of the auricle, between the superior and inferior venæ cavæ.

The *coronary valve* is a thin fold at the orifice of the coronary sinus, which serves to prevent regurgitation into it.

The *Eustachian valve* is a fold placed to the left of the vena cava inferior and immediately above the opening of the coronary sinus, which served in the fœtus to direct the current of blood from the inferior vena cava through the foramen ovale.

The *fossa ovalis* and *annulus ovalis* are remains of fœtal structure, found on the inner wall of the right auricle in the position of the *foramen ovale* or communication between the 2 auricles in the fœtus.

The *annulus ovalis* is a muscular ring which is generally well marked, and which surrounds the shallow *fossa ovalis*, formed by a thin membrane thrown across the foramen ovale. This membrane is produced from the anterior and posterior margins of the foramen immediately after birth, and the 2 portions gradually obliterate the opening by overlapping one another; not unfrequently, however, a small oblique opening will be found at their point of junction, through which a probe can be introduced.

The *right ventricle* consists of a main cavity, the walls of which are irregular, owing to the projections of the muscular substance of the heart; and of a smooth funnel-shaped portion (*infundibulum* or *conus arteriosus*) leading upward and to the left into the pulmonary artery. The projections on the wall of the ventricle are the *columnæ carneæ* (fleshy columns), of which 3 varieties are

described: 1 in which the column merely stands out in relief, being attached to the wall of the ventricle in its whole length; a 2d in which the column is attached at both ends, but is free in the middle, so that a probe may be passed between it and the wall; and a 3d variety called the *musculi papillares*. These last project into the cavity of the ventricle and give attachment by their extremities to the *chordæ tendineæ*, or fibrous cords attached to the flaps of the auriculo-ventricular valve.

The right auriculo-ventricular valve consists of 3 portions, and is hence called *tricuspid*. The flaps are formed by a reduplication of the *endocardium* or lining membrane of the heart, between the layers of which are some tendinous and muscular fibers, the former being continuous with the chordæ tendineæ. The entire valve is attached above to a fibrous ring (zona tendinosa), which bounds the auriculo-ventricular opening, and is divided below into 3 portions—anterior, posterior, and internal.

The *pulmonary artery* is attached to a fibrous ring which intervenes between it and the muscular substance of the heart, but the lining membrane of the artery is continuous with that of the ventricle.

The *semilunar valves* of the pulmonary artery, 2 anterior and 1 posterior, are 3 reduplications of the lining membrane, strengthened by fibrous tissue which is col-

lected principally at the attached border of each valve, the thin portion near the free border being called the *lunula*. The attached border is convex, and is fixed to the wall of the artery; the free border is subdivided into 2 slightly concave portions by a little fibrous body called the *corpus Arantii*.

The semilunar valves act during dilatation of the ventricle (diastole), and prevent the regurgitation of the blood from the pulmonary artery.

The blood (which is venous or dark-colored) is carried by the pulmonary artery to its bifurcation, and then by the right and left pulmonary arteries to the lungs, where it is aerated; and is brought back to the heart by the 4 pulmonary veins as arterial or red blood. The pulmonary veins open into the left auricle.

The *left auricle* presents the openings of the 4 pulmonary veins, 2 on each side, and the left auriculo-ventricular opening.

The *musculi pectinati* of the auricular appendix are like those of the right side, but smaller; and on the septum of the auricles will be seen the *annulus ovalis* and *fossa ovalis* corresponding to those on the right side.

The *left ventricle* is thicker than the right, and reaches to the apex of the heart. The *columnæ carneæ*, *musculi papillares*, and *chordæ tendineæ* resemble those of the right

side, but are longer and much more fully developed.

The left auriculo-ventricular valve consists of 2 portions, and is hence called *bicuspid*, or (from the resemblance to a miter) *mitral*. The flaps of the valve are composed of the lining membrane of the heart, strengthened by tendinous fibers derived from the chordæ tendineæ like those on the right side, and are attached to the fibrous ring bounding the auriculo-ventricular opening.

The closure of the mitral valve accompanies the "first sound" of the heart, which is best heard at the apex.

The *aortic semilunar valves* resemble those of the pulmonary artery, but are more fully developed, and the *corpora Arantii* are better seen on the right side. The aortic valves occupy a position the converse of those of the pulmonary artery—viz.: 1 in front and 2 behind; and above each of the 3 valves there is a dilatation of the aorta, called the *aortic sinus* or *sinus of Valsalva*. At the bottom of the anterior and left posterior sinuses are seen the orifices of the coronary arteries, the first branches of the aorta.

The closure of the aortic valves accompany the "second sound" of the heart, which is best heard over the base of the heart and along the sternum.

The blood is carried by the branches of the aorta to the various parts of the body. The

arteries end in capillaries, in which the veins begin, and all unite to form the cavæ.

The *fœtal circulation* is best described by Heath, in the following manner:

In the fœtus the blood is brought from the placenta by the umbilical vein, which enters the body at the umbilicus. It then passes along the longitudinal fissure of the liver, and at the transverse fissure divides into 2 branches, one of which joins the portal vein, and the other, which is the *ductus venosus*, joins the inferior vena cava. In the inferior vena cava the placental blood is joined by that returned from the lower extremities, and afterward through the hepatic veins, by that circulated through the liver; and is then poured into the right auricle. The Eustachian valve, of large size in the fœtus, directs the current across the auricle to the foramen ovale, which is patent, and the blood enters the left auricle. From the left auricle the blood necessarily passes into the left ventricle, and is thence propelled through the aorta to the head and upper extremities. From these it is returned by the superior vena cava, which enters the upper part of the right auricle, and the blood descends at once into the right ventricle, thus taking a course at right angles to the former one. From the right ventricle the blood is propelled into the pulmonary artery, and a small portion reaches the lungs through the right and left pulmonary

arteries, but by far the larger portion passes through the *ductus arteriosus* (a short tube connected with the pulmonary artery close to the bifurcation), and enters the descending portion of the arch of the aorta. Through the aorta the blood reaches the iliac arteries, and a small portion passes by the external iliacs to the lower extremities, but the rest passes by the internal iliacs to the hypogastric arteries, which run to the umbilicus and then wind round the umbilical vein to the placenta.

ORGANS OF URINATION.

THE KIDNEYS

are situated in the lumbar regions, and lie between the last rib and crest of the ilium, upon the diaphragm and quadratus lumborum. The outer border is convex. The inner border, called the *hilum*, is concave. The vessels entering the *hilum* are from before backward, renal vein, artery, and ureter. The expansion of the ureter—the duct of the kidney—forms the *pelvis*, which is subdivided into 3 portions, called the *infundibula*. These again subdivide into small membranous sacs, the *calices*, projecting into which are small nodules of kidney substance called *papillæ*, which are the apices of triangular dark bodies called the *Malpighian pyramids* or *cones*. These constitute the *medullary* substance of the kidney.

The *cortical substance* forms the circumference of the kidney. In it the *Malpighian bodies* or *glomeruli* are formed. They consist each of a capillary plexus with an arterial twig—the *afferent* vessel—entering it, and a venous radicle—the *efferent* vessel—leaving it. Each body is inclosed in a capsule continuous with the *uriniferous*

tube, which becomes convoluted in the cortical substance, and a secondary intertubular plexus is formed upon it by the venous radicle, after it has emerged from the Malpighian tuft. The uriniferous tubes enter the basis of the pyramids, converge to the apices, and empty into the calices; from these the urine drops into the infundibula, and thence into the pelvis and ureter. The venous radicles, after they form the secondary plexus on the tubes, unite at the base of the pyramids, between which they pass to emerge at the hilum as the emulgent or renal vein.

The water of the urine is believed to come from the Malpighian body, and the salts from the venous plexus.

The *ureters* are tubes about 18 in. long, of the diameter of a quill. They extend from the pelvis to the bladder, and carry the urine to that organ. They lie over the Psoas muscle, pass beneath the spermatic vessels, cross the com. or ext. iliac artery, and enter the fundus of the bladder.

The suprarenal capsule is a small triangular yellow body placed above each kidney. It is composed of minute tubes—function unknown.

THE BLADDER

is in the anterior part of the pelvis when empty, but rises into the abdomen when distended.

The *neck* is the narrow portion attached to the prostate gland.

The *fundus* is the lowest part, resting on the horizontal portion of the rectum, with the vesiculæ seminales and vasa deferentia intervening.

The *trigone* is the space included between the vesiculæ seminales externally, and internally the smooth space between the openings of the ureters and the orifice of the urethra.

The *uvula* is a small elevation of mucous membrane at the orifice of the urethra.

The ligaments of the bladder are 4 true and 5 false.

The *true* ligaments, 2 anterior and 2 lateral, are reflections of pelvic fascia.

The *false* ligaments are reflections of the peritoneum. They are 2 posterior, 2 lateral, and 1 superior. They partially inclose the obliterated hypogastric arteries and the urachus.

The bladder has 4 coats—peritoneal, muscular, fibrous or cellular, and mucous.

The *peritoneal* coat invests all but the anterior portion of the bladder.

The *muscular* coat has 3 layers—*external* or longitudinal, *detrusor urinæ;* middle or circular, *sphincter vesicæ;* internal, continuous with longitudinal.

The *fibrous* coat is composed of connective tissue.

The *mucous* coat is arranged in rugæ, ex-

cept in the trigone. It is covered by tessellated epithelium.

THE URETHRA

averages 8 inches in length, and is divided into prostatic, membranous, bulbous, and spongy portions.

The *prostatic portion*, covered by the prostate gland, is about $1\frac{1}{4}$ in. in length.

The *veru montanum* or *caput gallinaginis* is a ridge in this portion dividing the hollow into 2 portions called the *prostatic sinuses*, in which the *prostatic ducts* open. Near the post. part of the veru montanum is a little blind pouch, the *sinus pocularis*, into which open the *ejaculatory ducts*.

The *membranous portion* is the shortest and narrowest portion of the urethra. It is between the 2 layers of the triangular ligament. The upper wall measures $\frac{3}{4}$ in., and the floor $\frac{1}{2}$ in. The mucous membrane presents no orifices.

The *bulbous portion* corresponds to the bulb externally, and is about an inch long; but there is no line of demarkation between it and the spongy portion. The canal is dilated at this spot, and in the floor of it are the 2 minute orifices of the ducts of *Cowper's glands*, which run obliquely through the wall of the urethra for some distance. The cut edge of the bulb will be seen to be continuous with the corpus spongiosum which surrounds the spongy or anterior

portion of the urethra, and expands again to form the *glans penis.*

The *spongy portion* is the longest part of the canal, and averages 5 inches in length. Its calibre is somewhat smaller than that of the bulbous portion, but it expands in the glans penis to form the *fossa navicularis*, again becoming contracted at the *meatus* or orifice, at which point the urethra is as small as in the membranous portion, and occasionally smaller.. Along the floor of the spongy portion are numerous mucous follicles or *lacunæ*, the orifices of which are directed toward the meatus; a few similar follicles are situated on the upper surface of the urethra, one of which, opposite the fossa navicularis, is the *lacuna magna.*

ORGANS OF GENERATION.

THE MALE ORGANS.

THE PENIS

consists of a body, neck, and glans.

The *corpora cavernosa* compose the upper portion of the body.

The *crura* are the narrowest portions of the corp. cav., and are attached to the rami of isch. and pub. They are covered by the erector penis.

The *septum pectiniforme* is the partition along the median line marking the union of the 2 corp. cav. It is wanting in front.

The *corpus spongiosum* incloses the urethra. It commences in the bulb of the urethra, and extends to the extremity.

The *glans penis* is the expanded portion of the corp. spong. at its extremity. It is marked by an elevation, the *corona glandis*, at which the loose integument of the body becomes reflected over the glands to become continuous with its internal mucous surface.

The *prepuce* is the loose fold formed by the reflection inward of the skin.

The *frenum* is the fold below the meatus urinarius.

The *suspensory ligament* is the continua-

tion of the superficial fascia of the abdomen on to the dorsum of the penis. It contains between its laminæ the dorsal vessels and nerves.

THE PROSTATE GLAND

consists of 3 lobes, 1 middle and 2 lateral. It is placed over the commencement of the 3d part of the rectum, and in front of, but below, the level of the bladder. It is partly glandular and partly muscular, and is invested by a process of recto-vesical fascia, which forms the capsule of the gland. It measures transversely at the base $1\frac{1}{2}$ in., antero-posteriorly 1 in., and $\frac{3}{4}$ in. in depth. The ducts open into the prostatic sinuses of the urethra.

COWPER'S GLANDS

are 2 lobulated bodies, about the size of peas, bet. the 2 layers of deep perineal fascia on each side of the memb. port. of urethra. Its ducts open into the bulbous portion.

THE TESTICLES

are 2 glandular organs secreting semen. They pass through the inguinal canal before birth into the scrotum, and are suspended by the spermatic cord. The coverings are:

Scrotum. { Skin. / Dartos — contractile reddish tissue.

Intercolumnar or spermatic fascia.

Cremaster muscle.

Infundibuliform, fascia propria or internal spermatic fascia.

The tunics proper to the testis itself are tunica vaginalis, tunica albuginea, and tunica vasculosa.

The *tunica vaginalis* is derived from the peritoneum during descent. It consists of 2 portions—visceral or tunica vaginalis propria, and parietal or tunica vaginalis reflexa.

The *tunica albuginea* is a fibrous coat reflected into the interior of the testis to form an incomplete vertical septum called the *mediastinum* or *corpus Highmorianum*. From this slender cords are given off called trabeculæ.

The *tunica vasculosa* or pia mater testis is the vascular covering. It consists of a plexus of vessels held together by areolar tissue.

The glandular structure consists of about 400 lobules made up of minute convoluted tubes, called *tubuli seminiferi*. These unite to form the *vasa recta*. These enter the mediastinum to form the *rete testis*. The vessels of the rete testis unite at the upper end of the mediastinum to form 12 to 20 ducts, the *vasa efferentia*. Perforating the tun. albuginea they form the *coni vasculosi*, which together make up the *globus major of the epididymis*. The efferent vessels then open into a single duct which, by its convolu-

tions, forms the *body* and *globus minor* of the epididymis. Unraveled, this tube measures more than 20 feet.

The *vas deferens*, the excretory duct of the testis, is the continuation of the epididymis. It ascends on the inner and posterior side of the testis and epididymis, and along the back of the spermatic cord, through the spermatic canal, to the int. abdom. ring. From the ring it descends in the pelvis to the inner side of the external iliac artery. It then winds over the back of the bladder, crossing the obliterated hypogastric artery. At the base of the prostate it unites with the duct of the vesiculæ seminales, to form the ejaculatory duct.

THE VESICULÆ SEMINALES

are 2 lobulate membranous pouches, the reservoirs of the semen, placed between the base of the bladder and the rectum, converging to enter the prostate close to the median line. They consist of convoluted tubes which become straight at the base of the prostate, and join the corresponding vas deferens to form the common ejaculatory duct, which opens into the sinus pocularis.

THE FEMALE ORGANS

are external and internal.

The *external* are the mons veneris, labia majora and minora, clitoris, meatus urina-

rius, and orifice of vagina. They are all included under the term vulva or pudendum.

The *mons veneris* is the rounded eminence in front of the pubes covered with hair.

The *labia majora* are 2 longitudinal cutaneus folds continuous with the mons veneris above, and with the perineum behind and below. They are united by anterior and posterior commissures.

In a virgin, a small transverse fold of mucous membrane may be seen just within the posterior commissure, which is called the *fourchette*, and between the two is the *fossa navicularis.*

By separating the labia, the *clitoris* will be seen at the upper part of the vulva, resembling a penis in appearance, and having a small *glans* and *prepuce.*

The *nymphæ* or *labia minora* extend obliquely downward from each side of the clitoris, being connected with both the organ itself and its prepuce, and being lost in the labia majora and wall of the vagina below.

The *vestibule* is a triangular interval with the apex at the clitoris and the base at the orifice of the vagina, the sides being formed by the nymphæ. An inch below the clitoris is the *meatus urinarius* which is slightly prominent, and is placed immediately above the orifice of the vagina.

The *hymen* is a reduplication of mucous

membrane, usually of a crescent form, with the concave border upward, partially occluding the vagina. When ruptured it forms the *caruncul*æ *myrtiformes*, 3 or 4 little projections from the vaginal wall. On each side of the vagina, immediately in front of the hymen, or its remains, are the orifices of the *vulvo-vaginal glands*, or glands of Bartholin. The orifices of numerous sebaceous follicles will also be found scattered over the vulva.

The urethra of the female is about 1½ in. long. It is imbedded in the anterior wall of the vagina, the concavity of its curve being directed forward and upward. Its diameter is about ¼ in. Its structure is similar to that of the male.

THE VAGINA

is a membranous canal extending from the vulva to the uterus. Its length is about 4 in. along its anterior wall, and 6 in. along its posterior. It is composed of longitudinal muscular fibers, inclosing erectile tissue, and lined by a mucous membrane which forms transverse rugæ. Two longitudinal ridges on the ant. and post. walls are called the columns of the vagina.

THE OVARIES

are placed 1 on either side of the womb, in the folds of the peritoneum, called the broad ligaments of the uterus. Each ovary, en-

veloped by a white fibrous membrane, consists of a pulpy brownish-gray substance, highly vascular, and containing from 15 to 20 minute vesicles, each of which is composed of a thin membrane containing a viscid yellowish fluid; these are called the *Graafian vesicles.*

THE FALLOPIAN TUBES,

the excretory ducts of the ovaries, are about 4 inches in length, and are contained in the broad ligament, one extremity being attached to the superior angle of the uterus, into which it opens by a small orifice (*orificium uterinum*), the other being free and surrounded by a fringe (*corpus fimbriatum*), in the center of which is the peritoneal aperture (*orificium superius*). Here the mucous membrane of the Fallopian tube communicates with the serous membrane, the peritoneum forming the only exception to the rule that the serous membranes are shut sacs.

THE UTERUS

is a pear-shaped organ divided into the *fundus*, the *body*, and *cervix*. The fundus is superior and posterior, and receives at each angle the Fallopian tube; the body is between the fundus and the neck, the latter being inferior and anterior, and surrounded by the vagina; at the extremity of the neck is a small elliptical opening, called *os tincæ* or *os uteri*. The cavity of

the uterus is small compared to the thickness of its walls, and is of triangular shape; its superior and outer angles presenting the orifices of the Fallopian tubes, the inferior angle presenting the os tincæ. The uterus is placed between the bladder and rectum. It has 6 ligaments formed of peritoneum, 2 ant., 2 post., and 2 lat.

THE MAMMÆ

are 2 glands connected to the Great Pectoral muscles by a capsule of condensed cellular tissue. They consist of vessels and numerous lactiferous tubes, arising from dilated blind extremities or cells; the tubes group together to form lobes and lobules; as they approach the nipple they become dilated to form sinuses, but in the nipple they are again contracted, and terminate at the apex by orifices surrounded by delicate muscular tissue. The *nipple* is a conical process, surrounded by a brownish areola, and composed externally of the integuments, which are very thin, and internally of the lactiferous tubes, with numerous blood-vessels, from which the nipple derives its erectile property.

REGIONAL ANATOMY.

THE TRIANGLES OF THE NECK

are formed within a quadrilateral space, bounded *above* by the stylo-maxillary ligament and body of the lower jaw; *below*, by the clavicle; *in front*, by the median line of the neck; and *behind*, by the border of the Trapezius muscle. This space is divided into 2 triangles by the diagonal *Sterno-mastoid.* These are the great *Anterior* and *Posterior* triangles.

I. The *Posterior triangle* is bounded *in front* by the Sterno-mastoid; *behind*, by the *Trapezius; below*, by the clavicle. Its floor is formed from above downward by Splen. Cap., Lev. Ang. Scap., Scal. Post. and Med., and upper dig. of Ser. Mag. The posterior belly of the Omo-hyoid muscle cuts this triangle into 2:

1. The *suboccipital triangle* is bounded *in front* by Sterno-mast.; *behind*, by Trapez.; *below*, by post. belly of Omo-hyoid. It contains branches of sup. cerv. plex., spinal accessory nerve running into Trapez., musc. br. of deep cerv. plex., transversalis colli vein, and lymphatic glands.

2. The *subclavian triangle* is bounded *in front* by Sterno-mast.; *above*, by post. belly

of Omo-hyoid; *below*, by clavicle. It contains the brachial plexus, 3d part of subclavian artery, transversalis colli artery, suprascapular vessels, and external jugular vein. The subclavian artery is divided into 3 portions by the Scalenus Anticus.

Relations.

First portion of right subclavian, from the art. innom. to inner bord. of Scal. Ant. *In front*, Sterno-mast., Sterno-hy., Sterno-thyr., int. jug. and vert. veins, pneumogast. card. and phren. nerves; *beneath*, pleura; *behind*, recurrent laryngeal, sympathetic, Longus Colli, trans. proc. of 7th cerv. vert.

First portion of left subclavian, from arch of aorta to inner marg. of Scal. Ant. *In front*, pleura and left lung, pneumogastric card. and phren. nerves, left carotid artery, left int. jug. and innom. veins, Sterno-hy., Sterno-thyr., and Sterno-mast.; *inner side*, esophagus, trachea, thoracic duct; *outer side*, pleura; *behind*, esoph. and thor. duct, inf. cerv. gang. of symp., Long. Colli and vertebral column.

Second portion of both right and left, beneath Scal. Ant. *In front*, Scal. Ant., phren. nerve, subclav. vein.; *above*, brach. plex.; *below*, pleura; *behind*, pleura and Scal. Med.

Third portion of both in subclavian triangle. In front, cerv. fascia, ext. jug., sup. scap., and trans. cerv. veins, descending br.

of cerv. plex., Subclav. muscle, sup. scap. art., and clavicle; *above*, brach. plex.; *below*, 1st rib; *behind*, Scal. Med.

II. The *Anterior triangle* is bounded *in front* by median line; *behind*, by Sterno-mastoid; *above*, by stylo-max. lig. and body of jaw. It is subdivided into 3 smaller by the digastric above, and ant. belly of Omo-hyoid below.

1. The *inferior carotid triangle* is bounded *in front* by median line; *behind*, by Sterno-mast.; *above*, by ant. belly of Omo-hyoid. It is covered by integ., sup. fasc., platysma and deep fasc., bet. which ramify descend. br. of superfic. cerv. nerve. Beneath these are Sterno-hy., Sterno-thy., which, with ant. bord. of Sterno-mast., conceal lower part of com. carotid in the sheath with pneumogast. and int. jug. v.

2. The *superior carotid triangle* is bounded *behind* by Sterno-mast.; *below*, by ant. belly of Omo-hy.; *above*, by post. belly of digast. It contains the com. carotid div. into ext. and int., the int. jug. v., hypoglossal n., descending noni, pneumogast; behind the sheath, the sympathetic; on the outer side, the spinal access.; on the inner, the sup. laryng.; and below, the inf. laryng. and ext. laryng. The upper part of larynx and pharynx are also in this space.

3. The *submaxillary triangle* is bounded *above* by stylo-max. lig. and body of jaw; *behind*, by post. belly of digast.; *in front*,

by ant. belly of digast. It contains ant. belly of digast., Mylo-hy. and Hyo-gloss., submax. gland, fac. art., and v. and br., subment. art., mylo-hy. art. and n., ext. carot. parotid gland, fac. nerve, post. auric. temp. and int. max. art., int. carot. art. and int. jug. v., pneumog. n. sep. from ext. car. by Stylo-gloss. and Stylo-phar. muscles and glosso-pharyngeal nerve.

The thoracic relations of the *left common carotid* are: *In front*, sternum, Sterno-hy., Sterno-thy., left innom. v., remains of thym. gland; *internally*, arteria innom.; *externally*, left pneumog. n. and left subclav. art.; *behind*, trachea, esophag., thoracic duct.

The cervical relations of both *common carotids* are: *In front*, Integ. and Fasc., Platysma, Sterno-mast., Sterno-hy., Sterno-thyr., Omo-hy., descend. noni n., sterno-mast. art., Thyr., ling., and fac. v., ant. jug. v.; *externally*, int. jug. v., pneumo-gast. n.; *internally*, trachea, thyr. gl., recur. laryng., inf. thyr. art., larynx, pharynx; *behind*, Long. Col., Rect. Ant. Maj., sympath. n., inf. thyr. art., and recur. laryng. n.

The cervical relations of the *ext. carotid* are: *In front*, integ., fasciæ, platysma, hypogl. n., ling. and fac. v., Digast. and Stylo-hy. muscles, parotid gl. with fac. n. and temp. max. v. in its substance; *behind*, sup. laryng. n., Stylo-gloss., Stylo-pharyng., Glosso-phar., parotid gl.; *internally*, hyoid bone, pharynx, par. gl., ram. of jaw.

The cerv. relations of the *intern. carotid* are: *In front*, skin and fasciæ, par. gl., Stylo-gloss. and Stylo-phar. muscles, glosso-pharyng. n.; *externally*, int. jug. v., pneumogast. n.; *internally*, pharynx, ascend. pharyng. art., tonsil; *behind*, Rect. Cap., Ant. Maj., sympath., sup. laryng. n.

THE AXILLARY SPACE

is a pyramidal space bounded *anteriorly* by Pect. Maj. and Min.; *posteriorly*, by *Subscap.*, *Ter. Maj.*, and Lat. Dorsi; *internally*, by first 4 ribs and Serrat. Mag.; *externally*, by humerus, coraco-brach. and biceps. It contains the axillary vessels, brach. plex. and their branches, branches of intercostal nerves, lymphatic glands, fat, and areolar tissue. The important vessels and nerves lie on the *outer boundary*.

The relations of the axillary artery are:

First portion—In front, Pect. Maj., costo-corac. memb., subclavius, cephal. v.; *externally*, brach. plex.; *internally*, axillary v.; *behind*, 1st intercostal space and muscle, 1st serration of Ser. Mag., post. thorac. n.

Second portion—In front, Pect. Mag. and Min.; *externally*, outer cord of plex.; *internally*, axillary v. and inner cord of plex.; *behind*, subscapularis and post. cord of plex.

Third portion—In front, Integ. and Fasc., Pect. Maj.; *outer side*, corac. brach., med. n., musc. cut. n.; *inner side*, ulnar n. int. cut. nerves, axil. v.; *behind*, subscapularis

tendons of Lat. Dorsi and Ter. Maj., musc. spir. and circ. nerves.

SCARPA'S TRIANGLE

is bounded *externally* by the Sartorius; *internally*, by the Adductor Longus; *above*, by Poupart's ligament. Its floor is formed by the Psoas, and Iliacus, Pectineus, Adductor Longus, and Brevis. It contains the upper part of the femoral artery and vein, orig. of profunda and v., ant. crural n.

The relations of the *femoral artery* are: *In front*, Fascia Lata, br. of ant. crur. n., Sartorius, long saphenous n., apon. cov. of Hunter's canal.; *internally*, fem. v. at upper part, Adduct. Long., Sartorius; *outer side*, Vast. int., fem. v. at lower part; *behind*, Psoas, prof. v., Pectin., Adduct. Long., fem. v., Adduct. Mag.

THE POPLITEAL SPACE

is bounded ext. by Biceps, int. by Semitend. and Semimemb. Its lower part has one of the heads of Gastroc. on each side. The floor is formed by back of femur, post. lig. of knee joint, Poplit. muscle, and fascia.

The relations of the popliteal artery are: *In front*, femur, lig. post., Popliteus.; *int.*, Semimemb.; *ext.*, Biceps; *behind*, poplit. v., int. poplit. n., fascia.

THE PERINEUM

is bounded in front by pubic arch, on each

side by ram. and tub. of isch. and gr. sac. sci. lig., and behind by the coccyx, a line drawn bet. the 2 tub. of isch. divides it into anterior or genital space, and posterior, containing the termination of alimentary canal. In the post. space is the ischio-rectal fossa on each side of the rectum, bounded by tub. isch. and Glut. Max. It is filled with fat. The anterior space consists of 2 layers of aponeurosis, connected posteriorly and at the sides (triangular ligament), and inclosing a triang. space in which are contained the root of penis with its muscles, vessels, and nerves. The whole of these parts are covered in by superficial perineal fascia, which is continuous with the triang. lig. posteriorly, and is firmly attached on each side to ramus of pubes and ischium, while anteriorly it is continuous with the cellular base of the common sup. fasc. of scrotum and abdomen.

The muscles, nerves, and vessels have been described.

HERNIA.

All varieties of hernia have 6 coverings. All varieties have 3 coverings alike, namely: *peritoneum*, *superficial fascia*, and *integument*. The other 3 vary with the canal through which the gut passes.

THE INGUINAL CANAL

has 2 openings: (1) *external abdominal ring*,

in the external oblique, closed by *intercolumnar fascia* stretched between the *pillars* of the ring; (2) *internal abdominal ring*, in the transversalis fascia, closed by *infundibuliform fascia* which is merely a funnel-like prolongation of the transversalis fascia over the cord, in its passage down the canal. Between these 2 openings the canal is 1½ in. long, and filled by the spermatic cord. *In front* are tend. of ext. oblique, lower part of int. oblique and cremaster (which is derived from it); *behind* are the trans. fasc., conjoined tend. of int. oblique and trans., and triang. fascia (a reflection of Poup. lig. to lin. alba); *below* is Poup. lig; *above*, the arched bord. of Trans. muscle, and space bet. it and int. oblique. *Oblique hernia* is that variety in which the gut takes the course of the inguinal canal. *Direct hernia* is that variety in which it takes a course directly through the tissues in Hesselbach's triangle, crossed by conj. tend., and bounded *ext.* by Epigast art.; *int.*, by Rectus; *below*, by Poup. lig.

FEMORAL HERNIA

is that variety in which the gut passes through the femoral canal, which is formed as follows: The iliac fascia passes down over the pect. line beneath Poupart's ligament, forming the post. wall of the sheath of the femoral vessels; the transversalis fascia passes from Poup. lig. in front of

the vessels forming the ant. wall. Septa pass down from ant. to post. wall bet. the vessels, and between them and the ext. and int. walls of the sheath. The crural canal is the space bet. the fem. v. and outer wall of sheath, where it expands away from the vessel to become continuous with the fasciæ above. This is filled up by a lymph. gland and areolar tissue called the *septum crurale.* It is bounded *above* by Poup. lig.; *int.*, by Gimbernat's lig., a reflect. of Poup. lig. to pect. line; *ext.*, by septum bet. it and vein; *behind*, by pect. eminence. Length ½ in.

At the extremity of the canal is an opening (*saphenous*), in the fascia lata of the thigh, where the pubic port. joins the iliac, the former being post. The arched fibers above are called the *falciform process.* This opening is filled by cribriform fascia, through which small veins enter the saph.

The coverings of hernia, in all 3 varieties, are as follows:

In all—peritoneum, sup. fasc., and integ.

Oblique inguinal—infundibuliform fascia closing int. ring, Cremaster muscle in the canal, and intercolumnar fascia closing ext. ring.

Direct inguinal—transversalis fasc., conj. tend., and intercolumnar fasc.

Femoral—septum crurale, femoral sheath, and cribriform fascia.