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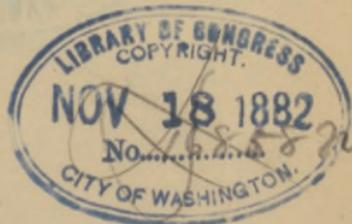
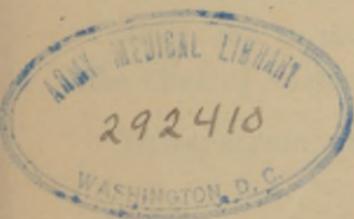
# HUMAN ANATOMY.

BY,

SAMUEL O. L. POTTER, M.A., M.D.,

AUTHOR OF "AN INDEX OF COMPARATIVE THERAPEUTICS," AND OF THE LEA PRIZE  
ESSAY OF JEFFERSON MEDICAL COLLEGE, ON "DYSALIA, A STUDY  
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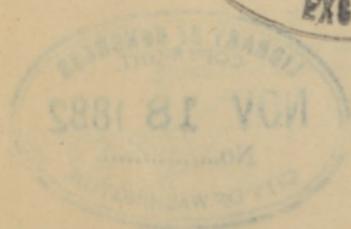
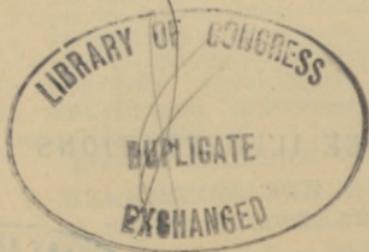
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## PREFACE.

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This little book contains a series of questions and answers, comprising a concise description of the bones, articulations, muscles, arteries, veins, absorbents and nerves of the human body, including the heart and brain as essential parts of the circulatory and nervous systems respectively. Intended especially for the use of the medical student in preparing for the exercises of the quiz-room and for final examination, it includes the essential points of the structures named above, arranged in such a manner as to facilitate their acquirement in the shortest possible time. With this object I have omitted all superfluous description, and have confined the matter to those points which must be known in order to pass. In the general descriptions I have closely followed Gray, and have retained the Latin names so universally used by anatomists, believing that in both these respects my course would be that most acceptable to the student. For many of the special arrangements I am indebted to the lectures of Professor W. H. Pancoast, of Jefferson Medical College, and to the quizzes of Dr. Henry Morris, Assistant to the Chair of Anatomy in the same Institution.

S. O. L. P.

PHILADELPHIA, 1882.



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# QUESTIONS

ON

## HUMAN ANATOMY.

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**Define the term Anatomy.**—Derived from the Greek *ἀνα* *ana*, through, and *τέμνειν* *temnein*, to cut, it strictly means *dissection*, but is technically applied to that science which treats of the structure of organized bodies.

**What are the divisions of Descriptive Human Anatomy?**—They are,—*Osteology*, the anatomy of the bones; *Syndesmology*, of the joints; *Myology*, of the muscles; *Angiology*, of the vessels; *Neurology*, of the nerves; *Splanchnology*, of the internal viscera; *Adenology*, of the glands; *Dermatology*, of the skin; *Genesiology*, of the generative organs.

**State the number of Bones in the adult human skeleton.**—It is variously stated by different anatomists. Excluding the teeth, the Wormian and sesamoid bones, and the ossicles of the middle ear, the whole number would be 200; excluding also the two patellæ, and the hyoid bone, would leave in the skeleton proper, 197 bones.

**Describe the Long Bones.**—They number 90, act as supports, or levers, and are known by having a medullary canal in the centre of each, a shaft (*diaphysis*), and two extremities. They are developed by osseous deposit in cartilage.

**Describe the Short Bones.**—Numbering 30, they are found where strength is required, but limited motion. They also are developed by osseous deposit in cartilage.

**Describe the Flat Bones.**—They number 38, protect the viscera by forming walls around them, and afford extensive attachment for muscles. They are developed by osseous deposit in membranes, and consists of two dense layers, separated by a cellular or cancellated osseous tissue, the diploë.

**What are the Irregular Bones?**—They are 39 in number, and include the vertebræ, the temporal, ethmoid, and sphenoid bones, and the bones of the face.

**Name the Bones of the Head.**—They number 22, and comprise the—*Cranial Bones* (8)—the frontal, 2 parietal, occipital, 2 temporal, the sphenoid and the ethmoid bones.

*Facial Bones* (14)—2 superior maxillary, 2 malar, 2 nasal, 2 lachrymal, 2 palate, and two inferior turbinated bones.

**Name the Bones of the Trunk.**—They number 53, as follows, viz.—*Vertebrae* (24)—7 cervical, 12 dorsal, and 5 lumbar vertebrae.

*Thorax* (25)—7 pairs of true ribs, 3 pairs of false ribs, 2 pairs of floating ribs, and the sternum, [with the bodies of the dorsal vertebrae].

*Pelvis* (4)—the sacrum, the coccyx, and 2 ossa innominata; each os innominatum consisting of 3,—the ilium, ischium, and pubes.

**Name the Bones of each Upper Extremity.**—They number 32, as follows:—

*Shoulder* (2)—the clavicle and scapula.

*Arm* (1)—the humerus.

*Forearm* (2)—the radius and ulna.

*Hand* (27)—8 carpal bones,—the scaphoid, semilunar, cuneiform, pisiform, trapezium, trapezoid, os magnum, and unciform,—5 metacarpal, and 14 phalanges.

**Name the Bones of each Lower Extremity.**—They number 29, viz.—

*Thigh* (1)—the femur.

*Leg* (2)—the tibia and fibula.

*Foot* (26)—7 tarsal bones,—the astragalus, os calcis, scaphoid, cuboid, external middle and internal cuneiform,—5 metatarsal, 14 phalanges.

**Name the Unclassified Bones.**—They are the—

*Patella* (2), which are sesamoid bones, each developed in the tendon of the quadriceps extensor femoris muscle.

*Hyoid Bone* (1)—the tongue-bone, not articulated to the skeleton.

*Malleus, Incus, Stapes* (3 pairs)—the bones of the middle ear.

*Sesamoid Bones*, of variable number, situated in the tendons of the gastrocnemius and peroneus longus muscles, and in the flexor tendons of the great toe and the thumb.

*Wormian Bones*, (ossa triquetra), sometimes found in the cranial sutures, are not constant in number or size.

**Name the principal Eminences on Bones.**—*Heads*, are convex and smooth, for articulation in movable joints. *Condyles*, are irregularly-shaped heads. *Trochanters*, when for turning the bone. *Tuberosities*, are broad uneven prominences. *Tubercles*, are small tuberosities. *Spines*, or *Spinous processes*, when sharp and slender. *Apophysis*, is a process which has been an

Epiphysis, or separated from the shaft by cartilage, but has become united thereto by ossification.

**What other names are given to bony prominences?**—There are several adjectives applied to them from their fancied resemblances, such as—*azygos*, without a fellow; *clinoid*, like a bed; *coracoid*, like a crow's beak; *coronoid*, like a crown; *hamular*, hook-like; *malleolar*, like a mallet; *mastoid*, like a nipple; *odontoid*, tooth-like; *pterygoid*, wing-like; *rostrum*, a beak; *spinous*, thorn-like; *styloid*, pen like; *squamous*, scaly; *vaginal*, ensheathing, etc.

**Name the Cavities of bones.**—Articular cavities are called *cotyloid*, cup like; *glenoid*, shallow; *trochlear*, pulley-like; *facet*, if smooth; *alveolar*, or *alveoli*, when socket-like. Non-articular cavities are named fossæ, sinuses, aqueducts, foramina, canals, fissures, notches, cells, grooves, depressions, etc.

**What is the Composition of Bone?**—*Organic* or animal matter, about  $\frac{1}{3}$ rd, consisting of gelatin, vessels and fat. *Inorganic*, or mineral, about  $\frac{2}{3}$ rds, consisting of phosphate and carbonate of calcium ( $62\frac{1}{2}$  per cent.), with fluoride of calcium, phosphates of magnesium, sodium, and chloride of sodium ( $4\frac{1}{3}$  per cent.). *Heat* will remove the organic matter and leave the inorganic; dilute *nitric* or *hydrochloric acid* will remove the inorganic, and leave the organic. In old age the inorganic constituents predominate, and the bones are brittle; in youth the organic predominate, and epiphyseal dislocation is more common than fracture, especially in the long bones of the extremities.

**Describe the Structure of Bone.**—Bone is composed of an outer compact layer, and an inner cellular or spongy structure. It is surrounded, except at the articular cartilages, by a vascular fibrous membrane, the *periosteum*, which receives the insertions of all tendons, ligaments, etc.; and the central cavity of long bones is lined by a similar structure, the *endosteum*. A transverse section of bone, examined microscopically, shows—

*Haversian canals*, diameter  $\frac{1}{3000}$  inch, for the passage of vessels.

*Canaliculi*, diameter  $\frac{1}{10000}$  inch, radiating from the canals, and connecting them with the lacunæ.

*Lacunæ*, arranged circularly around the canals, and contain the bone-cells, appearing as irregular dark spaces.

*Haversian spaces*, connect the canals with the medullary spaces, and divide one Haversian system from another. An *Haversian system* comprises an Haversian canal with its lamellæ, lacunæ, and canaliculi.

*Concentric lamellæ* of bone tissue, around the canals.

*Circumferential lamellæ*, are bone layers binding the canals together.

*Interstitial lamellæ*, woven in between the concentric lamellæ.

**What is the Marrow of bone?** A substance consisting of fat in varying proportion and extractive matters, found in the medullary canal, the cancellous texture, and the large Haversian spaces.

**What Vessels are found in bones?** Arteries, veins, and some say lymphatics. *The arteries* are,—the nutrient, entering at the nutrient foramen; the articular, nourishing the cancellous structure; and the periosteal, which supply the periosteum and the compact structure. *The veins* emerge from the ends, the shaft, and from the nutrient foramen.

**Describe the process of Ossification.** The site of bone is first occupied by a mucoid substance, which becomes temporary cartilage (*blastema*) in the second month of foetal life. The young bone-cells (*osteoblasts*) are then deposited in the cartilage at certain points, and their deposition and subsequent pressure cause the absorption of the cartilage. In most of the bones of the head and face, ossification is intra-membranous instead of intra-cartilaginous. *The first bones* in which ossification appears are the clavicle and inferior maxillary (5th to 7th foetal week); the *last* is the pisiform bone (12th year). *Epiphyses* ossify after birth and become united to the bone about the age of puberty, and in the inverse order to that in which their ossification began, except the lower end of the fibula, which ossifies and is joined to the shaft earlier than its upper end.

## THE BONES OF THE HEAD.

### THE FRONTAL BONE.

**Describe the points on its vertical portion.** They are as follows,—  
Externally,—

*Frontal eminences*, one on each side of the median line.

*Depression*, marking the site of the frontal suture before obliteration.

*Superciliary ridges*, behind which are the frontal sinuses.

*Supraorbital notches or foramina*, in the supraorbital arches, at about their inner third, for the supraorbital vessels and nerves.

*Nasal eminence*, at lower end of the frontal depression.

*External angular processes*, articulate with the malar bones and form the anterior part of the temporal ridges.

*Internal angular processes*, articulate with the lachrymal bones.

*Nasal spine and notch*, between the internal angular processes.

Internally,—

*Groove*, for superior longitudinal sinus and the falx cerebri.

*Frontal crest*, for attachment of the falx cerebri.

*Foramen cæcum*, for a small vein to the longitudinal sinus.

*Depressions and elevations*, for convolutions of the brain.

Between the two tables of the vertical portion in the adult are the—

*Frontal sinuses*, two spaces at the anterior inferior part of the bone, which are lined with mucous membrane, and open into the middle meatus of the nose by means of an *infundibulum* for each.

**Describe its horizontal portion, or orbital plates.** They each present the following points, viz.—

*Fossa*, for the lachrymal gland, near the external angular process.

*Depression*, at the nasal margin for the pulley of the superior oblique muscle.

*Ethmoidal notch*, having the following foramina on its margin.

*Anterior ethmoidal foramen*, for anterior ethmoidal vessels and the nasal branch of the ophthalmic nerve.

*Posterior ethmoidal foramen*, for posterior ethmoidal vessels.

*Grooves*, on the cranial surface, for branches of the anterior and middle meningeal arteries.

**Describe its articulations, development and muscles.** The frontal articulates with 12 bones,—the sphenoid, ethmoid, 2 parietal, 2 nasal, 2 superior maxillary, 2 lachrymal and 2 malar. It is developed by 2 centres in membrane, one for each lateral half. The muscles attached to it are 3 pairs,—the temporal, corrugator supercilii, and orbicularis palpebrarum.

## THE PARIETAL BONES.

**Describe their general characteristics.** They are two quadrilaterally shaped bones situated at the superior and lateral regions of the cranium. The superior border of each joins the other by the *sagittal suture*; the anterior border joins the frontal bone by part of the *coronal suture*; the posterior border articulates with the occipital, forming the *lambdoidal suture*; the inferior border with the sphenoid and temporal bones. Forming the lateral walls of the skull they are named parietal, from *paries*, a wall.

**Describe the points on each Parietal bone.** Externally the bone is concave and presents for examination,—

*Temporal ridge*, continuous with the same on the frontal bone.

*Parietal eminence*, the point where ossification commenced.

*Parietal foramen*, close to the upper border, transmits a vein to the superior longitudinal sinus. Is not constant.

Internally, the bone is concave, and marked by—

*Depressions* for the Pacchionian bodies, and for the cerebral convolutions.

*Furrows*, for branches of the middle meningeal artery.

*Groove*, for the lateral sinus, at the posterior inferior angle.

*Half-groove*, along the upper border, for the superior longitudinal sinus of the dura mater.

**Describe their articulations, development, and muscles.** Each parietal bone articulates with 5 bones,—the frontal, occipital, sphenoid, temporal, and opposite parietal. It is developed from 1 centre in membrane. The only muscle attached to it is the temporal.

### THE OCCIPITAL BONE.

**Describe its general features and surfaces.** It is trapezoidal in form, curved upon itself, and placed at the posterior and inferior region of the cranium. Externally its surface is convex and presents for examination the following, viz.—

*External occipital protuberance, and crest,* for the attachment of the ligamentum nuchæ.

*Superior and inferior curved lines,* extending outwards on each side of the external occipital crest.

*Foramen magnum,* transmitting the spinal cord and its membranes, the vertebral arteries, and the spinal accessory nerves.

*Condyles,* 2 in number, for articulation with the atlas vertebra.

*Tubercles,* one on each condyle, for the check ligaments.

*Anterior condyloid foramina,* 2, for the hypoglossal nerves.

*Posterior condyloid foramina,* 2, (often absent) for veins.

*Jugular processes,* 2, each helping to form the foramen lacerum posterius basis cranii.

Internally, the surface is concave, showing—

*Fossæ,* 4, for the cerebellar and posterior cerebral lobes.

*Internal occipital protuberance,* where the cranial sinuses meet to form the torcular (wine-press) Herophili.

*Crucial ridge,* the vertical portion for the falx cerebri and falx cerebelli; the transverse portion for the tentorium cerebelli, having also a groove for the lateral sinus.

*Groove,* for the lateral sinus, and the inferior petrosal sinus, along the postero-lateral border.

*Internal openings* of the foramina described above.

**Describe the Basilar Process of the Occipital.** It lies in front of the foramen magnum, articulates with the body of the sphenoid bone, smooth and grooved internally for the medulla oblongata, which lies upon it; rough inferiorly for the attachment of muscles, and presenting the—

*Pharyngeal spine,* for the attachment of the superior constrictor muscle of the pharynx and its tendinous raphé.

**Describe its articulations and development.** The occipital articulates with 6 bones,—the 2 parietal, 2 temporal, sphenoid, and atlas. It is developed by 4 centres, one each for the posterior part, the basilar process,

and the two condyles; its ossification being completed about the 6th year of age.

**What muscles are attached to the occipital bone?** There are 12 muscles attached on each side to the following portions, viz.—

*Superior curved line 3*—the occipito-frontalis, trapezius, and sterno-cleido-mastoid.

*Space between the curved lines 2*—the complexus and splenius.

*Space below the inferior curved line 3*—the obliquus capitis superior, rectus capitis posticus major and minor.

*Basilar process 3*—the superior constrictor of the pharynx, rectus capitis anticus major and minor.

*Jugular process 1*—the rectus capitis lateralis.

### THE TEMPORAL BONES.

**Describe their situation and divisions.** They are situated at the inferior lateral portions of the skull, and contain the organs of hearing. Each bone is divided into 3 parts, the *squamous* (scale-like),<sup>a</sup> *mastoid* (nipple-like),<sup>b</sup> and *petrous* (hard);<sup>c</sup> and it is named from being the site of the first gray hairs (*tempus*, time).

**Describe the Squamous portion.** It is a semicircular plate, smooth externally, and grooved internally for the middle meningeal artery, with depressions for the cerebral convolutions. Externally are seen the—

*Zygomatic process*,<sup>d</sup> or zygoma, arising by 3 roots, and extending forwards to articulate with the malar bone.

*Zygomatic tubercle*,<sup>e</sup> at the base of the process, for the external lateral ligament of the lower jaw.

*Eminentia articularis*, formed by the anterior root of the zygoma.

*Glenoid fossa*,<sup>g</sup> between the anterior and middle roots of the zygoma; its anterior part receives the condyle of the lower jaw, and is covered with cartilage; its posterior part lodges the parotid gland.

*Glasserian fissure*, divides the glenoid fossa; it transmits the laxator tympani muscle, the tympanic artery, and the processus gracilis of the malleus.

FIG. 1.



*Opening of the canal of Hugier*, lies in the angle between the squamous and petrous portions of the bone; and transmits the chorda tympani nerve.

*Temporal ridge*, *f* in part.

**Describe the Mastoid portion.** It projects like a nipple from the inferior portion of the bone posteriorly. Internally it is grooved for the lateral sinus;<sup>9</sup> externally are seen the—

*Mastoid foramen*,<sup>h</sup> the largest of several foramina, for a vein.

*Mastoid process*, at the tip, for the sterno-cleido-mastoid, splenius, and trachelo-mastoid muscles.

*Digastric fossa*,<sup>j</sup> for the posterior belly of the digastric muscle.

*Occipital groove*,<sup>8</sup> for the occipital artery.

*Mastoid cells*, in the interior of the mastoid process, open on the posterior wall of the middle ear, and are lined with mucous membrane.

**Describe the Petrous Portion.** It is very hard, pyramidal in form, contains the internal and middle ear, projects inwards and forwards, and presents a base, an apex, three surfaces, and three borders.

On the Base are seen, the—

FIG. 2.



*Meatus auditorius externus*,<sup>i</sup> the external opening of the ear.

*Auditory process*, a bony ring for the external cartilage of the ear.

Apex lies internally, at the base of the skull, forming the outer boundary of the foramen lacerum medium, and contains the internal carotid canal.

Anterior Surface, presents from within, outwards—

*Opening of the carotid canal*,<sup>11</sup> for the internal carotid artery and plexus.

*Depression*, for the Gasserian ganglion of the 5th pair of cranial nerves.

*Hiatus Fallopii*, for great petrosal nerve and an artery.

*Foramen*, for small petrosal nerve.

*Eminence*, over the superior semicircular canal of the ear.

*Depression*, over the tympanum.

Posterior Surface, presents—

*Meatus auditorius internus*,<sup>12</sup> transmits the 7th pair of nerves and the auditory artery, and lodges a process of dura mater.

*Opening of the aqueductus vestibuli*,<sup>13</sup> transmits to the vestibule a small artery and vein, and lodges a process of dura mater.

Inferior surface, presents from within outwards—

*Rough quadrilateral surface*,<sup>10</sup> for the origin of the tensor tympani and levator palati muscles.

*Opening of the carotid canal*, transmitting the internal carotid artery, and the carotid plexus of the sympathetic nerve.

*Aqueductus cochleæ*, transmitting a vein to the cochlea.

*Jugular fossa*, a depression for the sinus of the internal jugular vein, forming with the occipital bone the foramen lacerum posterius, which transmits that vein and the 8th pair of cranial nerves.

*Foramen for Jacobson's nerve*, (tympenic branch of the glosso-pharyngeal), in the ridge between the jugular fossa and the carotid foramen.

*Foramen for Arnold's nerve*, (auricular branch of the pneumogastric), in the outer wall of the jugular fossa.

*Jugular surface*, for articulation with the jugular process of the occipital bone.

*Vaginal process*,<sup>1</sup> ensheathing the root of the styloid process.

*Styloid process*,<sup>14</sup> a long projection for the stylo-pharyngeus, stylo-hyoid, and stylo-glossus muscles (3); and the stylo-hyoid and stylo-maxillary ligaments (2), which are attached thereto.

*Stylo-mastoid foramen*,<sup>15</sup> between the styloid and mastoid processes, for the exit of the facial nerve, and the entrance of the stylo-mastoid artery.

*Auricular fissure*, for the exit of Arnold's nerve.

In the angle between the petrous and squamous portions, are seen the—

*Processus cochleariformis*, a lamina separating the following canals.

*Opening of the canal for the tensor tympani muscle.*

*Osseous opening of the Eustachian tube* inferiorly.

The Anterior Border articulates partly with the spinous process of the sphenoid bone.

The Posterior Border assists in forming the jugular foramen, and is grooved for the inferior petrosal sinus.

The Superior Border separates the anterior fossa of the skull from the middle fossa; to it is attached the tentorium cerebelli, and it is grooved for the superior petrosal sinus.<sup>10</sup>

**Describe its articulations and development.** The temporal articulates with 5 bones,—the occipital, parietal, sphenoid, malar, and inferior maxillary. It is developed by 4 centres, one each for the squamous portion, styloid process, and auditory process, and one for the petrous and mastoid portions. Its ossification is completed about the 2nd or 3rd year.

**What muscles are attached to it?** There are 14 muscles attached to the following-named portions. To the—

*Squamous portion* 2,—the temporal and masseter.

*Mastoid portion* 6,—the occipito-frontalis, sterno-cleido-mastoid, splenius capitis, trachelo-mastoid, digastric, and retrahens aurem.

*Petrous portion* 3,—the tensor tympani, levator palati, and stapedius.

*Styloid process* 3,—the stylo-glossus, stylo-hyoid, and stylo-pharyngeus.

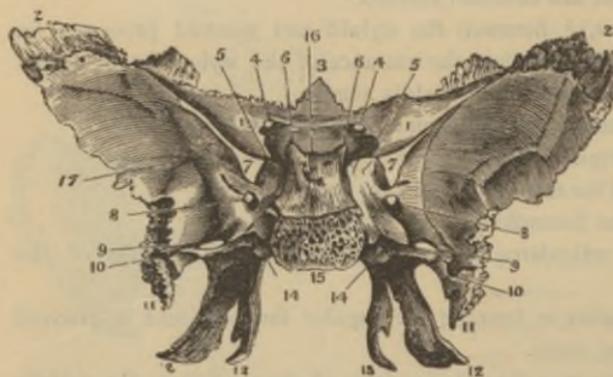
## THE SPHENOID BONE.

**Describe its position and form.** Wedged in between the bones of the skull anteriorly, it resembles a bat with out-stretched wings. It is named from the Greek word σφήν *sphane*, a wedge, enters into the formation of 5 cavities, 4 fossæ, 3 fissures, and has—

A Body.	2 Pterygoid processes.	12 Foramina.
2 Greater Wings. <sup>2</sup>	2 Styloid processes.	12 pairs of Muscles.
2 Lesser wings. <sup>1</sup>	6 Clinoid processes.	12 Articulations.
10 points of ossification.	3 Lesser processes.	

**Describe the Body of the Sphenoid Bone.** Placed in the median line, cuboid in shape, it presents on its UPPER SURFACE from before backwards, the following points, viz.—

FIG. 3.



*Ethmoidal spine*,<sup>3</sup> articulating with the ethmoid bone.

*A smooth surface*, grooved for the olfactory nerves.

*Optic groove*, supporting the commissure of the optic nerves.

*Olivary process*, an olive-shaped eminence behind the optic groove.

*Middle clinoid processes*, bounding the sella Turcica in front.

*Sella Turcica*,<sup>16</sup> (Turkish saddle), lodges the pituitary body and the circular sinus of the brain.

*Dorsum sellæ*, (back of the saddle), grooved for the 6th nerves.

*Posterior clinoid processes*,<sup>6</sup> for attachment of the tentorium cerebelli.

*Grooves*, laterally, for the cavernous sinus and internal carotid artery.

THE POSTERIOR SURFACE is rough and quadrilateral:<sup>15</sup> it articulates with the basilar process of the occipital bone, ossification being completed from the 18th to the 20th year.

THE ANTERIOR SURFACE is nearly vertical, and presents the—

*Lamella*, in the median line, articulating with the perpendicular plate of the ethmoid bone, and forming part of the nasal septum.

*Openings of the sphenoidal sinuses*,<sup>e</sup> or cavities in the body of the bone which exist in adults, not in children.

*Sphenoidal turbinated bones*, (pyramids of Wistar), which partially close the sinuses, and articulate with the ethmoid and palate bones.

THE INFERIOR SURFACE helps to form the nasal fossæ, and presents the—

*Rostrum*,<sup>d</sup> which articulates with a groove on the vomer.

*Vaginal processes*, one on each side of the rostrum.

*Pterygo-palatine grooves*, which, with the sphenoidal processes of the palate bones, form the pterygo-palatine canals, for the transmission of the pterygo-palatine arteries and nerves.

**Describe the Greater Wings of the Sphenoid.** Each wing, on its SUPERIOR SURFACE, presents the following points, viz.—

*Foramen rotundum*,<sup>8</sup> for the superior maxillary division of the 5th.

*Foramen ovale*,<sup>9</sup> for the inferior maxillary division of the 5th nerve, the small petrosal nerve, and the small meningeal artery.

*Foramen Vesalii*, transmitting a small vein.

*Foramen spinosum*,<sup>10</sup> transmitting the middle meningeal artery.

THE ANTERIOR SURFACE, assists in forming the external wall of the orbit, the spheno-maxillary and sphenoidal fissures. It articulates with the frontal and malar bones, and presents a—

*Notch*, transmitting a branch of the ophthalmic artery.

*Spine*, for part of the lower head of the external rectus muscle.

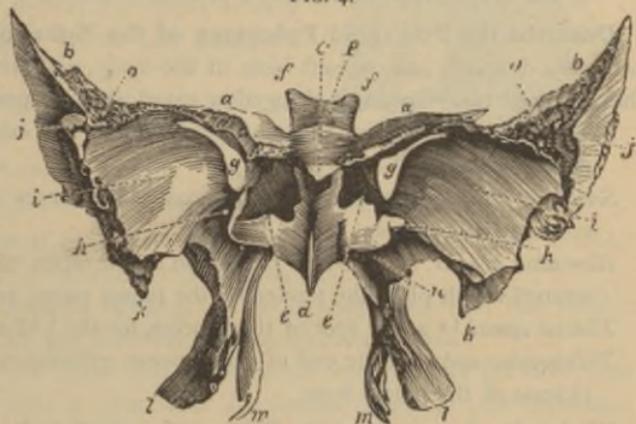
*External orbital foramina*, transmitting arterial branches.

THE EXTERNAL SURFACE presents the following points.—

*Pterygoid ridge*, dividing the temporal fossa from the zygomatic.

*Spine of the sphenoid*,<sup>11</sup> to which are attached the external lateral ligament of the lower jaw, and the laxator tympani muscle.

FIG. 4.



THE CIRCUMFERENCE is partly serrated for articulation with the temporal and frontal bones, and partly smooth for the anterior margin of the foramen lacerum medium and the inferior margin of the sphenoidal fissure, which margins it assists in forming.

**Describe the Lesser Wings<sup>1</sup> of the Sphenoid.** Called also the Processes of Ingrassias,<sup>a</sup> they terminate internally in the *anterior clinoid processes*;<sup>b</sup> their anterior borders articulate with the orbital plate of the frontal bone, the posterior are free, dividing the anterior cerebral fossa from the middle. Connected intimately with each of these wings are the—

*Optic foramen*,<sup>4</sup> formed by the separation of its roots, and transmitting the optic nerve and the ophthalmic artery.

*Sphenoidal fissure*,<sup>7</sup> or foramen lacerum anterius,<sup>g</sup> is bounded above by the lesser wing, below by the greater wing, and transmits the 3d, 4th, ophthalmic division of the 5th, and the 6th nerves, the ophthalmic vein, branches of the lachrymal and middle meningeal arteries, some filaments of the sympathetic nerve, and a process of the dura mater.

**Describe the Pterygoid Processes of the Sphenoid.** The wing-like processes descend, one on each side of the body, and divide each into two thin, bony plates,<sup>lm</sup> connected together anteriorly, and presenting—

*Pterygoid fossa*, between the plates posteriorly, the origin of the external pterygoid muscle.

*Scaphoid fossa*, at the base of the internal plate, serves as the origin of the tensor palati muscle.

*Hamular process*, a hook-like projection at the apex of the internal plate, around which plays the tendon of the tensor palati muscle.

*Vidian canal*,<sup>14</sup> at the root of the process, for the Vidian nerve and vessels.

*Triangular notch*, at the end of the process, articulates with the pterygoid process of the palate bone.

**With what bones does the Sphenoid articulate?** With 12, the other 7 bones of the cranium and 5 of the face,—the vomer, two malar, and two palate.

**How is the Sphenoid developed?** By 10 centres, as follows.—2 for the greater wings, 2 for the lesser wings and anterior part of the body, 2 for the posterior part of the body, 2 for the pterygoid processes, and 2 for the sphenoidal turbinated processes. Ossification begins in the 2d foetal month, and is completed about the 11th year, by the union of the turbinated processes with the body.

**What muscles are attached to the Sphenoid bone?** There are 12 pairs, as follows, viz.—

*Orbital muscles*, 6—all except the inferior oblique of the eye.

*Muscles of mastication*, 3,—the temporal, external and internal pterygoids. Superior constrictor, tensor palati, and laxator tympani, 3.

### THE ETHMOID BONE.

**Describe its general characteristics.** It is a spongy, light bone, depending from the ethmoidal notch of the frontal, and from between its orbital plates. It consists of a body and two lateral masses, and is named from the Greek word ἄθμος, *aythmos*, a sieve.

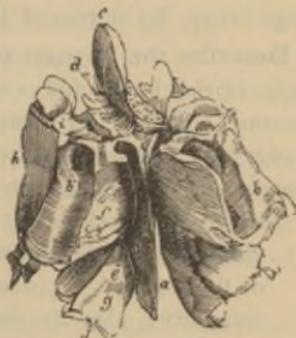
**What are the points on its body?** The body<sup>b</sup> consists of a horizontal or cribriform plate, and a perpendicular plate, and presents the—

*Crista galli*,<sup>c</sup> or cock's comb, projecting upwards, for the attachment of the anterior end of the falx cerebri.

FIG. 5.

*Cribriform plate*,<sup>d</sup> on each side of the crista galli. It is concave for the olfactory bulbs,<sup>i</sup> and perforated for the transmission of the olfactory nerves, the nasal branch of the ophthalmic nerve, and numerous small vessels.

*Perpendicular plate*,<sup>a</sup> assists to form the nasal septum, is usually inclined to one side, grooved for filaments of the olfactory nerves, and has attached to it the cartilage of the nose.



**Describe the lateral masses.** They consist of a number of cellular cavities, and each one presents the following points, viz.—

*Ethmoid cells*, the anterior opening by the infundibulum into the middle meatus of the nose, the posterior into the superior meatus.

*Os planum*,<sup>h</sup> or orbital plate, helps to form the inner wall of the orbit, and is notched superiorly to form with the frontal bone the two ethmoidal foramina.

*Unciform process*, descends to articulate with the inferior turbinate, and forms part of the inner wall of the antrum.

*Superior turbinate process*,<sup>f</sup> curves downwards and outwards.

*Middle turbinate process*,<sup>g</sup> is larger and more curved than the superior.

These processes bound the superior meatus of the nose, and are often called the superior and middle turbinated bones.

**Describe its articulations, development, and muscles.** The ethmoid articulates with 13 bones, viz.—all those of the face except the malar, and the frontal and sphenoid of the cranium. It is developed by 3 centres, one for each lateral mass, and one for the body, ossification being completed about the 6th year. There are no muscles attached to it.

### THE NASAL BONES.

**Describe them.** They are 2 small bones forming the bridge of the nose by articulation with each other in the median line. They are convex externally, concave internally and grooved for the external branch of the nasal nerve and for small arteries. They each *articulate* with 4 bones,—the frontal, ethmoid, superior maxillary, and the opposite nasal; are each *developed* by one centre of ossification, and have *no muscles* attached to them.

### THE SUPERIOR MAXILLARY BONES.

**Describe them.** They are 2 hollow bones, together forming the upper jaw. Each bone consists of four processes, and a body which possesses a large cavity, the antrum of Highmore.

**Describe the antrum of Highmore.** It is a pyramidal cavity in the body of the bone, and opens into the middle meatus of the nose by an aperture which is very small in the recent subject, admitting only a small probe. Its walls are very thin, and are covered internally by a mucous membrane. It presents the—

*Aperture*, partly closed by the articulation of the unciform process of the ethmoid with the ethmoidal process of the inferior turbinated; and that of the maxillary process of the palate with a fissure in the superior maxillary; also by the maxillary process of the inferior turbinated which hooks over the lower edge of the orifice.

*Posterior dental canals*, on the posterior wall of the cavity.

*Processes* in its floor, formed by the alveoli of the 1st and 2nd molar teeth, the roots of which occasionally perforate it.

**What other points are presented by the body?** The body has 4

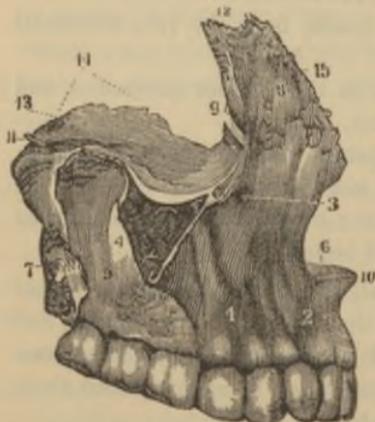
surfaces, the facial externally, the zygomatic posteriorly, the orbital superiorly, and an internal surface forming part of the outer wall of the nose and the cavity of the mouth. It presents the—

*Incisive fossa*,<sup>2</sup> on the facial surface, above the incisor sockets, for the origin of the depressor alæ nasi muscle.

*Canine fossa*,<sup>1</sup> more externally, for the levator anguli oris.

*Infraorbital foramen*,<sup>3</sup> above the canine fossa, transmitting the infraorbital vessels and nerve, from the *infraorbital canal* in the orbital surface of the bone.

FIG. 6.



*Maxillary tuberosity*, articulates with the tuberosity of the palate bone.

*Turbinated crests*, inferior and superior, on the inner surface, bounding horizontal grooves which correspond to the meati of the nose.

*Vertical grooves*, on the inner surface, one assisting to form the nasal duct, the other to form the posterior palatine canal.

*Rough surface*, for articulation with the palate bone.

*Orbital surface*, articulating with the lachrymal, ethmoid and palate bones interiorly, partly bounding the speno-maxillary fissure exteriorly, and forming the lower margin of the orbit anteriorly.

*Infraorbital groove*, along the orbital surface, ending in the infraorbital canal and foramen. (See *ante*.)

*Depression*, for the origin of the inferior oblique muscle of the eye.

**Describe its processes.** They number 4, as follows.—

**MALAR PROCESS**,<sup>4</sup> is triangular, looks outwards from the body, and is rough for articulation with the malar bone.

**NASAL PROCESS**,<sup>8</sup> is thin anteriorly and serrated superiorly for articulation with the nasal bone; posteriorly it is smooth and articulates with the lachrymal. It presents the—

*Turbinated crests*, superior and inferior, the former articulating with the middle turbinated process of the ethmoid bone.

*Outer surface*, gives origin to the orbicularis palpebrarum and levator labii superioris alæque nasi muscles, and the tendo oculi.

*Groove* on the posterior border, helping to form the nasal duct.

**ALVEOLAR PROCESS**, forms the curved line of the teeth, and presents—

*Alveoli*, or sockets, for 8 teeth in the adult, 5 in the child.

**PALATE PROCESS**, forms part of the floor of the nasal cavity, and the roof of the mouth. It articulates with the vomer, the palate bone, and with its fellow process, and presents the—

*Incisive foramen*, or foramen of Stenson, leading into the anterior palatine canal, for the anterior palatine vessels.

*Foramina of Scarpa*, 2, transmitting the naso-palatine nerves.

*Groove* on the under surface, for the protection of the vessels and nerves.

*Orifice* of the posterior palatine canal, at the posterior end.

*Nasal crest*, at the articulation of the two processes with the vomer.

*Anterior nasal spine*, the anterior extremity of the nasal crest.

**Describe its articulations and development.** The superior maxillary articulates with 9 bones,—the frontal,<sup>12</sup> ethmoid,<sup>14</sup> vomer,<sup>13</sup> nasal,<sup>15</sup> lachrymal, malar, palate, inferior turbinated and opposite superior maxillary.<sup>10</sup> It is developed probably by 4 centres,—one for the facial and nasal parts, another for the orbital and malar, a third for the incisive, and a fourth for the palate portion.

**What muscles are attached to it?** There are 11, viz.—the orbicularis palpebrarum, and levator anguli oris *alæque nasi*, 2, to the *nasal process*;—the levator labii superioris, levator anguli oris, compressor naris, depressor *alæ nasi*, orbicularis oris, and inferior oblique of the eye, 6, to the *body*;—the buccinator, 1, to the *alveolar process*;—the masseter, 1, to the *malar process*;—and the external pterygoid, 1, to the *tuberosity*.

### THE LACHRYMAL BONES.

**Describe them.** They are two small quadrilateral-shaped bones, situated in the anterior part of the inner wall of the orbit. Each presents a—  
*Groove*, on the external surface, forming part of the nasal duct.  
*Ridge*, also externally, for attachment of the tensor tarsi muscle.  
*Furrow*, internally, corresponding to the ridge on the external surface.  
*Hamular process*, projecting downwards to articulate with the lachrymal process of the inferior turbinated bone.  
*Internal surface*, closes the anterior ethmoidal cells.

**Describe its articulations, development, and muscles.** The lachrymal articulates with 4 bones,—the frontal, ethmoid, superior maxillary, and inferior turbinated. It is developed from one centre, and has but *one muscle* attached to it, the tensor tarsi, or Horner's muscle.

### THE MALAR BONES.

**Describe them.** The cheek bones are situated at the outer and upper part of the face, aiding to form the cavities of the orbits and the temporal and zygomatic fossæ. Each presents an—

- External surface*, convex, for attachment of the zygomatic muscles.
- Foramen*, externally, for the malar branch of the temporo-malar nerve.
- Foramen*,<sup>c</sup> internally, for the temporal branch of the same nerve.
- Frontal process*,<sup>a</sup> articulates with the external angular process of the frontal.
- Orbital process*,<sup>b</sup> projecting backwards, forming part of the floor and outer wall of the orbit, as well as part of the temporal fossa, and bounds the sphenomaxillary fissure anteriorly.

FIG. 7.



*Zygomatic process*,<sup>f</sup> projecting backwards to articulate with the zygomatic process of the temporal bone by a serrated edge.

*Upper border*,<sup>b</sup> forms the outer and inferior margin of the orbit.

*Lower border*, thick and rough, for the origin of the masseter muscle.

*Anterior border*,<sup>d</sup> articulates with the superior maxillary bone.

*Posterior border*, terminates the temporal fossa below.

**Name its articulations, centres, and muscles.** The malar articulates with 4 bones,—the frontal, sphenoid, temporal, and superior maxillary. It is developed by one centre of ossification, and has 5 muscles attached to it,—the levator labii superioris, zygomaticus major and minor, masseter and temporal.

### THE PALATE BONES.

**Describe them.** They are two irregularly-shaped bones, situated posteriorly in the nares. Each bone assists in forming the floor and outer wall of the nose, the roof of the mouth, the floor of the orbit, the inner wall of the antrum, the zygomatic, speno-maxillary and pterygoid fossæ, and presents the following points.

**HORIZONTAL PLATE,<sup>a</sup>** completes the nasal floor and hard palate; has a—

*Ridge*, on the inferior surface, for the tensor palati aponeurosis.

*Groove*, assisting to form the posterior palatine canal.

*Foramina*, transmitting the anterior and posterior palatine nerves.

*Anterior border*, is serrated, and joins the superior maxillary bone.

*Posterior border*, is free and concave, for the attachment of the soft palate.

*Inner border,<sup>d</sup>* is thick, and articulates with its fellow, forming a groove for the reception of the vomer.

Its posterior extremity is the—

*Posterior nasal spine*, for the origin of the azygos uvulæ muscle.

**VERTICAL PLATE,<sup>b</sup>** a broad and thick lamella, presents the following:—

*Superior turbinated crest*, on the inner surface. Below it is the—

*Inferior turbinated crest,<sup>g</sup>* dividing the middle meatus of the nose from the inferior, and articulating with the inferior turbinated bone.

*Posterior border*, articulates with the pterygoid process of the sphenoid.

*Groove*, on the external surface, helping to form the posterior palatine canal.

*Two smooth surfaces*, externally, one forming the inner wall of the zygomatic fossa; the other, part of the inner wall of the antrum.

*Two rough surfaces*, also externally, one for articulation with the superior maxillary; the other with the pterygoid process of the sphenoid.

*Deep notch*, which by articulation with the sphenoid bone, forms the *spheno-palatine foramen,<sup>h</sup>* for the spheno-palatine nerves.

**PTERYGOID PROCESS,<sup>c</sup>** is wedged into the notch between the plates of the pterygoid process of the sphenoid, with which it articulates laterally. In it are the—

*Palatine foramina*, for the external and posterior palatine nerves.

*Posterior surface*, aids in forming the pterygoid fossa.

FIG. 8.



**ORBITAL PROCESS,** *i* triangular in shape, large and hollow. It has—

*Three articular surfaces*, for the sup. maxillary, sphenoid, and ethmoid.

*Two free surfaces*, the orbital forming part of the floor of the orbit, the external aiding to form the zygomatic fossa.

*Rounded border*, forms a part of the spheno-maxillary fissure.

**SPHENOIDAL PROCESS,** *j* projects backwards, articulates superiorly with the body of the sphenoid, and externally with the pterygoid process of the sphenoid. On its upper surface is a—

*Groove*, which assists in forming the pterygo-palatine canal.

*Inner surface*, forms part of the outer wall of the nasal fossa.

**Describe its articulations, development and muscles.** The palate articulates with 6 bones,—the sphenoid, ethmoid, vomer, superior maxillary, inferior turbinate, and its fellow palate bone. It is developed by one centre at the junction of the two plates. There are 5 muscles attached to it,—the azygos uvulae, internal and external pterygoids, superior constrictor, and tensor palati.

### THE INFERIOR TURBINATED BONES.

**Describe them.** They are two thin curved osseous plates situated in the nasal fossae, their convex surfaces presenting inwardly. Each bone is attached above to the inferior turbinate crests of the superior maxillary and palate bones, and presents the following: viz.—

FIG. 9.



*Lachrymal process,* <sup>3</sup> aiding to form the nasal duct, by articulation with the lachrymal and superior maxillary bones.

*Ethmoidal process,* <sup>1</sup> articulating with the unciform process of the ethmoid, thus helping to partially close the aperture of the antrum.

*Maxillary process,* <sup>4</sup> also helps to partially close the aperture of the antrum, by hooking <sup>7</sup> over the lower edge of that orifice.

*Free border,* <sup>5</sup> below, coming to about  $\frac{1}{2}$  inch above the floor of the nose.

**Name its articulations, centres, and muscles.** The inferior turbinate articulates with 4 bones,—the ethmoid, lachrymal, palate, and superior maxillary. It is developed by one centre, and has no muscles attached to it.

### THE VOMER.

**Describe it.** The vomer (plough-share) forms the postero-inferior part of the nasal septum, but is usually bent to one side. Its—

FIG. 10.



*Superior border,* <sup>1 2</sup> has a groove and two alae or wings, for articulation with the rostrum and vaginal processes of the sphenoid bone.

*Anterior border*,<sup>3</sup> is grooved for the ethmoidal plate and the nasal cartilage.

*Inferior border*,<sup>4</sup> the longest, articulates with the nasal crest of the superior maxillary and palate bones.

*Posterior border*, is free and presents towards the pharynx.

*Naso-palatine grooves*, laterally, for the naso-palatine nerves.

*Furrows*, on the lateral surfaces,<sup>6</sup> for vessels and nerve-filaments.

**Name its articulations, centres, and muscles.** The vomer articulates with 6 bones,—the sphenoid, ethmoid, 2 superior maxillary, and 2 palate bones. It is developed by one centre, which appears about the 6th fetal week in cartilage between two laminae which coalesce after puberty. It has *no muscles* attached to it.

### THE INFERIOR MAXILLARY BONE.

**Describe its general characteristics.** The inferior maxillary bone forms the lower jaw, receives the inferior teeth, and is the second bone of the body in which ossification appears, the clavicle being the first. It consists of a body and two rami.

**Describe the Body of the bone.** It is shaped somewhat like a horse-shoe, and presents for examination the following: viz.—

*Alveolar portion*, above the oblique line, containing on its upper border *alveoli* for 16 teeth in the adult, for 10 in the child.

*Symphysis*, a vertical ridge on the median line, marking the junction of the two symmetrical portions of which the bone originally consisted.

*Mental process*, a prominent triangular eminence, forming the chin.

Externally on each side from the symphysis backwards, are the—

*Incisive fossa*, above the chin, for the origin of the levator menti.

*Mental foramen*, below the 2d bicuspid alveolus, transmitting the mental artery and nerve.

*External oblique line*, for the origins of the depressor labii inferioris and depressor anguli oris muscles from its anterior half.

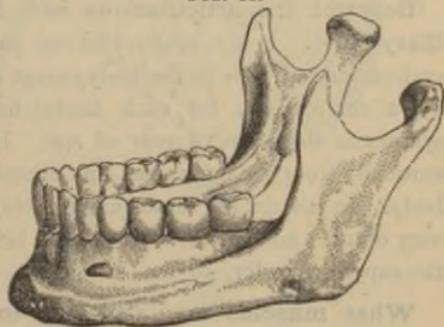
*Groove*, near the angle, for the facial artery.

Internally, on each side from the median depression backwards, are the—

*Genial tubercles*, the superior for the genio-hyo-glossus muscle; the inferior for the genio-hyoid.

*Mylo-hyoid ridge*, obliquely backwards, for the mylo-hyoid muscle.

FIG. 11.



*Sublingual fossa*, near the genial tubercles, for the sublingual gland.

*Fossa*, below the sublingual, for the anterior belly of the digastric muscle.

*Submaxillary fossa*, below the ridge, for the submaxillary gland.

**Describe the Rami of the inferior maxillary.** The rami, or ascending portions of the bone, are two in number, and each present the—

*Coronoid process*, anteriorly, for the insertion of the temporal muscle.

*Condylod process*, posteriorly. Its condyle articulates with the glenoid fossa of the temporal bone, its *neck* receives the insertion of the external pterygoid muscle, its *tubercle* has attached to it the external lateral ligament of the lower jaw.

*Sigmoid notch*, a deep depression separating the above-named processes from each other, and crossed by the masseteric vessels and nerve.

*Groove*, on the coronoid process internally, and prolonged downwards upon the body, for the attachment of the buccinator muscle.

*Ridges*, on the external surface, for the insertion of the masseter.

*Spine*, a projection on the internal surface, for the attachment of the internal lateral ligament of the jaw.

*Inferior dental canal*, opening behind the spine, lies within the ramus and body of the bone for the inferior dental vessels and nerve. It communicates with each alveolus and with the mental foramen.

*Mylo-hyoid groove*, below the spine, for the mylo-hyoid vessels and nerve.

*Rough surface*, behind the groove, for the internal pterygoid muscle.

*Angle of the jaw*, at the junction of the posterior border of the ramus with the inferior border of the body, for the insertion of the masseter and internal pterygoid muscles, and the stylo-maxillary ligament.

**Describe the articulations and development of the inferior maxillary bone.** It articulates with one pair of bones,—the temporal. It is the earliest formed bone in the body except the clavicle, and is probably developed by 2 centres, one for each lateral half, the two halves coalescing at the symphysis about the 1st year of age. In *adult life* the ramus arises almost vertically from the body, and the dental canal lies about the middle of the body. In *old age* the ramus extends obliquely backwards, the angle becoming very obtuse; and the alveolar portion being absorbed, the dental canal is near the superior border.

**What muscles are attached to the inferior maxillary?** They number 15 pairs,—the masseter, internal and external pterygoids and temporal, 4, to the *ramus*;—the genio-hyo-glossus, genio-hyoid, mylo-hyoid, digastric, and superior constrictor, 5, to the internal surface of the *body*;—the depressor labii inferioris, depressor anguli oris, levator menti, orbicularis oris, platysma myoides, and buccinator, 6, to the external surface of the *body*.

## THE ORBITS.

**Describe the orbital cavities.** The orbits are 2 conoidal cavities, situated between the forehead and the face, their bases outwards, their apices pointing backwards, the lines of axial prolongation meeting at the sella turcica of the sphenoid bone. They contain the organs of vision with their appendages, and are each formed by 7 bones,—the frontal,<sup>1</sup> ethmoid,<sup>2</sup> sphenoid,<sup>3 4 5</sup> lachrymal,<sup>6</sup> superior maxillary,<sup>7</sup> palate,<sup>8</sup> and malar,<sup>9</sup> of which the first three are common to both orbits. Each orbit communicates with 1 cavity and 4 fossæ, as follows, viz.—

*Cavity* of the cranium, by the optic foramen<sup>11</sup> and sphenoidal fissure.<sup>10</sup>

*Fossæ* (4)—the nasal, temporal, zygomatic, and speno-maxillary,—by the nasal duct<sup>12</sup> and the speno-maxillary fissure.<sup>13</sup>

**What Foramina communicate with each orbit?** Nine,—the optic foramen,<sup>11</sup> sphenoidal fissure,<sup>10</sup> anterior<sup>21</sup> and posterior<sup>22</sup> ethmoidal foramina, supra-orbital,<sup>14</sup> infraorbital,<sup>15</sup> and malar foramina,<sup>16</sup> the nasal duct,<sup>12</sup> and the speno-maxillary fissure.<sup>13</sup>

**Describe the roof of the orbit.** Formed by the orbital plate of the frontal bone anteriorly,<sup>1</sup> and the lesser wing of the sphenoid<sup>4</sup> posteriorly, it is concave, and presents the—

*Lachrymal fossa*,<sup>17</sup> at its outer angle, for the lachrymal gland.

*Depression*,<sup>18</sup> at the inner angle, for the pulley of the superior oblique.

**Describe the Floor of the Orbit.** Formed by the orbital surface of the superior maxillary bone,<sup>7</sup> and the orbital process of the malar<sup>9</sup> and palate bones,<sup>8</sup> it is nearly flat and presents the—

*Palato-maxillary suture* posteriorly.

*Infraorbital canal*, and a *depression* for the superior oblique muscle of the eye, anteriorly.

*Infraorbital groove*,<sup>19</sup> posteriorly.

FIG. 12.



**Describe the Inner Wall of the Orbit.** Formed by the nasal process of the superior maxillary bone,<sup>20</sup> the lachrymal,<sup>6</sup> the os planum of the ethmoid,<sup>2</sup> and the body of the sphenoid,<sup>3</sup> it presents—

- A groove*, for the lachrymal sac, and the *lachrymal crest*, anteriorly.  
*2 Sutures*,—the ethmo-lachrymal, and the ethmo-sphenoidal.

**Describe the Outer Wall of the Orbit.** Formed by the orbital process of the malar bone,<sup>9</sup> and the greater wing of the sphenoid,<sup>5</sup> it presents the *orifices*<sup>16</sup> of the malar canals, and the *spheno-malar suture*.

**Describe the Angles of the Orbit.** They present the following points.

IN THE SUPERIOR EXTERNAL ANGLE.

*Sphenoidal fissure*,<sup>10</sup> or foramen lacerum anterius, transmits the 3rd, 4th, ophthalmic division of the 5th, and the 6th nerves, the ophthalmic vein, branches of the lachrymal and middle meningeal arteries, filaments of the sympathetic nerve, and a process of the dura mater.

*Articulations*,—the fronto-malar, and fronto-sphenoidal.

IN THE SUPERIOR INTERNAL ANGLE.

*Suture*,—the lachrymo-ethmo-frontal, in which are the following foramina.

*Anterior ethmoidal foramen*,<sup>21</sup> transmitting the anterior ethmoidal artery and the nasal nerve.

*Posterior ethmoidal foramen*,<sup>22</sup> transmitting the posterior ethmoidal artery and vein.

IN THE INFERIOR EXTERNAL ANGLE.

*Spheno-maxillary fissure*,<sup>13</sup> (described under the Zygomatic Fossa).

IN THE INFERIOR INTERNAL ANGLE.

*A Suture*, the ethmo-maxillo-palato-lachrymal.

**What other points are connected with the Orbit?** Two, the supra-orbital notch, and the optic foramen, as follows, viz.—

*Supraorbital notch or foramen*,<sup>14</sup> at the junction of the inner and middle thirds of the upper circumference, transmitting the supraorbital artery, veins, and nerve. A line prolonged from this notch through the interval between the bicuspid teeth of either jaw, will cross both the infraorbital and mental foramina, and the canine fossa of the superior maxillary bone.

*Optic foramen*,<sup>11</sup> at the apex, is formed by the two roots of the lesser wing of the sphenoid, and transmits the optic nerve and the ophthalmic artery. From around its margin arises a tendinous ring, the common origin of the 4 recti muscles of the eye.

**What Muscles arise within the Orbit?** The four recti and two oblique of the eye, the levator palpebræ, and the tensor tarsi (8 in all).

## THE FOSSÆ.

**Describe the Nasal Fossæ.** Together they form the cavity of the nose, being separated from each other by the *septum nasi*.<sup>11</sup> They open in front by the anterior nares, behind by the posterior nares; and extend from the palate processes of the superior maxillary and palate bones<sup>17</sup> upwards to the base of the cranium. They are formed by 14 bones,—the ethmoid, sphenoid, frontal, vomer, 2 nasal, 2 superior maxillary, 2 lachrymal, 2 palate, and 2 inferior turbinated.

**Describe the Septum Nasi.**<sup>11</sup> It forms the inner wall of each nasal fossa, and is formed chiefly by the perpendicular plate of the ethmoid bone, the vomer, and the triangular cartilage of the septum; to a less extent by 5 other bones,—the rostrum of the sphenoid, the nasal spine of the frontal, and the crests of the nasal, palate, and superior maxillary bones.

**Describe the points presented by each Nasal Fossa.** They are—  
ON THE ROOF.

*Openings*, posteriorly, into the sphenoidal sinuses.

*Olfactory foramina*, and the *nasal slit*, in the cribriform plate of the ethmoid bone.

ON THE FLOOR.

*Orifice* of the anterior palatine canal.

*Suture*, between the bones forming the hard palate.

*Nasal spines*, anterior and posterior, and the *ridge* connecting them.

ON THE OUTER WALL, from above downwards.

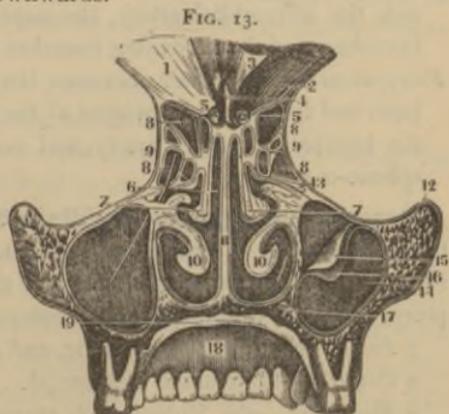
*Superior turbinated* process of the ethmoid.

*Superior meatus* of the nose, into which open 3 orifices,—those of the posterior ethmoidal and the sphenoidal sinuses, and the spheno-palatine foramen.

*Middle turbinated*<sup>7</sup> process of the ethmoid.

*Middle meatus* of the nose, into which open 2 orifices,—those of the antrum<sup>14</sup> and infundibulum,—the latter draining the anterior ethmoidal cells,<sup>8</sup> and the frontal sinus.

*Inferior turbinated bone*,<sup>10</sup> below which is the—



*Inferior meatus* of the nose, the largest; into it open 2 orifices,—those of the lachrymal, and anterior palatine canals. To these may be added the anterior and posterior nares.

**Describe the Temporal Fossa.** Situated on each side of the cranium, it is shallow above and behind, but deep in front and below; and is formed by parts of 5 bones,—the frontal, sphenoid, temporal, parietal and malar. It is bounded above and behind by the temporal ridge, in front by the malar frontal and sphenoid bones, and below by the zygoma and the pterygoid ridge on the greater wing of the sphenoid. It is traversed by 6 sutures,—the sphe-no-malar, sphe-no-frontal, sphe-no-parietal, sphe-no-temporal, fronto-parietal, and temporo-parietal. It opens below into the zygomatic fossa; and lodges the temporal muscle, and the deep temporal vessels.

**Describe the Zygomatic Fossa.** Extending downwards from the temporal fossa, it is thus bounded,—

*In front*, by the tuberosity of the superior maxillary bone.

*Externally*, by the zygoma, and the ramus of the inf. maxillary.

*Internally*, by the external plate of the pterygoid process.

*Above*, by the temporal fossa, the squamous portion of the temporal bone, and the greater wing of the sphenoid.

*Below*, by the alveolar border of the inferior maxillary bone.

**What Fissures open into the Zygomatic Fossa?** Two, the—

*Spheno-maxillary fissure*, between the greater wing of the sphenoid externally, and the superior maxillary and palate bones internally. It connects the orbit with the zygomatic, temporal, and spheno-maxillary fosse; and transmits the infraorbital artery, the superior maxillary nerve and its orbital branches, and the ascending branches of Meckel's ganglion.

*Pterygo-maxillary fissure*, between the tuberosity of the superior maxillary bone and the pterygoid process of the sphenoid. It transmits branches of the internal maxillary artery, and connects the zygomatic fossa with the spheno-maxillary.

**Describe the Spheno-Maxillary Fossa.** It is a triangular cavity between the pterygoid process of the sphenoid bone and the tuberosity of the superior maxillary, and is situated at the junction of the spheno-maxillary, pterygo-maxillary, and sphenoidal fissures. Into it open—

3 *Fossæ*,—the orbital, zygomatic, and nasal.

2 *Cavities*,—the cranial, and buccal.

5 *Foramina*,—the Vidian and pterygo-palatine canals, and the foramen rotundum, posteriorly; the spheno-palatine foramen on the inner wall; and the posterior palatine canal inferiorly;—occasionally also the accessory palatine canals.

## THE SUTURES AND FONTANELLES.

**Name the Sutures of the skull.** There are 17.

*At the Vertex* of the skull are 5, the—

Sagittal, or interparietal.

2 Coronal, or fronto-parietal.

2 Lambdoid, or occipito-parietal.

*At the sides* of the skull are 4, the—

2 Spheno-parietal.

2 Temporo-parietal.

*At the base* of the skull are 5, the—

2 Temporo-occipital.

Basilar, in the central line of the base.

2 Temporo-sphenoidal.

*In the Mesial line*, besides the sagittal and basilar, are 3, the—

Spheno-ethmoidal. Spheno-frontal. Ethmo-frontal.

**Describe the Facial Sutures.** The most important are the following, but the sutures of the face are very numerous.

*Zygomatic suture*, at the temporo-malar articulation.

*Transverse suture*, extending from one external angular process of the frontal bone across to the other, and connecting that bone with the malar, sphenoid, ethmoid, lachrymal, superior maxillary, and nasal bones.

*Symphysis of the chin*, the site of a foetal suture.

**How are the Sutures formed?** By indentations of the external tables interdigitating with each other, the adjacent edges of the internal tables lying in unjoined proximity. The sutures are not formed until a long time after the formation of the skull, probably to permit of the marginal growth of the bones.

**What are the Fontanelles?** They are 6 membranous intervals in the infant's skull, corresponding in situation with the angles of the two parietal bones. They are as follows, viz.—

*Anterior*, at the junction of the sagittal and coronal intervals.

*Posterior*, at the junction of the sagittal and lambdoid intervals.

*Lateral fontanelles*, 4, two at the anterior inferior angles, and two at the posterior inferior angles of the parietal bones.

**Describe the Wormian Bones.** They are supernumerary small pieces of bone, irregularly shaped, and developed by special centres in unclosed portions of the cranial sutures and fontanelles, being more frequent in the lambdoid suture. They are also called "*ossa triquetra*" from their triangular form.

**Describe the Hyoid Bone.** It is shaped like a horse-shoe, has no articulation with the skeleton, but supports the tongue. It consists of a *body*, two greater, and two lesser *cornua* or horns. On the body is a *crucial ridge*, with a *tubercle* at the centre. It is developed by 5 centres,—one for the body and one for each horn. Attached to it are 10 muscles, 3 ligaments, and 1 membrane, as follows; viz.—

*To the body*,—the genio-, mylo-, stylo-, sterno-, thyro-, omo-hyoid, the genio-hyo-glossus, and the hyo-glossus muscles; also the pulley of the digastric, the hyo-epiglottic ligament, and the thyro-hyoid membrane.

*To the greater cornu*,—the hyo-glossus, middle constrictor muscles, and part of the thyro-hyoid;—also the thyro-hyoid ligament.

*To the lesser cornu*,—the stylo-hyoid ligament.

## TABLE OF THE FORAMINA AT THE BASE OF THE SKULL,

*with the various structures transmitted by each.*

**Anterior Fossa** contains 1 single foramen and 5 in pairs, viz.—

*Foramen cæcum*,—lodges a fold of dura mater, and transmits a vein to the longitudinal sinus from the nose, sometimes one from the frontal sinus.

*Ethmoidal fissure*,—the nasal nerve, and the anterior ethmoidal artery.

*Olfactory*,—olfactory nerves, and nasal branches of the ethmoidal arteries.

*Anterior ethmoidal*,—anterior ethmoidal artery and the nasal nerve.

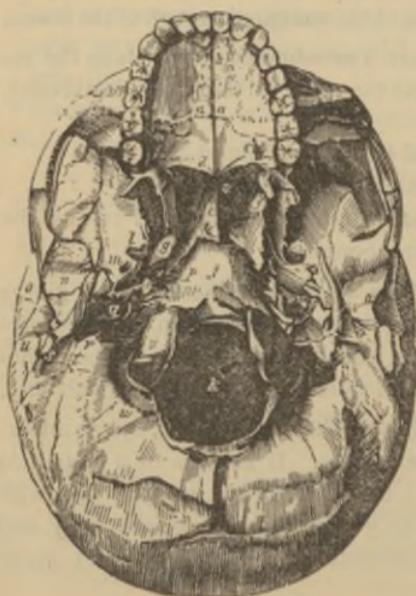
*Posterior ethmoidal*,—posterior ethmoidal artery and vein.

*Optic foramen*,—optic nerve and ophthalmic artery.

**Middle Fossæ** contain 8 pairs, viz.—

*Foramen lacerum anterius*, or *Sphenoidal fissure*,<sup>p</sup>—the 3rd, 4th, ophthalmic division of the 5th, and the 6th cranial nerves, and filaments of

FIG. 14.



the sympathetic; ophthalmic vein, a branch of the lachrymal artery, orbital branches of the middle meningeal artery, and a process of dura mater.

*Foramen rotundum*,—superior maxillary division of the 5th cranial nerve.

*Foramen Vesalii*,—a small vein. This foramen is often absent.

*Foramen ovale*,<sup>l</sup>—inferior maxillary division of the 5th nerve, lesser petrosal nerve, and the small meningeal branch of the internal maxillary artery.

*Foramen spinosum*,<sup>m</sup>—middle meningeal artery, meningeal veins, and sympathetic filaments from the cavernous plexus.

*Foramen lacerum medium, g* — internal carotid artery, carotid plexus, large petrosal nerve, and a branch from the ascending pharyngeal artery.

*Small foramen,*—lesser petrosal nerve.

*Hiatus Fallopii,*—large petrosal nerve, branch of middle meningeal artery.

**Posterior Fossa** contains 6 pairs and 1 single, viz.—

*Meatus auditorius internus,*—facial and auditory nerves, auditory artery.

*Aqueductus vestibuli,*—small artery and vein, process of dura mater.

*Foramen lacerum posterius, r* —glosso-pharyngeal, pneumo-gastric and spinal accessory nerves, internal jugular vein, meningeal branches of the ascending pharyngeal and occipital arteries.

*Mastoid foramen,* (often absent),—small vein, occasionally the mastoid artery.

*Anterior condyloid foramen,*—hypoglossal nerve, meningeal branch from the ascending pharyngeal artery.

*Posterior condyloid foramen, w* (often absent), posterior condyloid vein.

*Foramen magnum, k* —medulla oblongata and its membranes, the vertebral arteries, and the spinal accessory nerves.

**Externally,** at the base of the skull are 10 pairs, viz.—

*Opening of the Eustachian tube,*—air to the middle ear.

*Opening of tensor tympani canal,*—the tensor tympani muscle.

*Orifice of the Vidian canal,*—the Vidian nerve, and vessels.

*Glasserian fissure, n* —laxator tympani muscle, tympanic artery, processus gracilis of the malleus.

*Orifice of the canal of Hugier,*—chorda tympani nerve.

*Foramen for Jacobson's nerve,*—tympanic branch of glosso-pharyngeal.

*Foramen for Arnold's nerve,*—auricular branch of pneumogastric.

*Opening of the aqueductus cochleæ,*—vein to the cochlea.

*Stylo-mastoid foramen, t* —facial nerve, stylo-mastoid artery.

*Auricular fissure,*—exit of Arnold's nerve.

**Face,** presents 3 pairs, viz.—

*Supraorbital foramen or notch,*—supraorbital artery, vein and nerve.

*Infraorbital foramen,*—infraorbital artery and nerve.

*Mental foramen,*—mental artery and nerve.

**Palate** presents, on each side at least 6 pairs, viz.—

*Incisive foramina, b* (one or two),—nerves and vessels to the incisor teeth.

*Anterior palatine,*—anterior palatine vessels, naso-palatine nerves.

*Posterior palatine,*—posterior palatine vessels, anterior palatine nerve.

*Accessory palatine foramina* (one or two),—posterior palatine nerves.

*Pterygo-palatine foramen,*—pterygo-palatine vessels.

## THE BONES OF THE TRUNK.

## THE VERTEBRAL COLUMN.

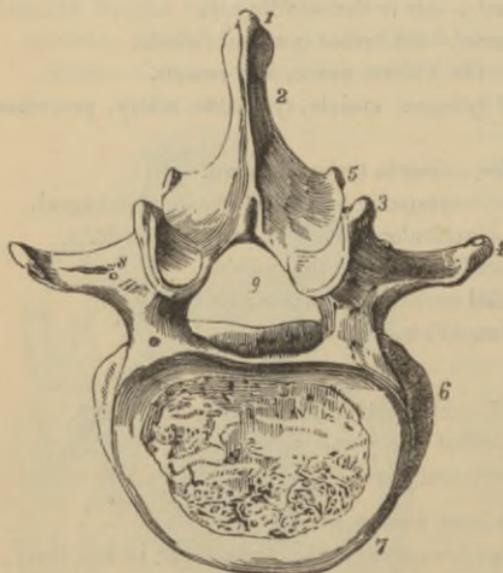
**What characteristics are common to the Vertebrae?** Each vertebra consists of a body and an arch, the latter being formed by 2 pedicles and 2 laminae, which support 7 processes.

*Body*<sup>6</sup> is thick and spongy, convex in front<sup>7</sup> from side to side, concave vertically, and on the upper and lower surfaces, which are surrounded by a bony rim. Anteriorly are small foramina for nutrient vessels, posteriorly a large foramen for the exit of the venae basis vertebrarum.

*Pedicles*, project backwards from the body, inclining outwards. They are notched above and below, thus forming with the adjacent notches, the *intervertebral foramina* for the entrance of vessels and the exit of the spinal nerves.

*Laminae*,<sup>2</sup> are two broad plates, meeting in the spinous process behind, and rough on their upper and lower borders for the attachment of the ligamentum subflava.

FIG. 15.



*Transverse processes*,<sup>4</sup> one on each side, projecting outwards.

*Articular processes*, two on each side, superior<sup>3</sup> and inferior,<sup>5</sup> project from the junction of the laminae and pedicles, and articulating above and below with the articular processes of the adjacent vertebrae. Their superior facets look upwards in the cervical region, outwards in the dorsal, and inwards in the lumbar.

*Spinous process*,<sup>1</sup> projects backwards from the junction of the laminae with each other, sometimes very obliquely.

*Spinal foramen*,<sup>9</sup> is the space enclosed by the body, pedicles, and laminae; and which, when the vertebrae are articulated, forms part of the spinal canal.

**How are the Vertebræ distinguished?** As cervical (7), dorsal (12) and lumbar (5). Each of these divisions has several peculiar features, but their especial characteristics are as follows.

*The cervical vertebræ* are pierced at the bases of their transverse processes, by the *vertebral foramina*, which transmit the vertebral artery, vein, and plexus.

*The dorsal vertebræ* have facets and demifacets on their bodies, for articulation with the heads of the ribs.

*The lumbar vertebræ* are marked by the absence of the foramina and facets which distinguish the other two classes.

**What are the Peculiar Vertebræ?** They are 9 in number,—the atlas or 1st cervical, the axis or 2d cervical, the *vertebra prominens* or 7th cervical, the 1st 9th 10th 11th and 12th dorsal, and the 5th lumbar.

*The atlas* is a bony ring supporting the head. A bony arch takes the place of a body, and its spinous process is a mere tubercle. Its *lateral masses* form its chief bulk, supporting large *articular processes* which all look inwards, the superior articulating with the condyles of the occipital bone.

*The axis* is marked by its *odontoid process* projecting upwards from the body into the anterior part of the spinal foramen of the atlas, where it articulates with the anterior arch, and receives the occipito-axoid and the check ligaments.

*The vertebra prominens* has a long and prominent spinous process which ends in a tubercle for the *ligamentum nuchæ*.

*The dorsal vertebræ.* The 1st has one facet and a demifacet. The 9th has a demifacet only. The 10th has but one facet on the body and one on the transverse process. The 11th and 12th have each but one facet on the body, and none on the transverse processes. The 12th resembles a lumbar vertebra in size and shape.

*The 5th lumbar* is much deeper in front than behind; its spinous process is small, but its transverse processes are large and thick, and point slightly upwards.

**What important relations have certain vertebræ?**

*The 3d cervical* corresponds to—the bifurcation of the common carotid artery, and the superior cervical ganglion.

*The 5th cervical*, to—the junctions of the larynx with the trachea, and the pharynx with the œsophagus, and the middle cervical ganglion of the sympathetic.

*The 2d lumbar*, to—the junction of the duodenum with the jejunum, the commencement of the thoracic duct and the portal vein, the origin of the superior mesenteric artery, the lower margin of the pancreas, the opening of the ductus communis cholédochus, the lower end of the spinal cord, and the crura of the diaphragm.

[The false vertebræ are described as bones of the pelvis.]

## THE THORAX.

**What is the Thorax?** An osseo-cartilaginous cage formed by the bodies of the dorsal vertebræ posteriorly, the ribs and costal cartilages laterally, and the sternum in front. Its shape is conical, the axis inclined forwards, the base below and closed by the diaphragm.

**What structures pass through its apex?** The trachea, œsophagus, large vessels of the neck, pneumogastric, phrenic and sympathetic nerves, thoracic duct, and in inspiration the apex of the lung.

**What structures are contained in its cavity?** The trachea, bronchi and lungs, the heart and great vessels, internal mammary arteries, azygos and bronchial veins, pneumogastric, phrenic and splanchnic nerves, œsophagus, thoracic duct, lymphatic vessels and glands.

## THE STERNUM.

**Describe it.** The sternum, or breast-bone, consists of 3 parts,—the manubrium,<sup>a</sup> or handle; the gladiolus,<sup>b</sup> or sword; and the ensiform or xiphoid appendix.<sup>c</sup> It presents the—

FIG. 16.



*Interclavicular notch*, on its superior border.

*Manubrium*,<sup>a</sup> articulates with the clavicle,<sup>d</sup> 1st costal cartilage,<sup>e</sup> and a part of the 2nd.<sup>f</sup>

*Gladiolus*, articulates with the costal cartilages from the 3rd to the 6th inclusive, and partly with the 2nd and 7th.

*Ensiform appendix* (the tip), articulates with the cartilage of the false ribs, and in part with the 7th costal cartilage.<sup>g</sup>

**Describe its development and muscles.** The sternum is *developed* by six centres, one each for the manubrium and ensiform appendix, and four for the gladiolus. The *muscles* attached to it are 9 pairs and one single muscle,—the sterno-cleido-mastoid, sterno-hyoid, and sterno-thyroid, 3,

to its upper part;—the rectus abdominis, external and internal oblique, transversalis and the diaphragm, 5, to its lower part;—the pectoralis major, 1, anteriorly;—and the triangularis sterni, 1, posteriorly.

## THE RIBS.

**Describe them.** There are 12 ribs on each side, of which 7 are “true ribs,” being each connected to the sternum by a separate cartilage;—and 5 are “false ribs.” Three of the latter are connected by their cartilages to the cartilage of the 7th rib, while two are called “floating ribs,” having each one extremity free.

**What are the characteristics common to most of the ribs?** They each consist of a head, neck, and shaft, and present the following points, viz.—

*Head, a* is divided by a ridge into two facets, which articulate with the facets on the bodies of the dorsal vertebræ; the ridge giving attachment to the inter-articular ligament.

*Neck*, about an inch long, having attached to its upper border the anterior costo-transverse ligament, to its posterior surface the middle costo-transverse ligament; its anterior surface is smooth.

*Tuberosity, b*

at the junction of the neck with the shaft, has a facet for articulation with the transverse process of the next lower

vertebra, and a rough surface for the posterior costo-transverse ligament.

*Shaft*, twisted on itself, is concave internally, convex externally, its upper border round and smooth, its lower border grooved *d* for the intercostal vessels and nerves. At its external extremity *c* is an oval depression for the insertion of the costal cartilage.

*Angle, e* just in front of the tuberosity, is marked by a rough line, to which are attached the muscles of the deep layer of the back.

**How are they developed?** Each rib has 3 centres, one each for the head, shaft, and tuberosity. The last two ribs, having no tuberosity, are developed each by two centres.

**Describe the peculiar ribs.** They are the 1st, 2nd, 10th, 11th and 12th. They respectively present the following peculiarities, viz.—

*1st Rib*, is broad, short, not twisted, has no angle, only one facet on the head; *a* but on its upper surface are seen two grooves for the subclavian artery *d* and vein, *e* and between them a tubercle *g* for the scalenus anticus muscle.

*2nd Rib*, is not twisted, its tuberosity and angle are very close

together, and its upper surface presents rough surfaces for the serratus magnus and scalenus posticus muscles.

FIG. 17.

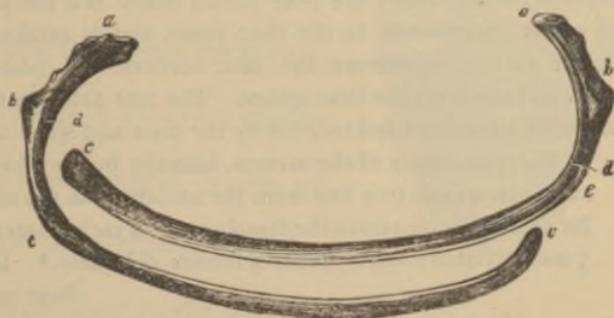


FIG. 18.



*10th Rib*, has but one facet on its head.

*11th Rib*, has no neck, no tuberosity, and but one facet on its head.

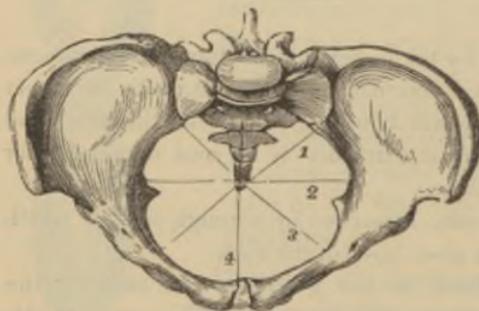
*12th Rib*, has neither neck, angle, tuberosity nor groove, and but one facet.

### THE PELVIS.

**Describe the Pelvis.** It is formed by the sacrum, coccyx, and two ossa innominata, and is divided into,—the *false pelvis*, comprising the upper and expanded portion,—and the *true pelvis*, below the ilio-pectineal line. The false pelvis corresponds to the iliac fossæ, and is marked by its walls being deficient anteriorly between the iliac borders, and posteriorly between the sacrum and the posterior iliac spines. The true pelvis has a—

*Brim* or inlet, bounded in front by the crest and spine of the pubes, behind by the promontory of the sacrum, laterally by the ilio-pectineal line. Its axis corresponds to a line from the umbilicus to the middle of the coccyx. Its average diameters in the female are,—4 inches antero-posteriorly,<sup>4</sup> over 5 inches transversely,<sup>2</sup> under 5 inches obliquely.<sup>3</sup> In the male each of

FIG. 19.



these measurements is about  $\frac{1}{2}$  an inch less.

*Cavity*, is a short curved canal, connecting the brim with the outlet. In front its depth is about  $1\frac{3}{4}$  inch, posteriorly 4 to  $4\frac{1}{2}$  inches in the female,  $4\frac{1}{2}$  to  $5\frac{1}{2}$  inches in the male. Its diameter is about  $4\frac{3}{4}$  inches in the female,  $4\frac{1}{2}$  inches in the male, all around.

*Outlet*, is bounded by the pubic arch above, the tip of the coccyx behind, and the tuberosities of the ischii laterally. Its axis, if prolonged, would touch the promontory of the sacrum. Its diameters in the female are each about  $4\frac{1}{4}$  inches, in the male about  $3\frac{1}{2}$  inches.

**State the chief differences between the male and female pelvises.** The *male pelvis* is marked by strength of the bones, prominence of the muscular impressions, a deep and narrow cavity, and large obturator foramina. The *female pelvis* has lighter bones, broader iliac fossæ, the spines being further apart, greater diameters at every point, the sacrum less curved, and the pubic arch wider.

**Describe the Sacrum.** The "sacred bone" is triangular, curved, with its convexity backwards, and is situated base upwards between the ossa innominata, forming with the coccyx the posterior wall of the pelvis. The bone is formed by the coalescence of 5 vertebræ, and presents the following points, viz.—

4 *Ridges*,<sup>4</sup> transversely across both surfaces, mark the union of its original segments.

8 *Anterior sacral foramina*, for the anterior sacral nerves.

8 *Grooves*,<sup>5</sup> shallow and broad, for the aforesaid nerves.

*Promontory*, at its junction with the last lumbar vertebra.

8 *Posterior sacral foramina*, for the posterior sacral nerves.

*Tubercles*, representing the spinous processes of the segments.

*Groove*, posteriorly, on each side of the spinous tubercles.

2 *Cornua*, at the posterior inferior portion of the bone.

*Auricular surface*,<sup>3</sup> on each side, articulates with the ilium.

*Notch*, laterally and inferiorly, for the 5th sacral nerve.

*Base*,<sup>2</sup> has all the characteristics of the lumbar vertebrae, with the last of which it articulates.

*Apex*,<sup>1,6</sup> has an oval surface for articulation with the coccyx.

*Sacral canal*, the continuation of the spinal, is incomplete posteriorly at its lower end. It transmits the *cauda equina*; into it open the sacral foramina laterally.

**Describe the Coccyx.** It consists of 4 or 5 rudimentary vertebrae coalesced into a triangular bone, the base<sup>1</sup> of which articulates with the apex of the sacrum. Its posterior surface is rough for muscles and ligaments, its anterior surface is smooth and marked by ridges at the junction of its constituent vertebrae. It presents the following points.—

2 *Cornua*,<sup>2</sup> superiorly, articulating with the sacral cornua to form foramina for the 5th sacral nerves.

*Apex*, is sometimes bifid and turned to one side.

**Describe the Ossa Innominata.** The unnamed bones are placed one on each side of the osseous pelvis, and are each formed by the union, about puberty, of three bones,—the ilium, ischium, and pubes. The innominate bone as a whole presents the following points, viz.—

*Acetabulum*, or cotyloid cavity, receives the head of the femur. It is situated at the junction of the three bones, the ilium and ischium each forming about two-fifths, and the pubes one-fifth of it. A depression in its centre lodges a mass of fat containing vessels for the nourishment of the synovial

FIG. 20.



FIG. 21.



membrane. The *cotyloid notch* is a deficiency in its lower anterior margin, transmitting nutrient vessels to the joint; to the edges of the notch are attached the ligamentum teres, and it is bridged over by the transverse ligament, a continuation of the cotyloid ligament which surmounts the brim of the acetabulum.

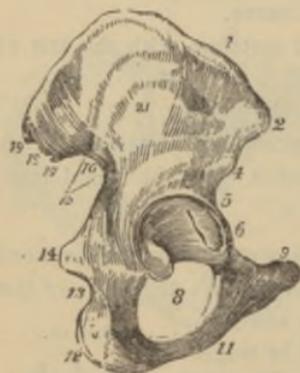
*Obturator, or thyroid foramen*,<sup>8</sup> on the anterior surface between the pubes and ischium, large and oval in the male, small and triangular in the female; is closed by the obturator membrane, except above where the obturator nerves and vessels pass through it.

**Describe the Ilium.** It is the superior part of the innominate bone, and presents the following points, viz.—

*Crest*,<sup>1</sup> along its upper border, having an outer and inner lip for muscular attachment, and ending in the superior spines.

*Anterior superior spine*,<sup>2</sup> to which is attached the sartorius and tensor vaginae femoris muscles, and Poupart's ligament.

FIG. 22.



*Anterior inferior spine*,<sup>4</sup> for the straight tendon of the rectus femoris.

*Notch*, between the above-named spines, transmitting the external cutaneous nerve, and lodging some fibres of the sartorius.

*Posterior superior spine*,<sup>19</sup> for the attachment of the erector spinae muscle, and the oblique part of the sacro-sciatic ligament.

*Posterior inferior spine*,<sup>17</sup> for the great sacro-sciatic ligament.

*Great sacro-sciatic notch*,<sup>16</sup> below the last-named spine, transmits the great sciatic, superior

gluteal, and pudic nerves, the pyriformis muscle, and the sciatic, pudic and gluteal vessels, and a nerve supplying the obturator externus muscle.

*Curved lines*,<sup>21</sup> superior middle and inferior, on the outer surface of the bone, from the spaces between which arise the glutei muscles.

*Groove*, above the acetabulum, for the reflected tendon of the rectus femoris muscle.

*Linea ilio-pectinea*, in part; on the inner surface, above which is a smooth surface, the *venter of the ilium*.

*Auricular surface*,<sup>18</sup> rough, articulates with the sacrum.

**Describe the Ischium.** It is the lowermost portion of the innominate bone, and presents the following points, viz.—

*Body*, forms two-fifths of the acetabulum, and the external margin of the obtu-

rator foramen; on it is a broad groove for the tendon of the obturator externus muscle. Its posterior margin assists in forming the great sacro-sciatic notch.

*Spine*,<sup>14</sup> for the gemellus superior, coccygeus, and levator ani muscles, and the lesser sacro-sciatic ligament.

*Lesser sacro-sciatic notch*,<sup>13</sup> below the spine, transmits the obturator muscle, its nerve, and the pudic vessels and nerve as they re-enter the pelvis, having crossed the spine of the ischium. The sacro-sciatic notches are converted into foramina by the sacro-sciatic ligaments; the greater notch by the lesser ligament, the lesser notch by the greater ligament.

*Tuberosity*,<sup>12</sup> the lowest and most prominent part, gives attachment to the greater sacro-sciatic ligament, and to several muscles. On it one rests when sitting.

*Ascending ramus*, bounds the obturator foramen inferiorly, articulates with the descending ramus of the pubes, and gives attachment to the obturator membrane and several muscles.

**Describe the Pubes.** The pubic or pectineal bone forms the anterior portion of the innominate. It presents the following, viz.—

*Body*, lies between the rami, with its fellow forms the *symphysis*, giving origin to several muscles and ligaments.

*Crest*,<sup>9</sup> is the upper part of the body, terminates externally in the *spine*, and internally in the *angle*.

*Spine*, affords attachment to one end of Poupart's ligament.

*Linea ilio-pectinea*, in part; gives attachment to the conjoined tendon, Gimbernat's ligament, and the triangular ligament.

*Horizontal ramus*, forms part of the brim of the pelvis, of the margin of the obturator foramen, and of the acetabulum. On its under surface is a groove for the obturator vessels and nerve.

*Pectineal eminence*,<sup>5</sup> gives attachment to the *psoas parvus* muscle.

*Descending ramus*,<sup>11</sup> flat and thin, joins the ascending ramus of the ischium, and bounds the obturator foramen internally.

**What Muscles are attached to the Os Innominate?** 36, comprising those of the abdomen, thigh, perineum, floor of the pelvis, and rotators of the hip-joint.

## BONES OF THE UPPER EXTREMITY.

### THE SHOULDER.

**What Bones form the Shoulder?** The clavicle and scapula connecting the arm with the trunk, and in this respect homologous to the innominate bone in the lower part of the body.

**Describe the Clavicle.** The collar- or key-bone, is a short bone by structure, having no medullary canal; and is curved like the letter *f*, its inner two-thirds being cylindrical, and convex anteriorly; its outer third flattened, and concave anteriorly. It is placed horizontally between the sternum and the scapula, and is the most elastic bone in the body. It presents, from within outwards, the following points, viz.—

*Facets*, for articulation with the sternum and the cartilage of the first rib, at its sternal end.

*Impression* for the rhomboid, or costo-clavicular ligament.

*Groove*, on the lower surface, for the subclavius muscle.

*Tubercle*, for the conoid part of the costo-clavicular ligament.

*Oblique line*, for the trapezoid part of the same ligament.

*Facet*, on the acromial end, for articulation with the scapula.

*Nutrient foramen*, in the subclavian groove.

**Describe the Scapula.** The shoulder blade is a large, flat, and triangular bone, situated on the posterior and lateral portion of the thorax, from the 2d rib to the 7th, inclusive.

THE VENTER, or anterior surface, presents from within outwards,—

*Ridges*, giving attachment to the subscapularis muscle.

*Marginal surface*, along the inner border, for the attachment of the serratus magnus muscle.

*Subscapular fossa, and angle*, for the subscapularis muscle.

THE DORSUM, or posterior surface, presents the following, viz.—

*Spine*, a bony ridge, which affords attachment to the trapezius and deltoid muscles, and ends in the acromion process.

*Supraspinous fossa*, above the spine, for the supraspinatus muscle.

*Infraspinous fossa*, below the spine, larger than the supraspinous, convex at its centre, lodges the infraspinatus muscle, and the nutrient foramen.

*Marginal surface*, along the external border, to which are attached the teres minor muscle above, the teres major below, and sometimes a few fibres of the latissimus dorsi at the lower angle.

*Groove* crossing the margin, for the dorsalis scapulæ vessels.

*Smooth surface*, behind the root of the spine, over which the trapezius muscle glides.

THE ACROMION PROCESS, or “summit of the shoulder,” extends from the spine, and projects over the glenoid cavity, articulating with the clavicle by an oval facet. It affords attachment to the deltoid and trapezius muscles, and by its apex to the coraco-acromial ligament.

THE CORACOID PROCESS, or “crow’s beak,” projects from the upper border and neck of the bone over the inner and upper part of the glenoid cavity.

Into it is inserted one muscle, the pectoralis minor; the coraco-brachialis, and the short head of the biceps arise from it by a common tendon; and 3 ligaments are attached to it,—the conoid, trapezoid, and coraco-acromial.

THE SUPERIOR BORDER presents the—

*Suprascapular notch*, converted into a foramen for the suprascapular nerve by the transverse ligament, over which passes the suprascapular artery. The omo-hyoid muscle is attached to the border just internal to the notch.

THE AXILLARY BORDER is the thickest, and presents, a—

*Rough surface*, for the long head of the triceps muscle, just below the glenoid cavity.

*Groove*, the origin of a part of the subscapularis muscle.

THE VERTEBRAL BORDER is the longest, and presents an—

*Anterior lip*, for the attachment of the serratus magnus.

*Posterior lip*, for the supra- and infra-spinatus muscles.

*Interspace*, between the lips, for the levator anguli scapulæ, the rhomboideus minor, and the fibrous arch of the rhomboideus major muscles.

OTHER POINTS of interest on the bone are the—

*Superior angle*, affords attachment to part of the serratus magnus, levator anguli scapulæ and supra-spinatus muscles.

*Inferior angle*, affords attachment to part of the serratus magnus and teres major muscles, and occasionally to a few fibres of the latissimus dorsi.

*Glenoid cavity*, at the external angle or head of the bone, a shallow cavity for the reception of the head of the humerus. It is deepened by the glenoid ligament which is attached around its margin; and at its upper part gives origin to the long head of the biceps flexor cubiti muscle.

*Neck*, is the contracted part of the bone behind the glenoid cavity; from it arises the anterior root of the coracoid process.

## THE ARM.

**Describe the Humerus.** It is the only bone in the arm, and articulates with the scapula above, and with the ulna and radius below. It presents the following points, viz.—

*Head*,<sup>b</sup> is nearly hemispherical, and smooth for articulation with the glenoid cavity of the scapula.

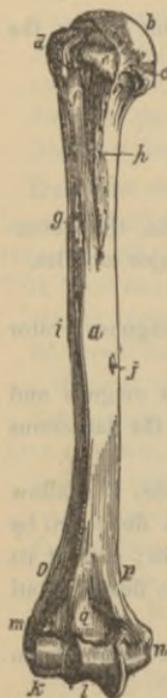
*Anatomical neck*,<sup>c</sup> is a constriction in the bone, just below the head, for the attachment of the capsular ligament.

*Greater tuberosity*,<sup>d</sup> has 3 small facets for the insertions of the supra-spinatus, infraspinatus and teres minor muscles.

*Lesser tuberosity, e* on the inner side of the bone, gives insertion to the subscapularis muscle.

*Bicipital groove, f* lies vertically between the tuberosities for the upper third of the bone, and lodges the tendon of the long head of the biceps flexor cubiti. Into its inner or posterior lip *h* are inserted the teres major and latissimus dorsi muscles, while its outer or anterior lip *g* receives the insertion of the tendon of the pectoralis major, which covers the groove.

FIG. 23.



*Surgical neck*, is situated immediately below the tuberosities, and is a slight constriction in the upper part of the shaft.

*Shaft, a* is cylindrical above, prismatic and flattened below.

*Rough surface, i* for the insertion of the deltoid muscle, about the middle of the external surface of the shaft.

*Musculo-spiral groove*, lodging the musculo-spiral nerve, and the superior profunda artery, is situated on the posterior surface of the shaft, separating the origins of the outer and inner heads of the triceps muscle.

*Orifice j* of the nutrient canal, about the middle of the shaft.

*Condyloid ridges, p* internal and external, arising from the respective condyles, extending upwards along the shaft.

*External condyle, m* gives attachment to the external lateral ligament and the extensor and supinator group of muscles.

*Internal condyle, n* lower and more prominent than the other, gives attachment to the internal lateral ligament and the flexor and pronator group of muscles of the fore-arm.

*Radial head, k* forms the external part of the inferior articular surface; for articulation with the radius.

*Trochlear surface, l* articulates with the greater sigmoid cavity of the ulna; is a deep depression between two borders, and extends from the anterior to the posterior surface of the bone.

*Coronoid fossa, g* in front of the trochlea, receives the coronoid process of the ulna when the fore-arm is flexed.

*Olecranon fossa*, behind the trochlea, receives the tip of the olecranon process, when the fore-arm is extended.

## THE FORE-ARM.

**Describe the Ulna.** The elbow-bone is the internal bone of the forearm. It is larger and longer than the radius, forming the greater portion of the articulation with the humerus. It does not enter into the formation of the wrist-joint, being excluded therefrom by an interarticular fibro-cartilage. It presents the following, viz.—

*Olecranon process,*<sup>d</sup> at the upper extremity, forming the elbow. It is curved forwards, its apex being received into the olecranon fossa of the humerus when the fore-arm is extended. Its posterior surface gives insertion to the tendon of the triceps. In its function and structure it resembles the patella.

*Coronoid process,*<sup>e</sup> below the olecranon, projects forwards, its apex being received into the coronoid fossa of the humerus when the fore-arm is flexed. Its upper surface is concave for articulation with the humerus, its lower surface rough for the insertion of the brachialis anticus muscle. Its inner surface has a margin for the internal lateral ligament, a tubercle for the flexor sublimis digitorum, and a ridge for the pronator radii teres.

*Greater sigmoid cavity,*<sup>f</sup> lies between the processes, and is divided by a vertical ridge into two unequal parts. It articulates with the trochlear surface of the humerus.

*Lesser sigmoid cavity*<sup>g</sup> lies external to the coronoid process; is oval and concave, articulating with the head of the radius, and giving attachment to the orbicular ligament.

*Shaft,*<sup>a</sup> large and prismatic above, smaller and rounded below, has the *nutrient foramen*<sup>f</sup> on its anterior surface, and a prominent margin<sup>g</sup> externally to which is attached the interosseous membrane. The shaft gives attachment to 9 of the 12 muscles of the forearm.

*Head,*<sup>h</sup> at the carpal end, articulates with the lesser sigmoid cavity of the radius, and the fibro-cartilage of the wrist-joint.

*Styloid process,*<sup>i</sup> projecting from the head internally and posteriorly, its apex gives attachment to the internal lateral ligament, and a depression at its root to the fibro-cartilage of the joint.

*Groove,* for the tendon of the extensor carpi ulnaris muscle.

FIG. 24.



**Describe the Radius.** The radius lies externally to the ulna when the forearm is in supination; it is prismatic in form with the base below where it articulates with the carpus. The bone is curved outwards and is shorter than the ulna, by the length of the olecranon. It presents the following points from above downwards, viz.—

*Head,*<sup>k</sup> cylindrical and cup-shaped, articulating with the radial head of the humerus, and the lesser sigmoid cavity of the ulna, and playing within the orbicular ligament.

*Neck,*<sup>l</sup> the constricted part below the head.

*Tuberosity,*<sup>m</sup> rough behind for the insertion of the biceps, and smooth in front where it is covered by a bursa.

*Shaft,*<sup>j</sup> prismoid in form, presents a sharp border internally for the attachment of the interosseous membrane, the *nutrient foramen* is on its anterior surface. It gives attachment to 8 of the 12 muscles of the forearm.

*Sigmoid cavity,* at the internal side of the carpal end, is shallow, and articulates with the head of the ulna.

*Articular surface,*<sup>o</sup> is divided by a ridge into two facets for articulation with the semilunar and scaphoid bones of the carpus.

*Styloid process,*<sup>p</sup> externally, gives attachment by its apex to the external lateral ligament, and by its base to the supinator longus muscle.

*Grooves,* on the posterior and external surfaces of the lower extremity, for the tendons of the 8 extensor muscles of the thumb, and those of the radial side of the wrist, and fingers.

## THE HAND.

**How are the bones of the hand divided?** Into the carpus (8), the metacarpus (5), and the phalanges (14). Total 27 bones.

FIG. 25.



**Name the bones of the Carpus.**

They are placed in two rows, one row in front of the other, with four bones in each row, as follows,—the left hand being in supination, naming from without inwards, viz.—

*1st, or proximal row,*—Scaphoid<sup>S</sup> Semi-lunar,<sup>L</sup> Cuneiform,<sup>C</sup> Pisiform.<sup>P</sup>

*2nd, or distal row,*—Trapezium,<sup>T</sup> Trapezoid,<sup>T</sup> Os-magnum,<sup>M</sup> Unciform.<sup>U</sup>

**State the number of Articulations in the Carpus.** 34, as follows,—the number after each bone representing the number of its articulations, viz.—

Scaphoid, 5. Semilunar, 5. Cuneiform, 3. Pisiform, 1.  
Trapezium, 4. Trapezoid, 4. Os-magnum, 7. Unciform, 5.

**What peculiarities have the Carpal bones?** The first three enter into the formation of the wrist-joint, the pisiform does not, but is wholly without it, and may be considered a mere appendage of the carpus. When the hand is in pronation—

*The Scaphoid*, or boat-shaped bone, has a tuberosity on its outer side, its largest articular facet is uppermost, and a transverse groove crosses its posterior surface.

*The Semilunar bone* has a crescentic facet externally, and a convex facet superiorly.

*The Cuneiform bone* is wedge-shaped, its convex surface above, and has an isolated facet for the pisiform articulation.

*The Pisiform bone* is the smallest, and has but one facet, which lies posteriorly when the bone is in position.

*The Trapezium* has a deep groove for the tendon of the flexor carpi radialis, and a saddle-shaped facet, inferiorly.

*The Trapezoid* is small and quadrilateral, bent on itself, with a saddle-shaped facet looking downwards.

*The Os-magnum* has a head looking upwards, a neck, and a body; is the largest bone of the carpus, and has a tubercle on the inner side of the base.

*The Unciform bone* is triangular, with a concavity which lies to the outer side; and the unciform process, long and curved, projecting from its palmar surface.

**Describe the Metacarpus.** The 5 metacarpal bones are placed between the carpus and the phalanges, are long bones, and each has a head, shaft, and base. Their heads articulate with the respective phalanges.

*1st Metacarpal bone,*<sup>d</sup> articulates with the trapezium, is shorter than the others by one-third, and its base has but one articular facet. This bone is classed among the phalanges by Professor W. H. Pancoast.

*2nd Metacarpal bone,*<sup>e</sup> articulates with 3 bones of the carpus,—the trapezium, trapezoid, and os-magnum; its base is large and has four articular facets.

*3rd Metacarpal bone,*<sup>f</sup> articulates with one bone of the carpus,—the os magnum; its base has a projecting process on the radial side, and two small facets on the opposite side.

*4th Metacarpal bone,*<sup>g</sup> does not articulate with any bone of the carpus, but does with the adjacent metacarpal bones; its base is small, and has two circular facets, one on each side.

*5th Metacarpal bone,*<sup>h</sup> articulates with one carpal bone,—the unciform; its base has one lateral articular facet.

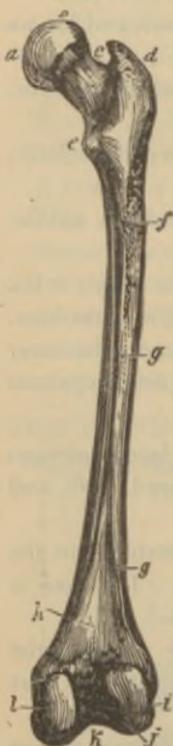
**Describe the Phalanges.** The finger-bones are 14 in number (15 according to Pancoast), three to each finger, and two to the thumb. They are long bones, and each has a base, a shaft, and a digital extremity. The *bases* of the first row articulate with the heads of the metacarpal bones. The *digital extremities* of the first and second rows have each two small lateral condyles, while in the terminal row they are rough for the attachment of the sensitive pulp of the fingers.

## BONES OF THE LOWER EXTREMITY.

### THE THIGH.

**Describe the Femur.** The thigh-bone is nearly cylindrical, and is the longest, largest and strongest bone in the body. In the vertical position of the skeleton it forms one side of a triangle, of which the base is the breadth of the pelvis, and the apex at the knee-joints. The base of this triangle is longest in the female, and consequently that sex is usually knock-kneed.

FIG. 26.



*Head, b* articulates with the acetabulum, forms about two-fifths of a sphere, and has an oval depression *a* below its centre for the attachment of the ligamentum teres.

*Neck, c* connects the head with the shaft, is pyramidal and flattened; its obliquity varies with age, being less before puberty, about 120 to 125 degrees in the adult, and nearly horizontal to the shaft in old or debilitated subjects.

*Great trochanter, d* a broad, rough, quadrilateral process directed outwards and backwards from the summit of the shaft to within three-fourths of an inch of the level of the head. On its outer surface the tendon of the gluteus maximus plays over a bursa. It gives insertion to the obturator internus, two gemelli, pyramidalis, and gluteus minimus and medius muscles.

*Digital fossa*, on the inner surface of the great trochanter, gives insertion to the obturator externus muscle.

*Lesser trochanter, e* at the inferior root of the neck posteriorly, is small and conical, and affords insertion to the tendon of the psoas magnus muscle, the tendon of the iliacus being inserted immediately below it.

*Inter-trochanteric lines*, anterior and posterior, the latter the most prominent; to the anterior is attached the capsular ligament of the hip-joint.

*Linea quadrati*, extends from the middle of the posterior inter-trochanteric line about two inches down the shaft, and gives attachment to the quadratus femoris muscle.

*Shaft*, is slightly curved forwards, broad and cylindrical at each end, and narrow and triangular in the centre. Its nutrient foramen perforates its posterior surface below the centre. From its anterior surface arise the crureus and sub-crureus muscles.

*Linea aspera*, *gg* a crest lying along the central third of the shaft posteriorly; bifurcating above towards each trochanter, also below towards the two condyles. To its outer lip is attached the vastus externus, to its inner lip, the vastus internus; and between them, the pectineus, adductor brevis, and gluteus maximus above the short head of the biceps below, and the adductors longus and magnus along the greater portion of the space.

*Groove*, crossing the internal condyloid ridge, and lodging the femoral artery.

*Popliteal space*, *h* triangular and smooth, lying between the condyloid ridges, for the popliteal artery.

*External condyle*, *i* broader and shorter than the internal, so as to form a horizontal articulation, the bone being inclined towards the median line. It gives attachment to the external lateral ligament, and the popliteus and gastrocnemius muscles.

*Internal condyle*, *l* the longest by half an inch; it gives attachment to the internal lateral ligament and the gastrocnemius muscle.

*Inter-condyloid notch*, *k* lodges the crucial ligaments. In front the condyles are continuous with each other, forming a concave depression or trochlea for the patella.

*Outer tuberosity*, on the external condyle, for the attachment of the external lateral ligament.

*Groove*, below the outer tuberosity, for the tendon of the popliteus muscle, terminating in a depression whence the muscle takes its origin.

*Inner tuberosity*, on the internal condyle, for the attachment of the internal lateral ligament.

*Tubercle*, above the inner tuberosity, for the insertion of the tendon of the adductor magnus muscle.

*Depression*, behind the tubercle, for the tendon of the inner head of the gastrocnemius.

## THE LEG.

**Describe the Tibia.** The shin-bone ranks next to the femur in respect to size and length. Its form is prismoidal, the upper extremity being much larger than the lower.

*Head*, expands into two lateral tuberosities, *bc* which articulate with the condyles of the femur.

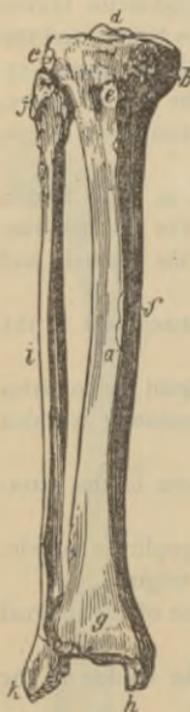
*Spine*, *d* projects vertically between the two articular surfaces, is bifid, affording attachment to the semilunar fibro-cartilages, and by depressions in front and behind its base to the crucial ligaments of the joint.

*Tubercle, e* anteriorly on the head, between the tuberosities, for the insertion of the ligamentum patellæ.

*Popliteal notch*, posteriorly between the tuberosities, affords attachment to the posterior crucial ligament.

*Groove*, on the inner tuberosity posteriorly, for the insertion of the tendon of the semi-membranosus muscle.

FIG. 27.



*Facet*, on the outer tuberosity posteriorly and looking downwards, for articulation with the head of the fibula.

*Popliteal line*, obliquely across the upper part of the shaft posteriorly, affords attachment to the fascia of the popliteus, and parts of the soleus, flexor longus digitorum, and tibialis posticus muscles.

*Nutrient canal*, the largest in the skeleton, opens just below the popliteal line, its orifice looking upwards.

*Shaft, a* has three sharp ridges,—one in front, the *crest* or *shin, f* and one on either side, to the external of which is attached the interosseous membrane.

*Lower extremity, g* is smaller than the upper, grooved posteriorly for the tendon of the flexor longus pollicis; externally has a rough triangular depression for articulation with the fibula, and for the attachment of the inferior interosseous ligament. Its inferior surface is concave and smooth for articulation with the upper surface of the astragalus.

*Internal malleolus, h* projects downwards from the internal side of the lower extremity. It articulates with the astragalus, is grooved posteriorly for the tendons of the tibialis posticus and flexor longus digitorum muscles, and affords attachment to the internal lateral ligament.

**Describe the Fibula.** It is a long slender bone, placed nearly parallel with the tibia on the outer side of the leg. It is also called the peroneus, or peroneal bone.

*Head, j* articulates with the external tuberosity of the tibia by a flat facet.

Externally it has a prominence for the attachment of the long external lateral ligament of the knee-joint.

*Styloid process*, projects upwards from the head posteriorly, and gives insertion to the tendon of the biceps muscle, and the short external lateral ligament of the knee-joint.

*Shaft i* is triangular and twisted on itself, having three marked ridges, the

innermost of which is sharp for the attachment of the interosseous membrane. The shaft arches backwards, and gives attachment to 8 of the 12 muscles of the leg.

*Nutrient canal*, opens about the centre of the shaft posteriorly, its orifice looking downwards.

*External malleolus*,<sup>k</sup> is the lower extremity of the bone. It is larger and longer than the internal, articulates with the astragalus by a triangular facet, and is grooved posteriorly for the tendons of the peroneus longus and brevis muscles. Its edge affords attachment to the external lateral ligament of the ankle-joint.

## THE FOOT.

**How are the bones of the Foot divided?** Into the tarsus (7), metatarsus (5), and phalanges (14). Total 26 bones.

**Name the bones of the Tarsus.** They are placed in two rows side by side, two bones in the external row, five in the internal, as follows, viz.—

*Internally*,— Astragalus.<sup>a</sup> Scaphoid.<sup>d</sup> 3 Cuneiform.<sup>e, f, g</sup>

*Externally*,— Os calcis.<sup>c</sup> Cuboid.<sup>h</sup>

**How many Articulations are in the Tarsus?** 28, each bone articulating with four others, except the os calcis, which articulates with two, and the external cuneiform with six bones.

**What peculiarities have the tarsal bones?** They may be divided transversely at the astragaloscaphoid-calcaneo-cuboid articulation, the site of Chopart's operation.

*The Astragalus*,<sup>a</sup> has a rounded head, a convex surface on which is a broad articular facet, and on its inferior surface a deep groove between two articular facets.

*The Os calcis*,<sup>c</sup> is a large bone, having on its upper surface a deep groove for the interosseous ligament, between two articular surfaces; anteriorly a large irregular portion, the head; and posteriorly an elongated portion forming the *heel*. On its internal surface is a projection, the *sustentaculum tali*, which supports the internal articulating surface; below which process the bone is deeply grooved for the plantar vessels and nerves and the flexor tendons. To the os calcis are attached 8 muscles and the plantar fascia.

FIG. 28.



*The Scaphoid bone,<sup>d</sup>* is boat-shaped, has three facets anteriorly for the cuneiform bones, a concave surface posteriorly for the astragalus, and a facet externally for the cuboid bone. A tubercle is situated on the lower surface internally, for the insertion of the tibialis posticus muscle.

*The Cuboid bone,<sup>h</sup>* has three articular surfaces, and a groove inferiorly for the tendon of the peroneus longus.

*The Internal Cuneiform bone,<sup>e</sup>* the largest of the three, has a tubercle on its plantar surface for the insertion of parts of the tendons of the tibialis anticus and tibialis posticus muscles.

*The Middle Cuneiform bone,<sup>f</sup>* is small and wedge-shaped with the narrow end downwards. Its anterior surface is considerably behind the line of the tarso-metatarsal articulation, thus forming a recess into which the base of the second metatarsal bone fits.

*The External Cuneiform bone,<sup>g</sup>* is also wedge-shaped, but longer than the middle one; and affords origin to one muscle, the flexor brevis pollicis.

**Describe the Metatarsus.** The metatarsal bones<sup>i</sup> are 5 in number, are long bones, having each a shaft and two extremities. Their bases articulate with the tarsal bones and with each other; their heads with the first row of phalanges.

*1st Metatarsal* is large but shorter than the others, and forms the inner border of the foot, articulating with the internal cuneiform.

*2d Metatarsal*, is the longest; its base has three facets for articulation with the three cuneiform bones in the recess formed by the shortness of the middle cuneiform.

*3d Metatarsal*, has two facets on the inner side of its base, besides the facets for the internal cuneiform and the 4th metatarsal bone.

*4th Metatarsal*, articulates with the cuboid bone, and also with the internal cuneiform.

*5th Metatarsal*, articulates obliquely with the cuboid bone, and has a tubercular projection on the outer surface of its base, which forms the guide to Hey's operation.

**Describe the Phalanges of the Foot.** They number 14 as in the hand, the great toe having two, the other toes three each. They are long bones, each having a base, a shaft and an anterior extremity. They are convex above, concave below, and articulate by the bases of the first row with the bones of the metatarsus. The anterior extremities of the distal phalanges<sup>k, n</sup> are expanded into surfaces for the support of the nails and pulp of the toes.

## THE ARTICULATIONS.

**Into what classes are the Articulations divided?** Into three,—1. *Synarthrosis*, immovable; 2. *Amphiarthrosis*, *synchondrosis*, or *symphysis*, having limited motion; 3. *Diarthrosis*, having free motion.

**How are the Synarthroses subdivided?** Into three divisions,—*Sutura*, by indentations; *Schindy'lesis*, by a plate of bone into a cleft in another; and *Gomphosis*, by a conical process into a socket. The *Sutura* are again subdivided into—*S. dentata*, having tooth-like processes; *S. serrata*, with serrated edges; *S. limbosa*, having beveled margins and dentated processes; *S. squamosa*, with thin beveled margins overlapping each other; *S. harmonia*, contiguous rough surfaces opposed to each other. The first three are also named *Sutura vera* (true sutures) having indented borders; the last two *Sutura notha* (false sutures) being formed by rough surfaces.

**How are the Diarthroses divided?** Into four divisions,—*Arthrodia*, gliding joint; *Enarthrosis*, ball-and-socket joint; *Ginglymus*, hinge-joint; and *Diarthrosis rotatorius*, a ring surrounding a pivot.

**Give an example of each of the above-named articulations.**

*Synarthrosis*,—bones of cranium and face, except the lower jaw.

*Sutura dentata*,—the inter-parietal suture.

*Sutura serrata*,—the inter-frontal suture.

*Sutura limbosa*,—the fronto-parietal suture.

*Sutura squamosa*,—the tempora-parietal suture.

*Sutura harmonia*,—the intermaxillary symphysis.

*Schindy'lesis*,—rostrum of sphenoid with the vomer.

*Gomphosis*,—the teeth in their alveoli.

*Amphiarthrosis*,—the bodies of the vertebræ, the sacro-iliac and pubic symphyses.

*Diarthroses*,—

*Arthrodia*,—sterno-clavicular articulation.

*Enarthrosis*,—hip-joint, shoulder-joint.

*Ginglymus*,—elbow-joint, ankle-joint, knee-joint.

*Diarthrosis rotatorius*,—the superior radio-ulnar, and atlo-axoid articulations.

**Name the varieties of motion in joints?** There are seven varieties, viz.—flexion, extension, adduction, abduction, rotation, circumduction, and gliding movement.

**What structures enter into the formation of joints?** There are five, viz.—the articular lamella of bone, ligaments, cartilage, fibro-cartilage, and synovial membrane.

*Articular lamella* of bone differs from ordinary bone tissue in being more dense, containing no Haversian canals nor canaliculi, and having larger lacunæ.

*Ligaments* are bands of white fibrous tissue, except the *ligamentum subflava* and the *ligamentum nuchæ*, which are both composed purely of yellow elastic tissue.

*Cartilage* is temporary or permanent. The first forms the original framework of the skeleton, and becomes ossified. Permanent cartilage is not prone to ossification, and is divided into three varieties,—*articular*, covering the ends of bones in joints; *costal*, forming part of the skeleton; *reticular*, arranged in lamellæ or plates to maintain the shape of certain parts. *Fibro-cartilage*, is *interarticular* (menisci), separating the bones of a joint; *connecting*, binding bones together; *circumferential*, deepening cavities; *stratiform*, lining grooves.

*Synovial membranes* secrete the synovia, a viscid, glairy fluid, and resemble the serous membranes in structure. They are *articular*, lubricating joints; *bursal*, forming closed sacs (*bursæ*); *vaginal*, ensheathing tendons.

**Describe the Vertebral Articulations.** They are formed by the adjacent surfaces of the bodies of the vertebræ, and their articular processes, and are connected by the following ligaments, etc.—(See Fig. 31).

*Intervertebral fibro-cartilages*, between the bodies of all true vertebræ, except the axis and atlas.

*Anterior common ligament*,<sup>1</sup> along fronts of the bodies.

*Posterior common ligament*, along backs of the bodies.

*Ligamenta subflava*, connect the laminæ of adjacent vertebræ.

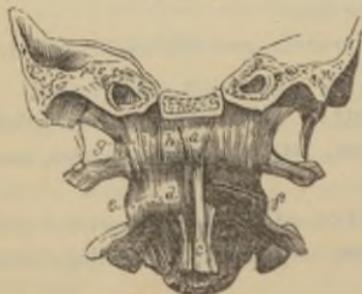
*Capsular*,<sup>4</sup> surround the articular processes, and are lined by synovial membrane.

*Supra-spinous and inter-spinous*, connect the spinous processes.

*Inter-transverse*,<sup>3</sup> connect the transverse processes.

**Describe the Occipito-atloid Articulation.** It is a double arthrodia formed by the condyles of the occipital bone with the superior articular surfaces of the atlas, and has 7 ligaments, viz.—

FIG. 29.



formed by the condyles of the occipital bone with the superior articular surfaces of the atlas, and has 7 ligaments, viz.—

1 *Anterior occipito-atloid*,<sup>a</sup> from the anterior margin of the foramen magnum to the anterior arch of the atlas.

2 *Posterior occipito-atloid*, from the posterior margin of the foramen magnum to the posterior arch of the atlas. It is perforated by the vertebral arteries and sub-occipital nerves.

2 *Lateral*, from the jugular processes of the occipital bone, to the bases of the transverse processes of the atlas.

2 *Capsular*,<sup>d</sup> around the articular surfaces, lined by synovial membrane.

**Describe the Occipito-axoid Articulation.** Formed by the occipital bone and the odontoid process of the axis, which do not articulate with each other strictly, but are connected by 4 ligaments.

*Occipito-axoid*,<sup>1</sup> (*apparatus ligamentosus colli*), a continuation of the posterior common spinal ligament, to the basilar process of the occipital bone.

2 *Lateral occipito-odontoid*,<sup>5</sup> (*check ligaments*), from the head of the odontoid process to the sides of the occipital condyles.

*Vertical occipito-odontoid* (*ligamentum suspensorium*), from the anterior margin of the foramen magnum to the odontoid apex.

**Describe the Atlo-axoid Articulation.** It is a double arthrodia between the articular processes, a double diarthrosis rotatorius between the atlas and the odontoid process, and has 6 ligaments, and 4 synovial membranes.

2 *Anterior and 1 posterior atlo-axoid*, continuations of the anterior and posterior common spinal ligaments.

2 *Capsular*, surrounding the articular surfaces, each lined by a synovial membrane.

*Transverse, or cruciform ligament*, divides the spinal foramen of the atlas into two portions, stretching across between the tubercles on the inner sides of the articular processes. It holds the odontoid process in place, having a synovial membrane interposed. Another synovial membrane is situated between the process and the anterior arch. The transverse ligament sends two vertical slips, one upwards the other downwards, from which it is named the *cruciform ligament*.

**Describe the Temporo-maxillary Articulation.** A double arthrodia between the condyle of the lower jaw and the anterior part of the glenoid cavity of the temporal bone. It has two synovial membranes with an inter-articular fibro-cartilage between them, and 4 ligaments, viz.—

*External lateral*, from the tubercle of the zygoma, to the outer side of the neck of the condyle of the lower jaw.

*Internal lateral*,<sup>d</sup> from the spine of the sphenoid, to the margin of the inferior dental foramen.

*Stylo-maxillary*,<sup>f</sup> from the styloid process of the temporal bone, to the angle of the inferior maxillary.

FIG. 30.



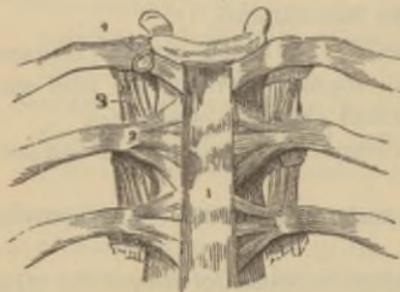
*Capsular,* from the edge of the glenoid cavity and the eminentia articularis, to the neck of the inferior maxillary condyle.

*Nerves,* are derived from the auriculo-temporal, and masseteric branches of the inferior maxillary.

**Describe the Costo-vertebral Articulations.** They are each a double arthrodia between the head of the rib and the bodies of two adjacent vertebræ, except in the 1st, 10th, 11th, and 12th ribs, which are each a single arthrodia, as they articulate with but one vertebra each. Their ligaments are 3, viz.—

*Anterior costo-vertebral,*<sup>2</sup> or *stellate ligament,* consists of three bundles, which fasten the anterior part of the head of the rib to the intervertebral disk and the two adjacent bodies.

FIG. 31.



*Inter-articular costo-vertebral,* in the interior of the joint, from the crest on the head of the rib to the intervertebral disk; on each side there is a separate synovial membrane.

*Capsular,* surrounding the articular surfaces.

**Describe the costo-transverse Articulations.** They are ten arthrodiol articulations between the tubercles of the first ten ribs and the transverse processes of the vertebræ next below. Their ligaments are 3, viz.—*anterior, middle, and posterior costo-transverse.*

**Describe the Costo-sternal Articulations.** One a synarthrodial, six are arthrodiol articulations, between the costal cartilages and the margin of the sternum. The first has no synovial membrane, the second only has an inter-articular fibro-cartilage. Each has 3 ligaments,—the *anterior and posterior costo-sternal,* and a *capsular.* The *costo-xiphoid ligament* connects the xiphoid appendix to the cartilage of the 6th or 7th rib.

**How are the Costal cartilages connected with the ribs and with each other?** With the ribs by a depression on the end of each rib, strengthened by the blending together of the periosteum and the perichondrium. The cartilages of the lower ribs, sometimes from the 5th to the 10th inclusive, articulate with each other by their borders and for each a capsular and an intercostal ligament, with 3 synovial membranes for the three articulations between the 6th and the 9th cartilages.

**What are the Ligaments of the Sternum?** An anterior sternal and a posterior sternal ligament, with a layer of cartilage between the manubrium and the gladiolus.

**Describe the Sacro-vertebral articulation.** It is similar to the other vertebral articulations, but has two additional ligaments on each side, viz.—

*Lumbo-sacral*, from the transverse processes of the 5th lumbar vertebra to the base of the sacrum laterally and anteriorly.

*Lumbo-iliac*, from the apices of the transverse processes of the 5th lumbar vertebra to the crest of the ilium.

**Describe the Sacro-coccygeal Articulation.** It is an amphiarthrodial joint, and has 3 ligaments, viz.—

*Anterior sacro-coccygeal.*

*Posterior sacro-coccygeal.*

*Interarticular fibro-cartilage*, in the joint.

**Describe the Sacro-iliac Articulation.** It is an amphiarthrodial joint, formed by the auricular surfaces of the sacrum and ilium. Its ligaments on each side are as follows, viz.—

*Anterior sacro-iliac.*

*Posterior sacro-iliac.*<sup>8</sup>

*Oblique sacro-iliac.*

**Describe the Sacro-ischiatic Articulation.** Its ligaments convert the sacro-sciatic notches into foramina, the greater notch by the lesser ligament, the lesser notch by the greater ligament. These foramina are described under the ilium and ischium bones.

*Great sacro-sciatic ligament*,<sup>13 14</sup> from the posterior inferior spine of the ilium and the posterior surfaces and margins of the sacrum and coccyx, to the inner margin of the tuberosity and the ascending ramus of the ischium.

*Lesser sacro-sciatic ligament*,<sup>15 16</sup> from the margins of the sacrum and coccyx, into the spine of the ischium.

**Describe the Pubic Articulation.** It is an amphiarthrodial joint, formed by the two pubic bones. It has an interarticular fibro-cartilage and 4 ligaments, viz.—

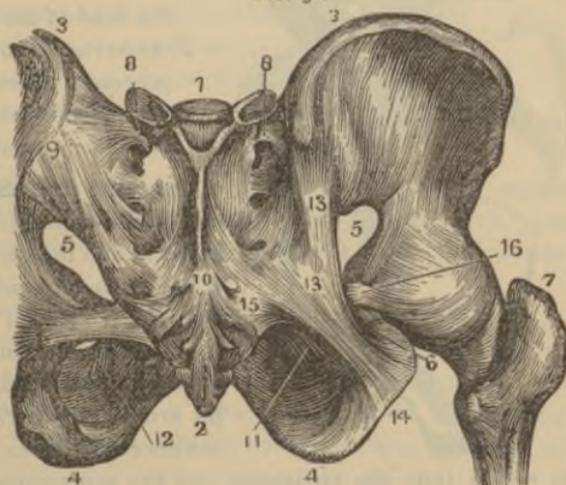
*Anterior pubic.*

*Posterior pubic.*

*Supra-pubic.*

*Sub-pubic*, forming a fibrous arch between the rami.

FIG. 32.



**Describe the Sterno-clavicular Articulation.** It is an arthrodial joint, formed by the sternal end of the clavicle with the sternum and the cartilage of the first rib. It has an interarticular fibro-cartilage, 2 synovial membranes, and 4 ligaments, viz.—

*Anterior sterno-clavicular.*

*Interclavicular.*

*Posterior sterno-clavicular.*

*Costo-clavicular or Rhomboid.*

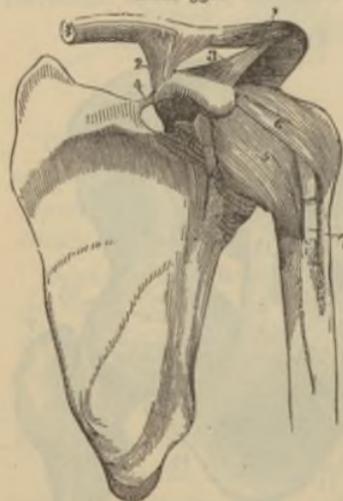
**Describe the Scapulo-clavicular Articulation.** It is an arthrodial joint, formed by the outer extremity of the clavicle and the acromion process of the scapula. It frequently has an interarticular fibro-cartilage and 2 synovial membranes; usually but one synovial membrane is present, and 3 ligaments, viz.—

*Superior acromio-clavicular.*<sup>1</sup> *Coraco-clavicular*<sup>2</sup> { Trapezoid, externally.

*Inferior acromio-clavicular.* divided into— { Conoid, internally.

**What are the proper ligaments of the Scapula?** They are 2, the coraco-acromial, and the transverse, as follows.—

FIG. 33.



*Coraco-acromial*,<sup>3</sup> completes the vault partially formed by the two processes over the head of the humerus.

*Transverse*,<sup>4</sup> from the base of the coracoid process to the margin of the suprascapular notch, converting it into a foramen, for the supra-scapular nerve.

**Describe the Shoulder-joint.** It is an enarthrodial joint, formed by the head of the humerus and the glenoid cavity of the scapula. It has a *synovial membrane* which is reflected upon the tendons of the biceps, subscapularis, and infraspinatus muscles, and communicates with bursæ beneath the two latter tendons. Its *arteries* are derived from the anterior and posterior circumflex and the suprascapular;

its *nerves* from the circumflex and the suprascapular. It has 3 ligaments, viz.—

*Capsular*,<sup>5</sup> from the margin of the glenoid cavity to the anatomical neck of the humerus; has 3 openings for the reflexions of the synovial membrane over the tendons.

*Coraco-humeral*,<sup>6</sup> intimately united with the capsular, extends from the coracoid process to the greater tuberosity.

*Glenoid*, a fibro-cartilaginous ring, continuous above with the tendon of the

long head of the biceps,<sup>7</sup> and attached around the margin of the glenoid cavity in order to deepen the articular surface.

**Describe the Elbow-joint.** It is a ginglymus articulation, formed by the lower end of the humerus with the greater sigmoid cavity of the ulna and the head of the radius. Its *synovial membrane* is reflected over the ligaments, and dips down between the surfaces of the superior radio-ulnar articulation. Its *arteries* are derived from the anastomotica magna, radial ulnar and interosseous recurrent, superior and inferior profunda arteries. Its *nerves* are branches of the ulnar and the musculo-cutaneous. It has 4 ligaments.—

*Anterior*, from the inner condyle and anterior surface of the humerus to the orbicular ligament of the radius and the coronoid process of the ulna.

*Posterior*, from the posterior surface of the humerus to the olecranon process of the ulna.

*External lateral*,<sup>4</sup> from the external condyle of the humerus to the orbicular ligament of the radius.

*Internal lateral*, from the internal condyle of the humerus to the coronoid and olecranon processes of the ulna.

**Describe the Radio-ulnar Articulations.** They are three in number, as follows: viz.—

**SUPERIOR RADIO-ULNAR ARTICULATION**, is a lateral ginglymoid joint, formed by the head of the radius and the lesser sigmoid cavity of the ulna. Its synovial membrane is a continuation of that in the elbow-joint. It has one ligament, the—

*Orbicular ligament*,<sup>5</sup> forms four-fifths of a circle and surrounds the neck of the radius. It is attached to the margins of the lesser sigmoid cavity of the ulna, and to the external lateral ligament of the elbow-joint.

**MIDDLE RADIO-ULNAR ARTICULATION**, is formed by the shafts of the radius and ulna, which do not touch each other, but are connected by 2 ligaments, as follows:—viz.—

*Oblique ligament*, from the tubercle at the base of the coronoid process of the ulna to the shaft of the radius.

*Interosseous membrane*,<sup>9</sup> obliquely downwards from the interosseous ridge on the radius to that on the ulna. Through the interval between its upper border and the oblique ligament, the posterior interosseous vessels pass.

**INFERIOR RADIO-ULNAR ARTICULATION**, is a lateral ginglymoid joint, formed by the head of the ulna and the sigmoid cavity of the radius. Its *synovial membrane* (membrana sacciformis) is very loose, and sometimes communicates

FIG. 34.



with that of the wrist-joint through an opening in the *triangular fibro-cartilage* which separates the head of the ulna from the wrist-joint, and acts as one of the ligaments of this articulation, which are 3, viz.—

*Anterior radio-ulnar.*

*Posterior radio-ulnar.*

*Triangular interarticular fibro-cartilage.*

**Describe the Wrist-joint.** It is chiefly an enarthrodial articulation though incapable of rotation, and is formed by the lower end of the radius and the triangular fibro-cartilage, with the scaphoid semilunar and cuneiform bones of the carpus. Its *arteries* are the anterior and posterior carpal from both the radial and ulnar, the anterior and posterior interosseous and ascending branches from the deep palmar arch. Its *nerves* are derived from the ulnar; it is lined by a *synovial membrane*, and has 4 ligaments, viz.—

*External lateral, (radio-carpal.)*

*Anterior.*

*Internal lateral, (ulno-carpal.)*

*Posterior.*

**Describe the Carpal Articulations.** They are in three sets, (1) between the bones of the first row, (2) between the bones of the second row, (3) between the two rows of bones.

- (1) The scaphoid, semilunar, and cuneiform bones are connected together by 2 *dorsal*, 2 *palmar*, and 2 *interosseous ligaments*. The pisiform bone has a separate capsular ligament and synovial membrane and *two fasciculi* connecting it with the unciform and the 5th metacarpal.
- (2) The four bones of the second row are connected together by 3 *dorsal*, 3 *palmar*, and 3 *interosseous ligaments*.
- (3) The two rows of bones are united by a *dorsal*, a *palmar*, and 2 *lateral ligaments*, the last named being continuous with the lateral ligaments of the wrist-joint.

**Describe the Carpo-metacarpal Articulations.** That of the thumb with the trapezium is an enarthrodial joint, having a *capsular ligament* and a separate synovial membrane. The four inner metacarpal bones form four arthro-dial joints with the adjacent carpal bones by 6 *dorsal*, 8 *palmar*, and 2 *interosseous ligaments*, irregularly disposed.

**Describe the Synovial Membranes of the Wrist.** They number 5, and are situated as follows, viz.—

- The first, or membrana sacciformis*, between the head of the ulna, the sigmoid cavity of the radius, and the triangular inter-articular fibro-cartilage.
- The second*, between the lower end of the radius, the triangular fibro-cartilage, and the scaphoid, semilunar, and cuneiform bones of the carpus.
- The third*, between all the carpal bones except the pisiform, and between the bases of the inner four metacarpal bones; but it extends only half-way into the two intervals between the three proximal bones of the carpus.

*The fourth*, between the trapezium and the metacarpal bone of the thumb.

*The fifth*, between the cuneiform and pisiform bones.

**Describe the Metacarpo-metacarpal Articulations.** The four inner metacarpal bones are connected together at their bases by *dorsal, palmar, and interosseous ligaments*; and at their digital extremities by the *transverse ligament*.

**Describe the remaining articulations of the hand.** The metacarpo-phalangeal and the phalangeal articulations are all ginglymoid joints, and each has an *anterior* and *2 lateral ligaments*, the former being lined each with a synovial membrane. There are no posterior ligaments to these articulations, the extensor tendons of the hand supplying their places.

**Describe the Hip-joint.** It is a true enarthrodial articulation, formed by the head of the femur with the acetabulum of the os innominatum. Its *synovial membrane* is extensive, investing most of the head and neck of the femur, the capsular cotyloid and teres ligaments, and the cavity of the acetabulum. Its *arteries* are derived from the obturator, sciatic, internal circumflex and gluteal. Its *nerves* are branches from the sacral plexus, great sciatic, obturator and accessory obturator. It has 5 ligaments, as follows: viz.—

*Capsular*, from the margin of the acetabulum and the transverse ligament, into the base of the neck of the femur above, the anterior inter-trochanteric line in front, and to the middle of the neck of the bone, behind.

*Ilio-femoral or Y-ligament*, from the anterior inferior spine of the ilium, into the anterior inter-trochanteric line by two fasciculi. It is a dissected portion of the capsular ligament which is very strong anteriorly.

*Ligamentum teres*, from a depression on the head of the femur into the margins of the cotyloid notch of the acetabulum and into the transverse ligament, by two fasciculi.

*Cotyloid*, a fibro-cartilaginous band surrounding the margin of the acetabulum in order to deepen its cavity.

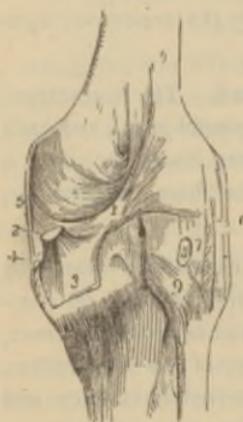
*Transverse*, that part of the cotyloid ligament which crosses over the cotyloid notch converting it into a foramen.

**Describe the Knee-joint.** It is a ginglymus articulation, formed by the condyles of the femur with the head of the tibia, and the patella in front. Its *synovial membrane* is the largest in the body, being reflected for two or three inches over the anterior surface of the femur, where it is supported by the subcrureus muscle, also over its condyles, the patella, semilunar cartilages, crucial ligaments and head of the tibia; and is prolonged through an opening in the capsular ligament beneath the tendon of the popliteus. Its *arteries* are derived from the anastomotica magna, the five articular branches of the popliteal, and the recurrent branch of the anterior tibial. Its *nerves* are branches

of the obturator, anterior crural, external and internal popliteal. It has 14 ligaments, of which 6 are external and 8 internal, as follows:—

*Anterior, or ligamentum patellæ*, is a continuation of the tendon of the rectus femoris muscle, extending from the apex of the patella to the lower part of the tubercle of the tibia.

FIG. 35.



*Posterior, or ligamentum Winslowii*,<sup>1</sup> from the inner tuberosity of the tibia to the external condyle of the femur, being partly derived from the tendon of the semimembranosus muscle.<sup>2</sup>

*Internal lateral*,<sup>3</sup> from the internal condyle of the femur to the internal surface of the tibia and semilunar cartilage.

*External lateral*,<sup>6</sup> from the external condyle of the femur to the head of the fibula. These ligaments are a long anteriorly and a short posteriorly, separated by the tendon of the biceps.

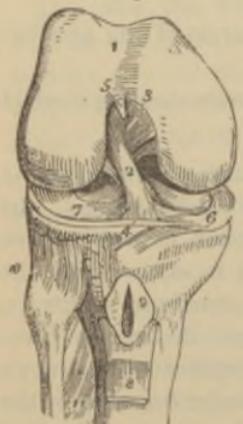
*Capsular*, is only present where intervals are left by the preceding ligaments. It is thin but very strong.

The Internal ligaments are as follows:—

*Anterior Crucial*,<sup>2</sup> from the depression in front of the spine of the tibia, to the inner side of the *outer condyle* of the femur.

*Posterior crucial*,<sup>3</sup> from the same depression, to the outer side of the *inner condyle*. [To remember the positions and insertions of these crucial ligaments, let the student cross his index fingers over each knee in succession; when over the right knee placing the right finger in front, when over the left knee the left finger in front. The positions of the fingers will then in each case correspond with those of the respective crucial ligaments.]

FIG. 36.



*Semilunar fibro-cartilages*,<sup>6</sup> external and internal, are situated between the articular surfaces, and attached to the depressions in front and behind the spine of the tibia.

*Transverse*,<sup>4</sup> is a connecting slip between the semilunar fibro-cartilages anteriorly.

*Coronary*,<sup>7</sup> are short bands connecting the outer margins of the fibro-cartilages to the tibia and the adjacent ligaments.

*Ligamentum mucosum*, is a triangular fold of the synovial membrane which at the lower border of the patella is given off to the intercondyloid notch of the femur.

*Ligamenta alaria*, are fringes on the sides of the

ligamentum mucosum and are attached to the sides of the patella.

*Bursa* in the vicinity of this joint are 5, viz.—one under the ligamentum patellæ,<sup>9</sup> one between the patella and the skin; one between the internal lateral ligament and the tendons crossing it; sometimes one replacing the synovial pouch on the anterior surface of the femur; and occasionally one in the popliteal space replacing the synovial pouch usually situated therein.

**Describe the Tibio-fibular Articulations.** They are 3 in number, as follows; viz.—

**SUPERIOR TIBIO-FIBULAR ARTICULATION,** is an arthro-dial joint, formed by the contiguous surfaces of the bones. It has a *synovial membrane* which is sometimes continuous with that of the knee-joint, and 2 ligaments, the—

*Anterior and posterior superior tibio-fibular,*<sup>10</sup> which connect the head of the fibula with the outer tuberosity of the tibia.

**MIDDLE TIBIO-FIBULAR ARTICULATION.** The shafts of these bones do not touch each other, but are connected by the *interosseous membrane* extending between their contiguous borders, and perforated, above for the anterior tibial artery, below for the anterior peroneal vessels.

**INFERIOR TIBIO-FIBULAR ARTICULATION,** is an amphi-arthrodial joint, formed by the contiguous rough surfaces on the bones. Its *synovial membrane* is derived from that of the ankle-joint, and it has 4 ligaments, viz.—

*Inferior interosseous,* continuous with the interosseous membrane.

*Anterior and posterior inferior tibio-fibular,* from the margins of the external malleolus to the front and back of the tibia.

*Transverse,* posteriorly between the two malleoli.

**Describe the Ankle-joint.** It is a ginglymoid articulation, formed by the lower ends of the tibia and fibula and their malleoli, with the astragalus. Its *synovial membrane* is prolonged upwards between the tibia and fibula for a short distance. Its *arteries* are derived from the malleolar branches of the anterior tibial and peroneal arteries; and its *nerves* from the anterior tibial nerve. It has 3 ligaments, viz.—

*Anterior,* connecting the margins of the tibia and astragalus.

*Internal lateral, or Deltoid ligament,* from the internal malleolus to the three adjacent tarsal bones.

*External lateral,* by anterior posterior and middle fasciculi, from the external malleolus to the astragalus and os calcis.

**Describe the Tarsal Articulations.** They are in three sets, (1) between the bones of the first row, (2) between the bones of the second row, (3) between the two rows of bones.

(1.) The astragalus and os calcis are united by 3 ligaments.

*External calcaneo-astragaloid.*

*Interosseous.*

*Posterior calcaneo-astragaloid.*

- (2.) The scaphoid, cuboid, and three cuneiform bones are united by an irregular number of *dorsal* and *plantar* and 4 *interosseous* ligaments, which latter are arranged transversely.
- (3.) The two rows of bones are united by 7 ligaments viz.—
- |   |                                    |
|---|------------------------------------|
| <i>Superior astragalo-scaploid.</i>               | <i>Inferior calcaneo-scaploid.</i> |
| <i>Superior calcaneo-cuboid.</i>                  | <i>Short calcaneo-cuboid.</i>      |
| <i>Superior calcaneo-scaploid.</i>                | <i>Long calcaneo-cuboid.</i>       |
| <i>Interosseous, or internal calcaneo-cuboid.</i> |                                    |

**Describe the Tarso-metatarsal Articulations.** They are five arthrodial joints formed by the bases of the metatarsal bones with the adjacent bones of the tarsus, the 2nd metatarsal bone articulating with all three cuneiform in the recess formed by the shortness of the second cuneiform. They are united by *dorsal, plantar and 3 interosseous ligaments*. The 2nd metatarsal bone has three dorsal ligaments, one from each cuneiform bone. The interosseous ligaments pass from the 2nd and 3rd metatarsal bones to the internal and external cuneiform.

**Describe the Synovial Membranes of the Tarsus and Metatarsus.** They are 6 in number, and are situated as follows: viz.—

*The first*, between the os calcis and the astragalus, behind the interosseous ligament.

*The second*, between the same bones in front of the interosseous ligament, also between the astragalus and the scaphoid.

*The third*, between the os calcis and the cuboid.

*The fourth*, between the scaphoid and the three cuneiform bones, running backwards between the scaphoid and the cuboid, forwards between the cuneiform bones, between the external cuneiform and the cuboid, between the middle and external cuneiform and the bases of the second and third metatarsal, passing also between the bases of these bones and the fourth metatarsal.

*The fifth*, between the cuboid and the fourth and fifth metatarsal bones, also running forwards between their bases.

*The sixth*, between the internal cuneiform and the base of the first metatarsal bone.

**Describe the Metatarso-metatarsal Articulations.** The metatarsal bones are connected together, except the first, at their bases by *dorsal, plantar, and interosseous ligaments*; and all five are connected at their digital extremities by the *transverse metatarsal ligament*.

**Describe the remaining articulations of the foot.** The metatarso-phalangeal and the phalangeal articulations are similar to those in the hand, each having an *anterior or plantar, and two lateral ligaments*. The extensor tendons of the foot supply the places of posterior ligaments.

## THE MUSCLES AND FASCIÆ.

**What are the Muscles?** They are the active organs of locomotion, formed of bundles of reddish fibres endowed with the property of shortening themselves upon irritation, which is called *muscular contractility*, and chemically consisting of syntonin, or muscular fibrin.

**How are the muscles divided?** Into two great classes, (1) *Voluntary, striped, or muscles of animal life*, comprise those which are under the control of the will. (2) *Involuntary, unstriped, or muscles of organic life*, are those which are not under the control of the will.

*Voluntary muscular fibre* consists of fasciculi about  $\frac{1}{400}$  inch in diameter, each surrounded by a tubular membranous sheath, the perimysium; and marked by fine striæ passing around them in curved parallel lines about  $\frac{1}{11000}$  inch apart. These fasciculi are formed of *fibrille* each about  $\frac{1}{18000}$  inch thick, also striated, presenting the appearance of a row of minute particles, the "sarcous elements" of Bowman, and surrounded by cellular tissue, the sarcolemma.

*Involuntary muscular fibre* consists of flattened fusiform or spindle-shaped fibres, averaging about  $\frac{1}{4000}$  inch in breadth, consisting of elongated cells, and bound together in bundles by areolar tissue. These fibres are found in the alimentary canal, in the posterior wall of the trachea, in the bronchi, the ducts of certain glands, in the ureters, bladder, urethra, genitalia of both sexes, walls of all arteries and most veins and lymphatics, in the iris and ciliary muscle, and in the skin.

**What are Tendons and Aponeuroses?** *Tendons* are white glistening cords or bands formed of white fibrous tissue almost entirely, have few vessels and no nerves, and serve to connect the muscles with the structures on which they act. *Aponeuroses* are fibrous membranes, of similar structure and appearance, and serve the same purpose.

**What are Fasciæ.** They are laminae of variable thickness which invest (*fascia*, a bandage) the softer structures. The superficial fascia is composed of fibro-areolar tissue, and is found beneath the skin almost over the whole body. The deep fascia is of aponeurotic structure, dense, inelastic and fibrous, ensheathing the muscles and affording some of them attachment, also the vessels and nerves, and binding down the whole into a shapely mass.

**To what structures are muscles attached?** To the periosteum and perichondrium of bone and cartilage, to the subcutaneous areolar tissue, and to ligaments. In the latter case only are their tendons in direct contact with the tissue on which they are to act.

**How many muscles are double-bellied?** Five,—the occipito-frontalis, biventer cervicis, digastric, omo-hyoid, and the diaphragm.

Describe each Muscle of the body, giving its origin, insertion, action, and nervous supply.

#### MUSCLES OF THE HEAD.

- Occipito-frontalis**, *a* from the external two-thirds of the superior curved line of the occipital bone, and the mastoid process of the temporal; also from the pyramidalis nasi, corrugator supercilii, and orbicularis palpebrarum fibres, —*into* an aponeurosis or “galea capitis,” which covers the vertex of the skull. *Action*, chiefly as a muscle of facial expression. *Nerves*, facial, supra-orbital, small occipital.
- Attollens aurem**, *from* the occipito-frontalis aponeurosis, —*into* the pinna of the ear superiorly. *Action*, to raise the pinna. *Nerve*, small occipital branch of the cervical plexus.
- Attrahens aurem** *from* the lateral cranial aponeurosis, —*into* the helix of the ear anteriorly. *Action*, to draw the pinna forwards. *Nerves*, facial, and auriculo-temporal branch of the inferior maxillary.
- Retrahens aurem**, *from* the mastoid process of the temporal bone, *into* the concha. *Action*, to retract the pinna. *Nerve*, facial.
- Orbicularis palpebrarum**, *from* the internal angular process of the frontal bone, the nasal process of the superior maxillary, and the borders of the tendo oculi, —*into* the skin of the eyelids, forehead, temple, and cheek, blending with the occipito-frontalis, and the corrugator supercilii. *Action*, to close the eyelids. *Nerve*, facial.
- Corrugator supercilii**, *from* the inner end of the superciliary ridge of the frontal bone, —*into* the orbicularis palpebrarum. *Action*, to draw eyebrow downwards and inwards. *Nerve*, facial.
- Tensor tarsi** (Horner’s muscle), *from* the crest of the lachrymal bone, *into* the tarsal cartilages by two slips. *Action*, to compress the puncta lachrymalia against the globe of the eye, and to compress the lachrymal sac. *Nerve*, facial.
- Levator palpebræ superioris**, *from* the lesser wing of the sphenoid, —*into* the upper tarsal cartilage. *Action*, to lift the upper lid. *Nerve*, 3rd cranial, or motor oculi.
- Rectus superior**, *from* the upper margin of the optic foramen and the sheath of the optic nerve, —*into* the sclerotic coat. *Action*, to rotate the eyeball upwards. *Nerve*, 3rd cranial.
- Rectus inferior**, *from* the ligament of Zinn, —*into* the sclerotic coat. *Action*, rotates the eyeball downwards. *Nerve*, 3rd cranial.
- Rectus internus**, *from* the ligament of Zinn, —*into* the sclerotic coat. *Action*, rotates the eyeball inwards. *Nerve*, 3rd cranial.

**Rectus externus**, by two heads, the upper from the outer margin of the optic foramen, the lower from the ligament of Zinn and a bony process at lower margin of the sphenoidal fissure,—into the sclerotic coat. *Action*, to rotate the eyeball outwards. *Nerve*, 6th cranial, or abducens.

Between the two heads of the external rectus pass the 3rd, nasal branch of the 5th, and the 6th cranial nerves, and the ophthalmic vein.

**Obliquus superior**, from about a line above the inner margin of the optic foramen, its tendon passing through a "pulley" near the internal angular process of the frontal bone and thence beneath the rectus superior,—into the sclerotic coat at right angles to the insertion of the rectus superior. *Action*, to rotate the eyeball on its antero-posterior axis. *Nerve*, 4th cranial, or patheticus.

**Obliquus inferior**, from the orbital plate of the superior maxillary,—into the sclerotic coat below the insertion of the external rectus and at right angles thereto. *Action*, to rotate the eye on its antero-posterior axis. *Nerve*, 3rd cranial.

**Pyramidalis nasi**,<sup>c</sup> from the occipito-frontalis,—into the compressor naris. *Action*, to depress the eyebrow. *Nerve*, facial.

**Levator labii superioris alæque nasi**,<sup>c</sup> from the nasal process of the superior maxillary bone,—into the cartilage of the ala of the nose and into the upper lip. *Action*, to elevate the upper lip, and dilate the nostril. *Nerve*, facial.

**Dilator naris anterior**, from the cartilage of the ala,—into the border of its integument. *Action*, to dilate the nostril. *Nerve*, facial.

**Dilator naris posterior**, from the nasal notch of the superior maxillary and the sesamoid cartilages,—into the integument at the margin of the nostril. *Action*, to dilate the nostril. *Nerve*, facial.

**Compressor naris**,<sup>d</sup> from the superior maxillary above the incisive fossa,—into the fibro-cartilage of the nose, being continuous with its fellow and the pyramidalis nasi aponeurosis. *Action*, to dilate the nostril. *Nerve*, facial.

**Compressor narium minor**, from the alar cartilage,—into the skin at the end of the nose. *Action*, to dilate the nostril. *Nerve*, facial.

FIG. 37.



- Depressor alæ nasi**, *from the incisive fossa of the superior maxillary,—into the septum and ala of the nose. Action, to contract the nostril. Nerve, facial.*
- Levator labii superioris**, *f from the lower margin of the orbit,—into the upper lip. Action, to elevate the lip. Nerve, facial.*
- Levator anguli oris**, *e from the canine fossa of the superior maxillary,—into the angle of the mouth. Action, as named. Nerve, facial.*
- Zygomaticus major**, *h from the malar bone,—into the angle of the mouth. Action, to raise the lip outwards. Nerve, facial.*
- Zygomaticus minor**, *g from the malar bone anteriorly,—into the angle of the mouth, blending with the levator labii superioris. Action, to raise the lip outwards. Nerve, facial.*
- Levator labii inferioris**<sup>m</sup> (Levator menti), *from the incisive fossa of the inferior maxillary bone,—into the integument of the lower lip. Action, as named. Nerve, facial.*
- Depressor labii inferioris**<sup>l</sup> (Quadratus menti), *from the external oblique line of the inferior maxillary bone,—into the lower lip. Action, as named. Nerve, facial.*
- Depressor anguli oris**<sup>n</sup> (Triangularis menti), *from the external oblique line of the inferior maxillary,—into the angle of the mouth. Action, as named. Nerve, facial.*
- Orbicularis oris**, *k by accessory fibres (accessorii orbicularis superioris and inferioris, and naso-labialis) from the nasal septum and the superior and inferior maxillary borders,—into the buccinator and other adjacent muscles, forming the sphincter of the mouth. Action, to close the mouth. Nerve, facial.*
- Buccinator**, *j from the posterior alveolar processes of both the maxillary bones and the pterygo-maxillary ligament,—into the orbicularis oris. Action, to compress the cheeks. Nerves, facial, and the buccal branch of the inferior maxillary.*
- Risorius**, *from the fascia over the masseter muscle,—into the angle of the mouth. Action, the laughing muscle. Nerve, facial.*
- Masseter**, *i from the anterior two-thirds and the inner surface of the zygoma and the malar process of the superior maxillary,—into the angle, ramus and coronoid process of the lower jaw. Action, to raise the back part of the lower jaw; a muscle of mastication. Nerve, inferior maxillary.*
- Temporal**, *from the temporal fossa and temporal fascia,—into the coronoid process of the inferior maxillary. Action, to bring the incisor teeth together; the biting muscle. Nerve, inferior maxillary.*

**Internal pterygoid**, from the pterygoid fossa of the sphenoid bone, and the tuberosity of the palate,—into the angle and inner surface of the ramus of the jaw, as high as the dental foramen. *Action*, raises and draws forward the lower jaw; a triturating muscle of mastication. *Nerve*, inferior maxillary.

**External pterygoid**, by 2 heads, the upper from the pterygoid ridge on the greater wing of the sphenoid, the lower from the external pterygoid plate, and the tuberosities of the palate and superior maxillary bones,—into a depression in front of the condyle of the inferior maxillary, and the inter-articular fibro-cartilage. *Action*, to draw the jaw forwards; a triturating muscle of mastication. *Nerve*, inferior maxillary.

Between the two heads of the external pterygoid muscle passes the internal maxillary artery.

#### MUSCLES OF THE EAR.

**Tensor tympani**, from the under surface of the petrous portion of the temporal bone, the cartilaginous Eustachian tube, and its own osseous canal,—into the handle of the malleus. *Action*, to draw the membrana tympani tense. *Nerve*, branch from otic ganglion.

**Laxator tympani major**, from the spinous process of the sphenoid and the cartilaginous Eustachian tube,—through the Glaserian fissure to the neck of the malleus just above the processus gracilis. *Action*, to relax the membrana tympani. *Nerve*, tympanic branch of the facial.

**Laxator tympani minor**, from the back of the external meatus,—passes between the layers of the membrana tympani into the handle of the malleus and processus brevis. *Action*, to relax the membrana tympani. Considered a ligament by many anatomists.

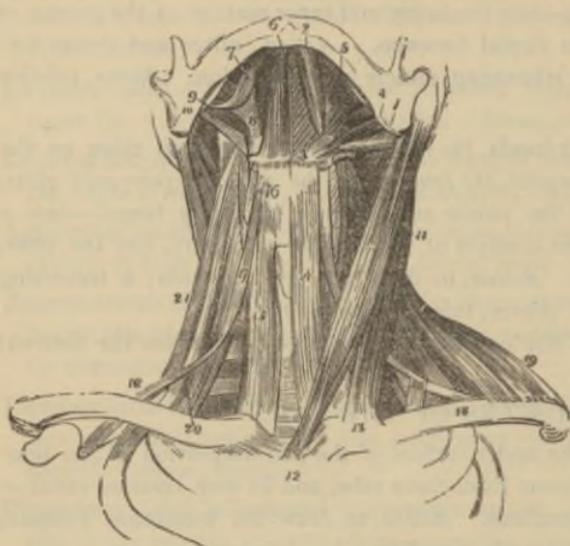
**Stapedius**, from the interior of the pyramid,—through the orifice at its apex into the neck of the stapes. *Action*, to depress the base of the stapes. *Nerve*, filament from the facial.

#### MUSCLES OF THE NECK.

**Platysma myoides**, from the clavicle, the acromion, and the fascia covering the pectoral, deltoid and trapezius muscles,—into the lower jaw, the angle of the mouth, and the cellular tissue of the face. *Action*, to wrinkle the skin, and depress the mouth. *Nerves*, facial and superficial cervical.

**Sterno-cleido-mastoid**,<sup>11</sup> by two heads from the sternum<sup>12</sup> and the clavicle<sup>13</sup> at its inner third,—into the mastoid process of the temporal bone, and the superior curved line of the occipital. *Action*, to depress and rotate the head. *Nerves*, spinal accessory, and branches of the cervical plexus.

FIG. 38.



Between the sternal and clavicular origins is a fossa, the *fonticulus gutturis*, which rises and falls during labored breathing.

**Sterno-hyoid**,<sup>14</sup> from the posterior surface of the sternum and the sternal end of the clavicle,—into the body of the hyoid bone. *Action*, to depress the hyoid bone. *Nerve*, a branch from the communicating loop between the descendens and communicans noni.

**Sterno-thyroid**,<sup>15</sup> from the posterior surface of the sternum and the cartilage of the 1st rib,—into the oblique line on the ala of the thyroid cartilage. *Action*, to depress the larynx. *Nerve*, a branch from the communicating loop between the descendens and communicans noni.

**Thyro-hyoid**,<sup>16</sup> from the oblique line on the thyroid cartilage,—into the body and greater cornu of the hyoid bone. *Action*, to elevate the larynx. *Nerve*, hypoglossal.

**Omo-hyoid**,<sup>17 18</sup> from the upper border of the scapula and the transverse ligament,—into the body of the hyoid bone. It has a tendon in its centre which is bound down to the cartilage of the 1st rib by a loop of the deep cervical fascia. *Action*, to depress the hyoid bone, and draw it backwards. *Nerve*, branch from the communicating loop between the descendens and communicans noni.

**Digastric**, by two bellies, the *posterior one*<sup>1</sup> from the digastric groove of the mastoid process of the temporal bone; the *anterior*<sup>2</sup> from a fossa on the inner surface of the inferior maxillary, near its symphysis,—into a central tendon<sup>3</sup> which perforates the stylo-hyoid muscle, and is bound down to the body of the hyoid bone by an aponeurotic loop. *Action*, to raise the hyoid bone and tongue. *Nerves*, facial, and mylo-hyoid branch of the inferior dental.

**Stylo-hyoid**,<sup>4</sup> from the styloid process of the temporal bone near its base,—into the body of the hyoid bone. *Action*, to elevate and retract the hyoid bone. *Nerve*, facial. This muscle is perforated by the digastric.

- Mylo-hyoid**,<sup>5</sup> *from* the mylo-hyoid ridge of the lower jaw,—*into* the body of the hyoid bone and a fibrous raphe in the median line running from the hyoid bone to the chin. *Action*, elevates the hyoid bone and draws it forwards, also forms the floor of the mouth. *Nerve*, mylo-hyoid branch of inferior dental.
- Genio-hyoid**,<sup>6</sup> *from* the inferior genial tubercle of the inferior maxillary,—*into* the body of the hyoid bone. *Action*, same as the mylo-hyoid. *Nerve*, hypoglossal.
- Genio-hyo-glossus**, *from* the superior genial tubercle of the inferior maxillary,—*into* the body of the hyoid bone, the side of the pharynx, and the whole length of the under surface of the tongue, forming a fan-like muscle. *Action*, to retract and protrude the tongue. *Nerve*, hypoglossal.
- Hyo-glossus**<sup>8</sup> (the basio-kerato-chondro-glossus,) *from* the body of the hyoid bone, its lesser cornu, and the whole length of its greater cornu,—*into* the side of the tongue. *Action*, to draw down the side of the tongue. *Nerve*, hypoglossal.
- Stylo-glossus**,<sup>9</sup> *from* the styloid process and the stylo-maxillary ligament,—*into* the side of the tongue and the hyo-glossus muscle. *Action*, to elevate and retract the tongue. *Nerve*, hypoglossal.
- Lingualis**, lies between the hyo-glossus and the genio-hyo-glossus, from the base to the tip of the tongue, along its under surface; some of its fibres being attached to the hyoid bone. *Action*, to elevate the centre of the tongue. *Nerve*, chorda tympani.
- Inferior constrictor**, *from* the sides of the cricoid and thyroid cartilages,—*into* the fibrous raphe of the pharynx. *Action*, to contract the pharyngeal calibre. *Nerves*, glosso-pharyngeal, pharyngeal plexus, and external laryngeal.
- Middle constrictor**, *from* the cornua of the hyoid bone and the stylo-hyoid ligament,—*into* the pharyngeal raphe. *Action*, to constrict the pharynx. *Nerves*, glosso-pharyngeal, pharyngeal plexus.
- Superior constrictor**, *from* the lower third of the margin of the internal pterygoid plate and its hamular process, the contiguous part of the palate bone, the tendon of the tensor palati, the pterygo-maxillary ligament, part of the alveolar process of the lower jaw and the side of the tongue,—*into* the pharyngeal raphe and the pharyngeal spine of the occipital bone. *Action*, to constrict the pharynx. *Nerves*, glosso-pharyngeal, pharyngeal plexus.
- Stylo-pharyngeus**,<sup>10</sup> *from* the inner side of the base of the styloid process,—*into* the constrictor and palato-pharyngeus muscles, and the thyroid car-

- tilage. *Action*, to elevate the pharynx. *Nerves*, glosso-pharyngeal, pharyngeal plexus. The former nerve crosses this muscle in passing to the tongue.
- Levator palati**, from the under surface of the apex of the petrous portion of the temporal bone and from the Eustachian tube,—into the posterior surface of the soft palate. *Action*, to elevate the soft palate. *Nerve*, facial, through the Vidian and petrosal.
- Tensor palati**, from the scaphoid fossa of the sphenoid bone, and the Eustachian tube,—reflected around the hamular process, into the anterior surface of the soft palate, and the horizontal portion of the palate bone. *Action*, to tense the palate. *Nerve*, a branch from the otic ganglion.
- Azygos uvulæ**, from the posterior nasal spine of the palate bone, and from the soft palate,—into the uvula. *Action*, possibly to raise the uvula. *Nerve*, facial, through the Vidian and petrosal. This muscle is wrongly named, as it is double.
- Palato-glossus** (anterior pillar of the fauces), from the anterior surface of the soft palate laterally,—into the side and dorsum of the tongue. *Action*, constrictor isthmi faucium. *Nerves*, palatine branches of Meckel's ganglion.
- Palato-pharyngeus** (posterior pillar of the fauces), from the soft palate,—into the side of the pharynx and the posterior border of the thyroid cartilage, having joined the stylo-pharyngeus. *Action*, to close the posterior nares. *Nerves*, palatine branches from Meckel's ganglion.
- Rectus capitis anti'cus major**, from the anterior tubercles of the transverse processes of the 3rd 4th 5th and 6th cervical vertebræ, by four slips,—into the basilar process of the occipital bone. *Action*, to flex the head. *Nerves*, sub-occipital and deep branches of cervical plexus. This muscle is a continuation of the scalenus anticus.
- Rectus capitis anti'cus minor**, from the anterior surface of the lateral mass of the atlas, and the root of its transverse process,—into the basilar process of the occipital bone. *Action*, to flex the head. *Nerves*, sub-occipital and deep branches of the cervical plexus.
- Rectus lateralis**, from the upper surface of the transverse process of the atlas,—into the jugular process of the occipital bone. *Action*, to draw the head laterally. *Nerve*, sub-occipital.
- Longus colli**, 3 portions,—the *superior oblique*, from the anterior tubercles of the transverse processes of the 3rd 4th and 5th cervical vertebræ, into a tubercle on the anterior arch of the atlas:—*inferior oblique*, from the bodies of the first two or three dorsal vertebræ, into the transverse processes of the 5th and 6th cervical:—*vertical portion* from the bodies of the lower three cervical and upper three dorsal vertebræ, to the bodies of the 2nd, 3rd and

4th cervical. *Action*, to flex the cervical vertebræ and slightly to rotate them. *Nerves*, branches from the lower cervical.

**Scalenus anti'cus**,<sup>20</sup> *from* a tubercle on the upper surface of the first rib,—*into* the transverse processes of the cervical vertebræ, from the 3d to the 6th inclusive. *Action*, to flex the neck laterally, or to raise the first rib. *Nerves*, branches from the lower cervical. (See Fig. 38.)

**Scalenus medius**,<sup>22</sup> *from* the upper surface of the first rib, behind the subclavian groove,—*into* the transverse processes of the lower six cervical vertebræ. *Action*, same as scalenus anticus. *Nerves*, branches from the lower cervical.

**Scalenus posti'cus**,<sup>21</sup> *from* the outer surface of the second rib,—*into* the posterior tubercles on the transverse processes of the lower two or three cervical vertebræ. *Action*, to flex the neck laterally, or to elevate the 2nd rib. *Nerves*, branches from lower cervical.

#### MUSCLES OF THE LARYNX AND EPIGLOTTIS.

**Crico-thyroid**, *from* the front and side of the cricoid cartilage,—*into* the lower and inner borders of the thyroid cartilage. *Action*, to elongate and make tense the vocal chords. *Nerve*, superior laryngeal.

**Crico-arytenoideus posticus**, *from* the cricoid cartilage posteriorly,—*into* the outer angle of the base of the arytenoid cartilage. *Action*, to rotate the arytenoid cartilages outwards and open the glottis, while keeping the vocal chords tense. *Nerve*, recurrent laryngeal.

**Crico-arytenoideus lateralis**, *from* the upper border of the cricoid cartilage laterally,—*into* the outer angle of the base of the arytenoid cartilage. *Action*, to rotate the arytenoid cartilages inwards and close the glottis. *Nerve*, recurrent laryngeal.

**Thyro-arytenoideus**, *from* the receding angle of the thyroid cartilage, and the crico-thyroid membrane,—*into* the base and anterior surface of the arytenoid cartilage. *Action*, to shorten and relax the vocal chords by approximating the cartilages. *Nerve*, recurrent laryngeal.

**Arytenoideus**, *from* the posterior surface and outer border of one arytenoid cartilage,—*into* the corresponding parts of the opposite cartilage, filling up the posterior concave surface of these cartilages. *Action*, by approximating the arytenoids, to close the back part of the glottis. *Nerves*, superior and recurrent laryngeal.

**Thyro-epiglottideus**, *from* the inner surface of the thyroid cartilage,—*into* the margin of the epiglottis and the aryteno-epiglottidean fold. *Action*, a depressor of the epiglottis. *Nerve*, recurrent laryngeal.

**Aryteno-epiglottideus superior**, from the apex of the arytenoid cartilage, —into the aryteno-epiglottidean folds. *Action*, to constrict the superior laryngeal aperture. *Nerve*, recurrent laryngeal.

**Aryteno-epiglottideus inferior**, from the arytenoid cartilage anteriorly, —into the sacculus laryngis and the margin of the epiglottis. *Action*, to compress the sacculus laryngis. *Nerve*, recurrent laryngeal.

### MUSCLES OF THE BACK.

**First layer (2)**—*Trapezius*. *Latissimus dorsi*.

**Second layer (3)**—*Levator anguli scapulæ*. *Romboideus major*, and *minor*.

**Third layer (3)**—*Serratus posticus superior*. *Serratus posticus inferior*.  
*Splenius capitis et colli*.

**Fourth layer (11)**—in four sets, viz.—

LUMBAR (1)—*Erector spinæ*.

EXTERNAL (3).	MIDDLE (3).	INTERNAL (4).
<i>Sacro-lumbalis</i> .	<i>Longissimus dorsi</i> .	<i>Spinalis dorsi</i> .
<i>Musculus accessorius ad sacro-lumbalem</i> .	<i>Transversalis colli</i> .	<i>Spinalis colli</i> .
<i>Cervicalis ascendens</i> .	<i>Trachelo-mastoid</i> .	<i>Biventer cervicis</i> .
		<i>Complexus</i> .

**Fifth layer (12)**—six having the word *spinal* in them, viz.—

<i>Semi-spinalis dorsi</i> .	<i>Inter-transversales</i> .
<i>Semi-spinalis colli</i> .	<i>Rectus capitis posticus major</i>
<i>Multifidus spinæ</i> .	<i>Rectus capitis posticus minor</i> .
<i>Rotatores spinæ</i> .	<i>Obliquus capitis superior</i> .
<i>Supra-spinales</i> .	<i>Obliquus capitis inferior</i> .
<i>Inter-spinales</i> .	<i>Extensor coccygis</i> .

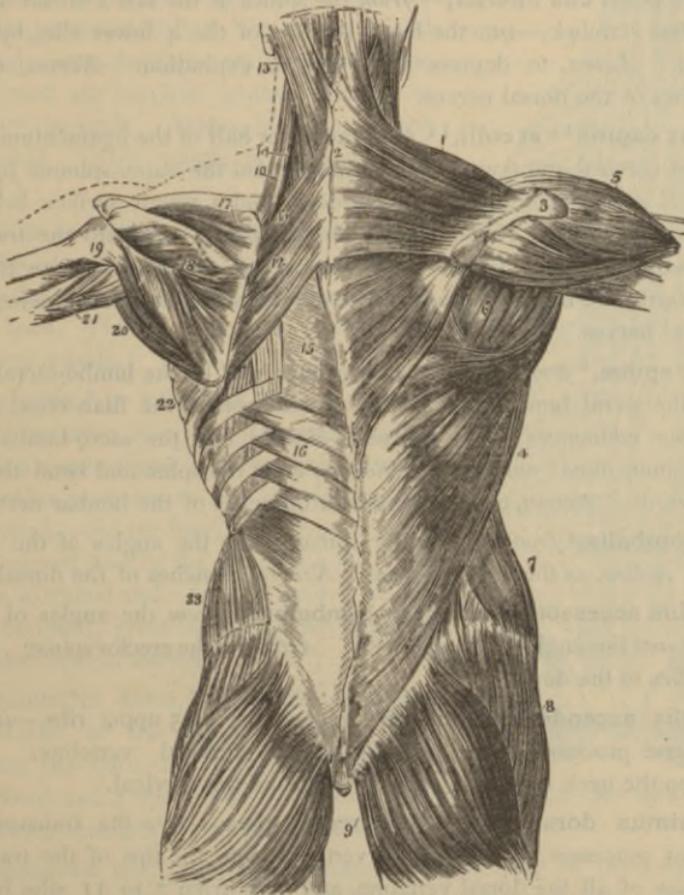
**Trapezius**,<sup>1</sup> from the inner third of the superior curved line of the occipital bone, the ligamentum nuchæ,<sup>2</sup> the spinous processes of the last cervical and all the dorsal vertebræ, and the supra-spinous ligament,—into the outer third of the posterior border of the clavicle, the superior margin of the acromion process, the whole length of the superior border of the spine of the scapula,<sup>3</sup> and a tubercle at its inner extremity. *Action*, to draw the head backwards. *Nerves*, spinal accessory, cervical plexus.

**LIGAMENTUM NUCHÆ**, from external occipital protuberance,—to the spines of the cervical vertebræ, from the 2d to the 7th inclusive.

**Latissimus dorsi**,<sup>4</sup> by an aponeurosis from the spines of the six lower dorsal and the lumbar and sacral vertebræ, the supra-spinous ligament, the crest of the ilium, and the three or four lower ribs,—into the bicipital groove of the humerus. *Action*, the *cursor ani* muscle, drawing the arm downwards and backwards; or raising the lower ribs and drawing the trunk forwards. *Nerves*, the subscapular.

**Levator anguli scapulæ,**<sup>10</sup> by 4 slips from the transverse processes of 3 or 4 upper cervical vertebræ,—into the posterior border of the scapula. *Action*, as named. *Nerves*, branches from the 5th cervical and the cervical plexus.

FIG. 39.



**Rhomboideus minor,**<sup>11</sup> from the ligamentum nuchæ and spines of the 7th cervical and 1st dorsal vertebræ,—into the smooth surface at the root of the spine of the scapula. *Action*, to draw the scapula backwards and upwards. *Nerve*, 5th cervical.

**Rhomboideus major,**<sup>12</sup> from the spines of the 4 or 5 upper dorsal vertebræ and the supra-spinous ligament,—into the scapula at the root of its spine and inferior angle, by a tendinous arch. *Action*, to draw the scapula upwards and backwards. *Nerve*, 5th cervical.

- Serratus posticus superior**, from the ligamentum nuchæ, and spines of the 7th cervical and 2 or 3 upper dorsal vertebræ,—into the upper borders of the 2d 3d 4th and 5th ribs, by four digitations. *Action*, to raise ribs in inspiration. *Nerves*, external posterior branches of the cervical nerves.
- Serratus posticus inferior**,<sup>16</sup> from the spines of the last 2 dorsal and first 3 lumbar vertebræ,—into the lower borders of the 4 lower ribs, by 4 digitations. *Action*, to depress these ribs in expiration. *Nerves*, external branches of the dorsal nerves.
- Splenius capitis**<sup>13</sup> **et colli**,<sup>14</sup> from the lower half of the ligamentum nuchæ, the last cervical and 6 upper dorsal spines, and the supra-spinous ligament,—the *S. capitis* into the mastoid process and a rough surface below the superior curved line of the occipital bone,—the *S. colli* into the transverse processes of the 3 or 4 upper cervical vertebræ. *Action*, to draw the head backwards and the neck erect. *Nerves*, external posterior branches of the cervical nerves.
- Erector spinæ**,<sup>1</sup> from the sacro-iliac groove, and by the lumbo-sacral tendon from the sacral lumbar and 3 lower dorsal spines, the iliac crest, and the posterior eminences of the sacrum,—*divides* into the sacro-lumbalis<sup>2</sup> and longissimus dorsi<sup>3</sup> muscles. *Action*, to erect the spine and bend the trunk backwards. *Nerves*, external posterior branches of the lumbar nerves.
- Sacro-lumbalis**,<sup>2</sup> from the erector spinæ,—into the angles of the 6 lower ribs. *Action*, as the erector spinæ. *Nerves*, branches of the dorsal.
- Musculus accessorius ad sacro-lumbalem**,<sup>2</sup> from the angles of 6 lower ribs,—into the angles of 6 upper ribs. *Action*, as the erector spinæ. *Nerves*, branches of the dorsal.
- Cervicalis ascendens**,<sup>5</sup> from the angles of 4 or 5 upper ribs,—into the transverse processes of the 4th 5th and 6th cervical vertebræ. *Action*, to keep the neck erect. *Nerves*, branches of the cervical.
- Longissimus dorsi**,<sup>3</sup> from the erector spinæ,—into the transverse and articular processes of the lumbar vertebræ, into the tips of the transverse processes of all the dorsal vertebræ, and into from 7 to 11 ribs between their tubercles and angles. *Action*, as the erector spinæ. *Nerves*, branches of the lumbar and dorsal nerves.
- Transversalis colli**,<sup>6</sup> from the transverse processes of the 3rd 4th 5th and 6th dorsal vertebræ,—into the transverse processes of the 5 lower cervical.<sup>9</sup> *Action*, to keep the neck erect. *Nerves*, cervical branches.
- Trachelo-mastoid**,<sup>7</sup> from the transverse processes of the 3rd 4th 5th and 6th dorsal vertebræ, and the articular processes of the 3 or 4 lower cervical,—into the posterior margin of the mastoid process. *Action*, to steady the head. *Nerves*, branches of the cervical.

**Spinalis dorsi**, from the last 2 dorsal and first 2 lumbar spines,—into all the remaining dorsal spines. *Action*, to erect the spinal column. *Nerves*, branches of the dorsal.

**Spinalis colli**, from the 5th and 6th cervical spines, sometimes from the 1st and 2nd dorsal,—into the spine of the axis, or the 3rd and 4th cervical spines. *Action*, to steady the neck. *Nerves*, branches of the cervical. [This muscle is frequently absent.]

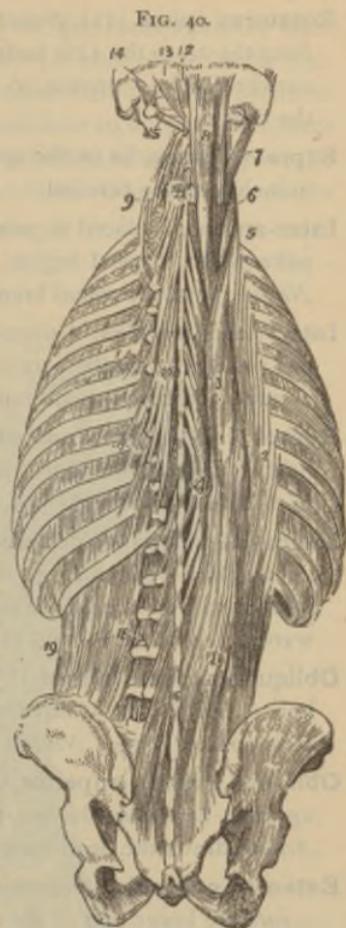
**Biventer cervicis**, from the transverse processes of 2 to 4 upper dorsal vertebræ,—into the superior curved line of the occipital bone. [Is but a portion of the complexus muscle.]

**Complexus**,<sup>8</sup> by 7 tendons from the tips of the transverse processes of the 7th cervical and 3 upper dorsal vertebræ, and from the articular processes of the 4th 5th and 6th cervical,—into the inner depression between the curved lines of the occipital bone. *Action*, to retract and rotate the head. *Nerves*, suboccipital, great occipital, and branches of the cervical nerves.

**Semispinalis dorsi**,<sup>10</sup> from the transverse processes of the dorsal vertebræ, from about the 5th to the 11th,—into the last 2 cervical and 4 upper dorsal spines. *Action*, to erect the spinal column. *Nerves*, branches of the dorsal nerves.

**Semispinalis colli**,<sup>11</sup> from the transverse processes of the 4 upper dorsal vertebræ, and the articular processes of the 4 lower cervical,—into the 2nd 3rd 4th and 5th cervical spines. *Action*, to erect the spinal column. *Nerves*, branches of the cervical.

**Multifidus spinæ**,<sup>16</sup> from the back of the sacrum, posterior superior spine of the ilium, posterior sacro-iliac ligaments, articular processes of lumbar and cervical vertebræ, and the transverse processes of the dorsal,—into the laminae and spines of the next 4 vertebræ above. *Action*, to erect and rotate the spinal column. *Nerves*, posterior spinal branches.



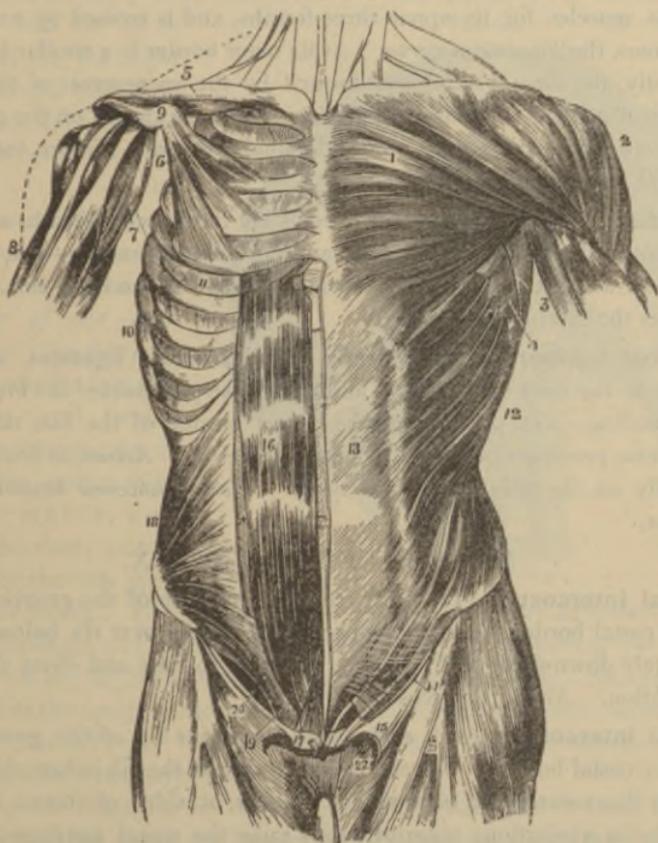
- Rotatores spinæ** (11), *from* the transverse processes of the dorsal vertebræ, from the 2d to the 12th inclusive,—each *into* the lamina of the next dorsal vertebra above. *Action*, to rotate the spinal column. *Nerves*, branches of the dorsal.
- Supra-spinales**, lie on the spinous processes in the cervical region. *Nerves*, branches of the cervical.
- Inter-spinales**, placed in pairs between the spines of contiguous vertebræ, 6 pairs in the cervical region, 3 in the dorsal, 4 sometimes 6 in the lumbar. *Nerves*, posterior spinal branches.
- Inter-transversales**,<sup>18</sup> placed between the transverse processes of contiguous vertebræ, 7 in the cervical region, 12 in the dorsal, and 4 in the lumbar. *Nerves*, posterior spinal branches.
- Rectus capitis posti'cus major**,<sup>13</sup> *from* the spine of the axis,—*into* the inferior curved line of the occipital bone and the surface below. *Action*, to rotate the head. *Nerves*, sub- and great occipital.
- Rectus capitis posti'cus minor**,<sup>12</sup> *from* the tubercle on the posterior arch of the atlas,—*into* a rough surface between the foramen magnum and the inferior curved line of the occipital bone. *Action*, to draw the head backwards. *Nerves*, sub- and great occipital.
- Obliquus capitis inferior**,<sup>15</sup> *from* the spinous process of the axis,—almost horizontally to the transverse process of the atlas. *Action*, to rotate the atlas and cranium. *Nerves*, sub- and great occipital.
- Obliquus capitis superior**,<sup>14</sup> *from* the transverse process of the atlas;—upwards and inwards *into* the occipital bone between the curved lines. *Action*, draws the head backwards. *Nerves*, sub- and great occipital.
- Extensor coccygis**, *from* the last bone of the sacrum or first of the coccyx, —*into* the lower part of the coccyx, posteriorly. *Action*, as named. *Nerves*, posterior sacral branches.

#### MUSCLES OF THE ABDOMEN.

- External oblique**,<sup>12</sup> *from* 8 lower ribs by 8 fleshy digitations,—*into* the anterior half of the outer lip of the crest of the ilium, and by a broad aponeurosis,<sup>12</sup> *into* the ensiform cartilage, linea alba, symphysis and spine of the pubes, and the pectineal line. Its aponeurosis is continuous with that of the pectoralis major above, and below it forms Poupart's<sup>14</sup> and Gimbernat's ligaments, and by the separation of its fibres, the external abdominal ring.<sup>15</sup> *Action*, to compress the viscera, and flex the thorax on the pelvis and *vice versa*. *Nerves*, lower intercostal, ilio-hypogastric and ilio-inguinal.
- Internal oblique**,<sup>13</sup> *from* the lumbar fascia, the anterior two-thirds of the middle lip of the crest of the ilium, and the outer half of Poupart's liga-

ment,—into the cartilages of 4 lower ribs; by its aponeurosis into the linea alba; and leaving an arched border<sup>20</sup> over the spermatic cord, by the conjoined tendon<sup>19</sup> with the transversalis into the pubic crest and the pectineal line. Its aponeurosis splits at the rectus abdominis for its upper three-fourths one layer passing in front the other behind that muscle, to unite again at the linea alba; for its lower one-fourth it passes in front of the rectus. *Action and Nerves*, same as the external oblique.

FIG. 41.



**Transversalis**, from the outer one-third of Poupart's ligament, the anterior two-thirds of the inner lip of the crest of the ilium, the cartilages of 6 lower ribs, and an aponeurosis from the spines and transverse processes of the lumbar vertebræ,—by its aponeurosis into the linea alba, and by the conjoined tendon<sup>19</sup> with the internal oblique, into the pubic crest and the pectineal line. Its aponeurosis passes behind the rectus abdominis for its upper three-fourths, in front of that muscle for its lower one-fourth.

**LUMBAR FASCIA**, or vertebral aponeurosis of the transversalis, divides into 3 leaflets, the *anterior* and *middle* being attached to the apices of the transverse processes of the lumbar vertebræ, the *posterior* leaflet to the apices of their spines. The anterior and middle leaflets enclose the quadratus lumborum muscle, the middle and posterior enclose the erector spinæ.

**Rectus abdominis**,<sup>16</sup> by 2 tendons from the pubic crest and the ligaments covering the symphysis,—into the cartilages of the 5th 6th and 7th ribs. It lies in a sheath formed by the aponeuroses of the internal oblique and transversalis muscles for its upper three-fourths, and is crossed by 2 to 5 tendinous lines, the *lineæ transversæ*. At its outer border is a similar line placed vertically, the *linea semilunaris*, formed by the aponeurosis of the internal oblique at its point of division. *Action*, to flex the thorax on the pelvis and *vice versâ*, also to compress the abdominal viscera. *Nerves*, same as the external oblique.

**Pyramidalis**,<sup>17</sup> lies in front of the rectus but in the same sheath, arises from the front of the pubic bone and the anterior pubic ligament,—into the linea alba, half-way to the umbilicus. *Action*, a tensor of the linea alba. *Nerves*, same as the external oblique.

**Quadratus lumborum**,<sup>19</sup> Fig. 40 from the ilio-lumbar ligament, adjacent 2 inches of the crest of the ilium, and transverse processes of the lower 3 lumbar vertebræ,—into one-half of the lower border of the last rib, and the transverse processes of the last 3 lumbar vertebræ. *Action*, to flex the thorax laterally on the pelvis and *vice versâ*. *Nerves*, anterior branches of the lumbar.

#### MUSCLES OF THE THORAX.

**External intercostals** (II), each from the outer lip of the groove in the inferior costal border,—into the upper border of the next rib below, directed obliquely downwards and forwards. *Action*, to raise and evert the ribs in inspiration. *Nerves*, intercostal.

**Internal intercostals** (II), each from the inner lip of the groove in the inferior costal border,—into the upper border of the rib below, directed obliquely downwards and backwards. *Action*, at sides of thorax to depress the ribs in expiration; anteriorly they raise the costal cartilages. *Nerves*, intercostals.

**Infra-costales** (10) obliquely from inner surface of one rib,—into the inner surface of the 1st 2d or 3d rib below. *Action*, muscles of inspiration. *Nerves*, intercostal.

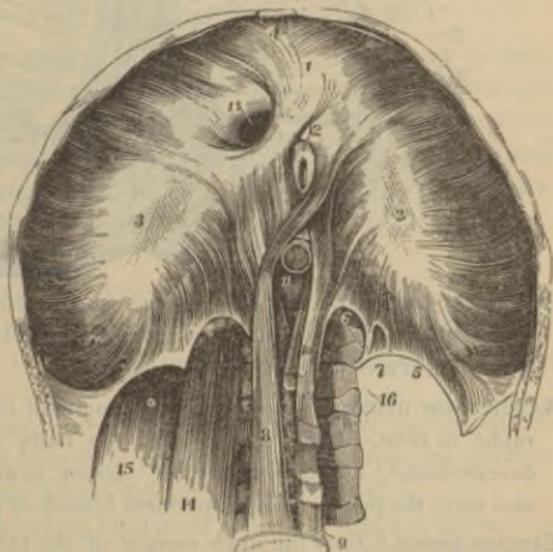
**Triangularis sterni**, from the inner surface of the ensiform cartilage, inner surfaces of costal cartilages of 3 or 4 lower true ribs, and lower sides of the

sternum,—into the lower border and inner surfaces of the 2d, 3d, 4th and 5th costal cartilages. *Action*, to draw down the cartilages in expiration. *Nerves*, intercostal.

**Levatores costarum**<sup>17</sup> Fig. 40 (12), each from the transverse process of a dorsal vertebra,—into the upper surface of the next rib below, near its angle. *Action*, to raise the ribs. *Nerves*, intercostal.

**Diaphragm**, from the ensiform cartilage,<sup>4</sup> inner surfaces of 6 or 7 lower ribs, ligamenta arcuata,<sup>5</sup> and by its crura<sup>8 10</sup> from the bodies of the lumbar vertebrae, from the 2d to the 4th on the right side, the 2d and 3d on the left,—into the central or cordiform tendon.<sup>2 3</sup> *Action*, the great muscle of respiration and expulsion. *Nerve*, the phrenic.

FIG. 42.



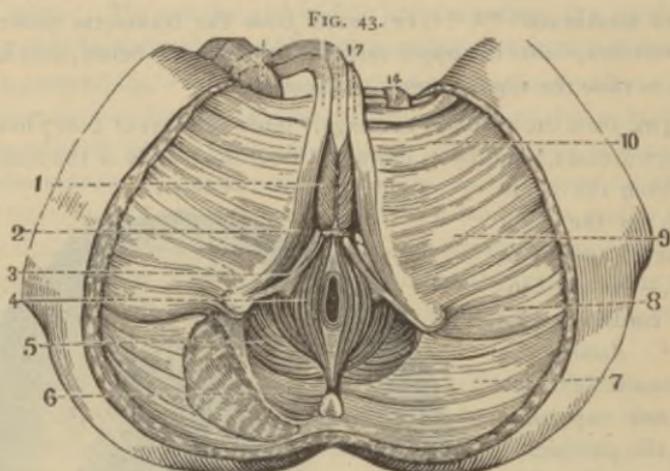
*Openings of the Diaphragm.* The Aortic,<sup>11</sup> in the middle line posteriorly, and behind the diaphragm; transmits the aorta, vena azygos major, and thoracic duct, occasionally the left sympathetic nerve. The Œsophageal,<sup>12</sup> in the muscular structure, transmits the œsophagus and the pneumogastric nerves. The opening for the vena cava<sup>13</sup> is the highest, and has four tendinous margins. The right crus<sup>8</sup> transmits the sympathetic and greater and lesser splanchnic nerves of that side. The left crus,<sup>10</sup> the greater and lesser splanchnic nerves of the left side and the vena azygos minor.

*Descent of the Diaphragm.* Its central tendon does not descend during inspiration, being connected by the fibrous pericardium with the deep cervical fascia.

## MUSCLES OF THE PERINEUM.

**Sphincter ani**,<sup>4</sup> from the tip of the coccyx and superficial fascia,—into the tendinous centre of the perineum. *Action*, to close the anus. *Nerve*, hemorrhoidal branch of the pudic.

**Internal sphincter**, a muscular ring, half an inch broad, about an inch from the margin of the anus; is an aggregation of the involuntary circular fibres of the intestine.



**Sphincter tertius of Hyrtl**,<sup>1</sup> from the sacrum, encircling the rectum about 4 inches above the anal orifice. [Demonstrated by Hyrtl, Nelaton and Velpeau, but denied by most anatomists.]

**Accelerator urinæ**,<sup>1</sup> from the central tendon of the perineum and the median raphé in front,—fibres spread over the bulb, corpus spongiosum, corpus cavernosum,<sup>17</sup> and dorsal vessels. *Action*, to accelerate the flow of urine, and erect the penis. *Nerve*, perineal branch of pudic.

**Erector penis**,<sup>2</sup> from the inner surface of the tuberosity of the ischium, the crus penis, and pubic ramus,—into the crus penis laterally and inferiorly. *Action*, to maintain erection. *Nerve*, perineal.

**Transversus perinei**,<sup>3</sup> from the ascending ramus of the ischium,—into the central tendon of the perineum. *Action*, to draw tense the central tendon. *Nerve*, perineal.

**Levator ani**,<sup>5</sup> from the body and ramus of the pubes posteriorly, pelvic fascia, and the spine of the ischium,—into the tendinous centre of the perineum, sides of the rectum (and vagina), apex of the coccyx, and a fibrous raphé extending from the coccyx to the anus. *Action*, to support the lower end of the rectum and vagina and the bladder, and assist in forming the floor of the pelvis. *Nerves*, inferior hemorrhoidal and 4th sacral.

**Compressor urethræ**, from the upper part of the ramus of the pubes,—into its fellow of the opposite side after encircling the membranous portion of the urethra. *Action*, stop-cock muscle. *Nerve*, perineal.

**Coccygeus**,<sup>6</sup> from the spine of the ischium and the lesser sacro-sciatic ligament, into the margin of the coccyx and the side of the last sacral segment.

*Action*, to support the coccyx, and close the outlet of the pelvis posteriorly.

*Nerve*, 5th sacral, anterior division.

**Sphincter vaginæ** (in the female), from the central tendon of the perineum, into the corpora cavernosa and body of the clitoris. Represents the accelerator urinæ of the male.

**Erector clitoridis** (in the female), replaces the erector penis.

#### MUSCLES OF THE SHOULDER AND ARM.

**Pectoralis major**, from the sternal one-half of the clavicle, by an aponeurosis from the front of the sternum as low as the 6th or 7th rib, the cartilages of all the true ribs, and the aponeurosis of the external oblique,—the fibres converge, cross and are inserted by a flat tendon into the external bicipital ridge of the humerus, having crossed the bicipital groove. *Action*, to draw the arm forwards and downwards; also to elevate the ribs in forced inspiration. *Nerves*, anterior thoracic.

**Pectoralis minor**, from the 3rd 4th and 5th ribs, and the intercostal aponeurosis,—into the coracoid process of the scapula. *Action*, to depress the point of the shoulder, also to elevate the ribs in forced inspiration. *Nerves*, anterior thoracic.

**Subclavius**, from the cartilage of the 1st rib,—into the under surface of the clavicle, in a groove about its middle third. *Action*, to draw the clavicle downwards. *Nerve*, a branch from the 5th and 6th cervical.

**Serratus magnus**, by 9 digitations from the 8 upper ribs (the 2nd rib having two) and from the intercostal aponeurosis,—into the whole length of the inner margin of the posterior border of the scapula. *Action*, to elevate the ribs in inspiration, also to raise the point of the shoulder. In lower animals the great sling-muscle, slinging the body between the upper extremities. *Nerve*, posterior thoracic.

**Deltoid**, from the outer one-third of the anterior and superior surfaces of the clavicle, the outer margin and upper surface of the acromion, and the whole lower border of the spine of the scapula,—into a prominence on the outer side of the shaft of the humerus, about its middle. *Action*, to raise the arm. *Nerve*, circumflex.

**Subscapularis**, from the inner two-thirds of the subscapular fossa,—into the lesser tuberosity of the humerus. *Action*, to rotate the head of the humerus inwards. *Nerves*, subscapular.

**Supra-spinatus**, from the inner two-thirds of the supra-spinous fossa,—into the upper facet of the greater tuberosity of the humerus. *Action*, to support the shoulder-joint, and to raise the arm. *Nerve*, supra-scapular.

**Infra-spinatus**, from the inner two-thirds of the infra-spinous fossa,—into the middle facet on the greater tuberosity of the humerus. *Action*, to rotate the humerus outwards. *Nerve*, supra-scapular.

**Teres minor**, from the upper two-thirds of the dorsal surface of the axillary border of the scapula,—into the lowest facet on the greater tuberosity of the humerus, and the bone below. *Action*, to rotate the humerus outwards. *Nerve*, circumflex.

**Teres major**, from the dorsal aspect of the inferior angle of the scapula,—into the internal bicipital ridge of the humerus. *Action*, to assist the latissimus dorsi. *Nerve*, subscapular.

**Coraco-brachialis**,<sup>11</sup> from the apex of the coracoid process<sup>2</sup> of the scapula,—into a ridge on the inner side of the shaft of the humerus, about its middle. *Action*, elevates the humerus forwards and inwards. *Nerve*, musculo-cutaneous, which perforates this muscle.

FIG. 44.



**Biceps**<sup>15</sup> (BICEPS FLEXOR CUBITI). *Long head*<sup>8</sup> from the upper margin of the glenoid cavity, *short head*<sup>12</sup> from the apex of the coracoid process,<sup>2</sup> in common with the coraco-brachialis,—into the back of the tuberosity of the radius, and the fascia of the forearm.<sup>20</sup> *Action*, to flex and supinate the forearm, and to make tense its fascia. *Nerve*, the musculo-cutaneous.

**Brachialis anti'cus**,<sup>17</sup> from the lower half of the shaft of the humerus anteriorly and laterally, embracing the insertion of the deltoid,<sup>9</sup>—into the base of the coronoid process of the ulna.<sup>19</sup> *Action*, a flexor of the forearm. *Nerves*, musculo-cutaneous and musculo-spiral.

**Triceps**<sup>16</sup> (TRICEPS EXTENSOR CUBITI), by three heads, *the outer and inner* from the posterior surface of the shaft of the humerus, the outer above, the inner below the musculo-spiral groove; the *middle or long head* from a depression below the glenoid cavity of the scapula,—into the upper end of the olecranon process of the ulna. *Action*, to extend the forearm. *Nerve*, musculo-spiral.

**Subanconeus**, from the humerus above the olecranon fossa,—into the posterior ligament of the elbow-joint. *Action*, probably a tensor of the ligament. *Nerve*, musculo-spiral.

## MUSCLES OF THE FOREARM.

Muscles of the forearm (20), arranged in groups of five and threes. (Pancoast.)

ANTERIORLY, 5 flexors, 2 pronators, 1 tensor of palmar fascia:—

<i>Flexor carpi radialis.</i>	<i>Pronator radii teres.</i>
<i>Flexor carpi ulnaris.</i>	<i>Pronator quadratus.</i>
<i>Flexor longus pollicis.</i>	<i>Palmaris longus.</i>
<i>Flexor sublimis digitorum perforatus manis.</i>	
<i>Flexor profundus digitorum perforans manis.</i>	

POSTERIORLY (12), in 4 sets of threes:—

<i>Supinator longus.</i>	<i>Extensor indicis.</i>
<i>Extensor carpi radialis longior.</i>	<i>Extensor communis digitorum.</i>
<i>Extensor carpi radialis brevior.</i>	<i>Extensor minimi digiti.</i>
<i>Extensor ossis metacarpi pollicis.</i>	<i>Extensor carpi ulnaris.</i>
<i>Extensor primi internodii pollicis.</i>	<i>Anconeus.</i>
<i>Extensor secundi internodii pollicis.</i>	<i>Supinator brevis.</i>

**Pronator radii teres**,<sup>4</sup> by two heads, one from above the internal condyle of the humerus, the common tendon, fascia and the intermuscular septum; the other from the inner side of the coronoid process of the ulna,—into a rough ridge on the outer side of the shaft of the radius, about its middle. *Action*, to pronate the hand. *Nerve*, median, which passes between the two heads of the muscle.

**Flexor carpi radialis**,<sup>5</sup> from the internal condyle by the common tendon, the fascia, and intermuscular septa,—into the base of the metacarpal bone of the index finger. *Action*, to flex the wrist. *Nerve*, median.

**Palmaris longus**,<sup>6</sup> from the same origin as the flexor carpi radialis,—into the annular ligament and the palmar fascia.<sup>9</sup> *Action*, to make the palmar fascia tense. *Nerve*, median.

**Flexor carpi ulnaris**,<sup>8</sup> by two heads, one from the internal condyle by the common tendon, the other from the inner margin of the olecranon, the upper two-thirds of the posterior border of the ulna, and the intermuscular septum,—into the pisiform bone, the annular ligament, and the base of the 5th metacarpal bone. *Action*, to flex the wrist. *Nerve*, ulnar.

**Flexor sublimis digitorum** (perforatus),<sup>7</sup> by three heads, one from the inner condyle by the common tendon, the internal lateral ligament, and the intermuscular septum; the 2nd from the inner side of the coronoid process; the 3rd from the oblique line of the radius,—into the lateral margins of the

FIG. 45.



second phalanges by 4 tendons which are split for the passage of the deep flexor tendons. *Action*, to flex the second phalanges. *Nerve*, median.

**Flexor profundus digitorum** (perforans), from the upper two-thirds of the shaft of the ulna, a depression on the inner side of the coronoid process, and the interosseous membrane,—into the bases of the last phalanges, by 4 tendons which perforate the tendons of the superficial flexor. *Action*, to flex the phalanges. *Nerves*, ulnar, and anterior interosseous.

**Flexor longus pollicis**, from the upper two-thirds of the shaft of the radius, and the interosseous membrane,—into the base of the last phalanx of the thumb, which it flexes. *Nerve*, anterior interosseous.

**Pronator quadratus**, from the oblique line on the lower one-fourth of the ulna, and the internal body of the ulna,—into the lower one-fourth of the external border of the shaft of the radius. *Action*, to pronate the hand. *Nerve*, anterior interosseous.

**Supinator longus**,<sup>13</sup> from the upper two-thirds of the external condyloid ridge on the humerus, and the intermuscular septum,—into the base of the styloid process of the radius. *Action*, to supinate the hand. *Nerve*, musculo-spiral.

**Extensor carpi radialis longior**,<sup>e</sup> from the lower one-third of the external condyloid ridge on the humerus, and the intermuscular septum,—into the base of the metacarpal bone of the index finger, <sup>g</sup> on its radial side. *Action*, to extend the wrist. *Nerve*, musculo-spiral.

**Extensor carpi radialis brevior**,<sup>f</sup> from the external condyle by the common tendon, the external lateral ligament, and the intermuscular septa,—into the radial side of the base of the 3rd metacarpal bone. <sup>g</sup> *Action*, to extend the wrist. *Nerve*, posterior interosseous.

**Extensor communis digitorum**,<sup>h</sup> from the external condyle by the common tendon, the deep fascia, and the intermuscular septa,—into the 2d and 3d phalanges of all the fingers, by 3 tendons, one of which divides into two. *Action*, to extend the fingers. *Nerve*, posterior interosseous.

**Extensor minimi digiti,**<sup>i</sup> from the common tendon and the intermuscular septa,—into the 2d and 3d phalanges of the little finger, with the tendon derived from the common extensor. *Action*, as named. *Nerve*, posterior interosseous.

**Extensor carpi ulnaris,**<sup>j</sup> from the common tendon, the middle one-third of the posterior border of the ulna, and the fascia of the forearm,—into the base of the 5th metacarpal bone. *Action*, to extend the wrist. *Nerve*, posterior interosseous.

**Anconeus,**<sup>k</sup> from the external condyle of the humerus, posteriorly,—into the side of the olecranon, and upper one-third of the posterior surface of the shaft of the ulna. *Action*, to extend the forearm. *Nerve*, the musculo-spiral.

**Supinator brevis,** from the external condyle of the humerus, the external lateral and orbicular ligaments, and an oblique line on the ulna,—into the inner surface of the neck of the radius, the outer edge of its bicipital tuberosity, and the oblique line. *Action*, to supinate the hand. *Nerve*, posterior interosseous, which pierces it.

**Extensor ossis metacarpi pollicis,**<sup>l</sup> from the posterior surfaces of the shafts of the radius and ulna, and the interosseous ligament,—into the base of the metacarpal bone of the thumb. *Action*, to extend the thumb. *Nerve*, posterior interosseous.

**Extensor primi internodii pollicis,**<sup>n</sup> from the posterior surface of the shaft of the radius and the interosseous membrane,—into the base of the 1st phalanx of the thumb. *Action*, to extend the thumb. *Nerve*, posterior interosseous.

**Extensor secundi internodii pollicis,**<sup>m</sup> from the shaft of the ulna posteriorly and the interosseous membrane,—into the base of the last phalanx of the thumb. *Action*, to extend the thumb. *Nerve*, posterior interosseous.

**Extensor indicis,** from the shaft of the ulna posteriorly and the interosseous membrane,—into the 2d and 3d phalanges of the index finger with the tendon of the common extensor. *Action*, to extend the index finger. *Nerve*, posterior interosseous.

FIG. 46.



## FASCIÆ OF THE HAND.

**ANTERIOR ANNULAR LIGAMENT**, *from* the pisiform and unciform bones,—*to* the tuberosity of the scaphoid and the ridge on the trapezium. It is pierced by the tendon of the flexor carpi radialis, and beneath it pass the tendons of the superficial and deep flexors and the flexor longus pollicis, also the median nerve. It is continuous with the palmar fascia and the fascia of the forearm.

**POSTERIOR ANNULAR LIGAMENT**, *from* the ulna, cuneiform, and pisiform bones and the palmar fascia,—*to* the margin of the radius and the ridges on its posterior surface. It has 6 canals for the passage of the extensor tendons, each lined by a synovial membrane. It is continuous with the fascia of the forearm.

**PALMAR FASCIA**, ensheathes the muscles of the hand, and divides into slips for the four fingers, each slip dividing and forming tendinous arches for the passage of the flexor tendons.

## MUSCLES OF THE HAND.

**Abductor pollicis**,<sup>11</sup> *from* the ridge of the trapezium and annular ligament,—*into* the radial side of the base of the 1st phalanx of the thumb. *Action*, to draw the thumb from the median line. *Nerve*, median.

**Opponens pollicis**, *from* the palmar surface of the trapezium and annular ligament,—*into* the radial side of the metacarpal bone of the thumb, for its whole length. *Action*, as a flexor ossis metacarpi pollicis. *Nerve*, median.

**Flexor brevis pollicis**,<sup>12</sup> *from* the trapezium, annular ligament, trapezoid, os magnum, base of the 3rd metacarpal, and the sheath of the tendon of the flexor carpi radialis,—*into* both sides of the base of the 1st phalanx of the thumb, by two tendons, each of which has a sesamoid bone in it. *Action*, to flex the thumb. *Nerves*, median and ulnar.

**Adductor pollicis**, *from* the whole palmar surface of the 3rd metacarpal bone,—*into* the ulnar side of the base of the 1st phalanx of the thumb, and the internal sesamoid bone. *Action*, to draw the thumb towards the median line. *Nerve*, ulnar.

*Thenar eminence*, or ball of the thumb, is formed by the above-named 4 muscles. The following first 4 form the *hypo-thenar eminence*.

**Palmaris brevis**,<sup>10</sup> *from* the annular ligament and palmar fascia,—*into* the skin on the inner border of the palm of the hand. *Action*, to corrugate the skin of the hand. *Nerve*, ulnar.

**Abductor minimi digiti**, *from* the pisiform bone and the tendon of the flexor carpi ulnaris,—*into* the ulnar side of the base of the 1st phalanx of the little finger. *Action*, as named. *Nerve*, ulnar.

- Flexor brevis minimi digiti**, from the tip of the unciform process and the annular ligament,—into the base of the 1st phalanx of the little finger, with the preceding muscle. *Action*, as named. *Nerve*, ulnar.
- Opponens minimi digiti**, from the unciform process and annular ligament,—into the whole ulnar margin of the 5th metacarpal bone. *Action*, a flexor of the 5th metacarpal bone. *Nerve*, ulnar.
- Lumbricales** (4), from the tendons of the deep flexor,—into the expanded tendons of the common extensor, on the dorsi of the phalanges. *Action*, probably to flex the 1st phalanges. *Nerves*, median and ulnar.
- Dorsal interossei** (4), by two heads from the adjacent sides of the metacarpal bones,—into the bases of the 1st phalanges of the index, middle and ring fingers, the middle finger having two. *Action*, abductors of the fingers from the median line. *Nerve*, ulnar.
- Palmar interossei** (3), from the palmar surfaces of the 2nd 4th and 5th metacarpal bones,—into the bases of the 1st phalanges of the same fingers. *Action*, adductors of the fingers. *Nerve*, ulnar.

## MUSCLES OF THE HIP AND THIGH.

- Psoas magnus**,<sup>11</sup> from the bodies, transverse processes, and intervertebral substances of the last dorsal and all the lumbar vertebræ,—into the lesser trochanter of the femur, by a common tendon with the iliacus. *Action*, to flex and rotate the femur outwards, also to flex the trunk and pelvis on the thigh. *Nerves*, anterior lumbar branches.
- Psoas parvus**, from the bodies of the last dorsal and first lumbar vertebræ, and the intervertebral substance,—into the ilio-pectineal eminence, and the iliac fascia. *Action*, when present it is a tensor of the iliac fascia. *Nerves*, anterior lumbar branches.
- Iliacus**,<sup>10</sup> from the iliac fossa, inner margin of the iliac crest, ilio-lumbar ligament, base of the sacrum, anterior spinous processes of the ilium and the notch between them, and from the capsule of the hip-joint,—into the outer side of the tendon of the psoas magnus. *Action*, the same as the psoas magnus. *Nerve*, anterior crural.
- FASCIA LATA**, the deep fascia of the thigh, extends from Poupart's ligament to the prominent points around the knee-joint, and from the margin of the sacrum and coccyx around the limb to the pubic arch and pectineal line. It sends two strong intermuscular septa down to the linea aspera, and contains the *saphenous opening*, which is formed by the reflected margins of its pubic and iliac portions. *Poupart's ligament* is made by the knife, and is only the line of junction between the aponeurosis of the external oblique

FIG. 47.



muscle and the fascia lata; extending from the anterior superior spine of the ilium to the spine of the pubic bone.

**Tensor vaginæ femoris**,<sup>4</sup> from the anterior part of the outer lip of the iliac crest, and the anterior superior spinous process,—into the fascia lata laterally, for one-fourth down the thigh. *Action*, a tensor of the fascia lata. *Nerve*, superior gluteal.

**Sartorius**,<sup>5</sup> from the anterior superior spine of the ilium<sup>2</sup> and half of the notch below it,—into the upper internal surface of the shaft of the tibia. *Action*, to flex and cross the legs. *Nerve*, anterior crural.

**Quadriceps extensor**, includes the rectus, vastus internus and externus, and the crureus muscles. Its tendon contains the patella.

**Rectus femoris**,<sup>6</sup> by two tendons, *the straight* from the anterior inferior spine of the ilium, *the reflected* from a groove above the brim of the acetabulum,—into the tuberosity of the tibia by the tendon<sup>9</sup> common to this and the next three muscles. *Action*, to extend the leg. *Nerve*, anterior crural.

**Vastus externus**,<sup>7</sup> from the anterior border of the great trochanter and the whole length of the linea aspera,—into the tuberosity of the tibia, by the common tendon.

**Vastus internus**<sup>8</sup> and **Crureus**, are one muscle, arising from the inner lip of the linea aspera and nearly the whole of the shaft of the femur in front and laterally from the trochanters down to within the lower one-fourth of the bone,—into the tuberosity of the tibia by the common extensor tendon. *Action*, to extend the leg. *Nerve*, anterior crural.

**Subcrureus**, from the lower part of the femur anteriorly,—into the synovial pouch behind the patella. *Action*, to draw up the synovial sac. *Nerve*, anterior crural.

**Gracilis**,<sup>15</sup> from the inner margin of the rami of the pubes and ischium,—into the inner surface of the shaft of the tibia below the tuberosity. *Action*, to flex and adduct the leg. *Nerve*, obturator.

**Pectineus**,<sup>12</sup> from the ilio-pectineal line, and the bone in front thereof, also from an expansion of Gimbernat's ligament,—into the rough line extending

from the trochanter minor to the linea aspera. *Action*, to flex the thigh and rotate it outwards. *Nerves*, obturator, accessory obturator, and anterior crural.

**Adductor longus**,<sup>13</sup> from the front of the pubes,—into the middle third of the linea aspera. *Action*, to adduct the thigh, and flex it. *Nerve*, obturator.

**Adductor brevis**, from the descending ramus of the pubes,—into the upper part of the linea aspera. *Action*, to adduct and flex the thigh. *Nerve*, obturator.

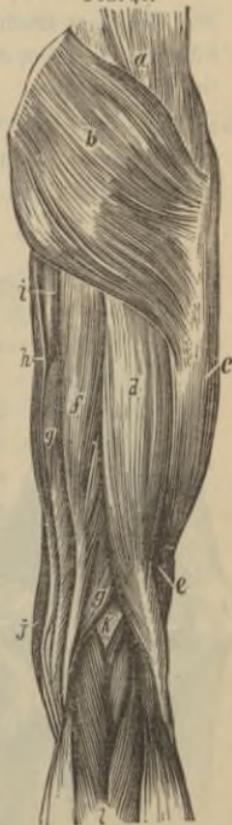
**Adductor magnus**,<sup>14</sup> from the rami of the pubes and ischium, and the outer margin and under surface of the tuberosity of the ischium,—into the rough line leading from the great trochanter to the linea aspera, the whole length of the linea aspera, and by a tendon into the tubercle above the inner condyle of the femur. *Action*, to adduct the thigh and rotate it outwards. *Nerves*, obturator and great sciatic. This muscle is pierced by 4 apertures for the 3 superior perforating and the profunda arteries, and about the lower one-third of its insertion an angular interval is left therein, the lower opening of Hunter's canal, for the passage of the femoral vessels into the popliteal space.

**Gluteus maximus**,<sup>b</sup> from the superior curved line of the ilium, the crest behind it, the last piece of the sacrum, the side of the coccyx and the great and posterior sacro-sciatic ligaments,—into the fascia lata and the rough line leading from the great trochanter to the linea aspera. *Action*, to extend and abduct the thigh and rotate it outwards, also to maintain the trunk erect. *Nerves*, inferior gluteal and a branch from the sacral plexus.

**Gluteus medius**,<sup>a</sup> from the ilium between the superior and middle curved lines, the crest between them and the fascia of the part,—into the oblique line on the great trochanter. *Action*, its posterior fibres rotate the thigh outwards, its anterior fibres rotate it inwards. It also abducts the thigh and draws it forwards, and assists to maintain the trunk erect. *Nerve*, superior gluteal.

**Gluteus minimus**,<sup>8</sup> from the ilium between the middle and inferior curved lines, and the margin of the great sacro-sciatic notch,—into the anterior

FIG. 48.



border of the great trochanter. *Action*, to rotate the thigh inwards, also to abduct and draw it forwards, and to maintain the trunk erect. *Nerve*, superior gluteal.

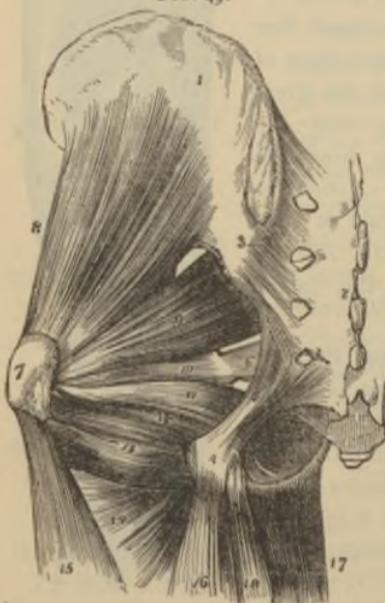
**Pyriformis**,<sup>9</sup> by 3 digitations from the front of the sacrum, from the margin of the great sacro-sciatic foramen and the great sacro-sciatic ligament,—into the upper border of the great trochanter,<sup>7</sup> having passed through the great sacro-sciatic foramen. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

**Obturator internus**,<sup>11</sup> from the posterior bony margin of the obturator foramen and the inner surface of the obturator membrane,—into the great trochanter,<sup>7</sup> passing through the lesser sacro-sciatic notch. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

**Gemellus superior**,<sup>10</sup> from the outer surface of the spine of the ischium,—into the great trochanter, being blended with the tendon of the obturator internus. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

**Gemellus inferior**,<sup>12</sup> from the tuberosity of the ischium,—into the tendon of the obturator internus and the great trochanter. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

FIG. 49.



**Obturator externus**, from the anterior inner bony margin of the obturator foramen, and the inner two thirds of the anterior surface of the obturator membrane,—into the digital fossa of the femur at the inner base of the great trochanter. *Action*, an external rotator of the thigh. *Nerve*, obturator.

**Quadratus femoris**,<sup>13</sup> from the tuberosity of the ischium,—into the upper part of the linea quadrati on the trochanter major posteriorly. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

**Biceps**,<sup>16</sup> by two heads, the *long head*<sup>d</sup> from the tuberosity of the ischium posteriorly, the *short head*<sup>e</sup> from the outer lip of the linea aspera, and the intermuscular septum,—into the outer side

of the head of the fibula; its tendon embracing the external lateral ligament of the knee-joint, and forming the *outer hamstring*, the tendons of the semi-

tendinosus, semi-membranosus, gracilis and sartorius, forming the *inner hamstring*. *Action*, to flex the leg and rotate it outwards. *Nerve*, great sciatic.

**Semi-tendinosus**, *f* from the tuberosity of the ischium by a tendon<sup>4</sup> common to it and the long head of the biceps, and from the adjacent aponeurosis,—into the shaft of the tibia at its upper and inner surface, its tendon curving around the inner tuberosity. *Action*, to flex the leg upon the thigh. *Nerve*, great sciatic.

**Semi-membranosus**, *s* from the tuberosity of the ischium above the origin of the above-named muscles,—into the inner tuberosity of the tibia; its tendon dividing into 3 parts, one over the popliteus muscle and another forming the posterior ligament of the knee-joint. *Action*, to flex the leg, and rotate it inwards. *Nerve*, great sciatic.

*External rotators of the hip-joint* are  $12\frac{1}{2}$ ,—the 3 adductors, pyriformis, 2 obturators, 2 gemelli, pectineus, psoas magnus, iliacus, sartorius, and posterior half of the gluteus medius.

*Internal rotators of the hip-joint* are  $2\frac{1}{2}$ ,—the tensor vaginae femoris, gluteus minimus, and the anterior half of the gluteus medius.

#### MUSCLES OF THE LEG.

Muscles of the leg arranged in groups of threes. (Pancoast.)

*Tibialis anticus.*

*Extensor proprius pollicis.*

*Extensor longus digitorum.*

*Gastrocnemius.*

*Soleus.*

*Plantaris.*

*Popliteus.*

*Tibialis posticus.*

*Flexor longus pollicis.*

*Flexor longus digitorum.*

*Peroneus longus.*

*Peroneus brevis.*

*Peroneus tertius.*

**Tibialis anti'cus**<sup>3</sup> (flexor tarsi tibialis), *from* the outer tuberosity and upper two-thirds of the shaft of the tibia externally, the interosseous membrane, deep fascia, and intermuscular septum,—through the inner canal in the anterior annular ligament *into* the inner and plantar surface of the internal cuneiform bone, and the base of the 1st metatarsal. *Action*, to flex the tarsus on the leg, and elevate the inner border of the foot. *Nerve*, anterior tibial.

**Extensor proprius pollicis**,<sup>5</sup> *from* the middle two-fourths of the fibula anteriorly and the interosseous membrane,—through the 2d canal in the anterior annular ligament, *into* the base of the last phalanx of the great toe. *Action*, to extend that toe. *Nerve*, anterior tibial.

**Extensor longus digitorum**,<sup>4</sup> *from* the outer tuberosity of the tibia, the upper three-fourths of the shaft of the fibula anteriorly, interosseous membrane, deep fascia, and intermuscular septa,—*into* the 2d and 3d phalanges

FIG. 50.



of the four lesser toes, by 4 tendons which pass over the dorsum of the foot, from the outer canal in the anterior annular ligament. *Action*, to extend the lesser toes. *Nerve*, anterior tibial.

**Peroneus tertius,**<sup>6</sup> (*flexor tarsi fibularis*), from the outer lower one-fourth of the fibula, interosseous membrane and intermuscular septum,—into the base of the 5th metatarsal bone. This muscle is a part of the last-named, and passes through the same canal in the annular ligament. *Action*, to flex the tarsus. *Nerve*, anterior tibial.

**Gastrocnemius**, by two heads from the condyles of the femur, and the supra-condyloid ridges,—unites with the tendon of the soleus to form the *tendo Achillis*, into the posterior tuberosity of the os calcis. *Action*, to extend the foot. *Nerve*, internal popliteal.

**Soleus**, from the head and upper one-half of the shaft of the fibula posteriorly, the oblique line of the tibia, and the tendinous arch,—unites with the tendon of the gastrocnemius as the *tendo Achillis* (see above). *Action*, to extend the foot. *Nerve*, internal popliteal.

**Plantaris**, from the outer bifurcation of the linea aspera, and posterior ligament of the knee-joint, by a very long, delicate tendon,—into the posterior surface of the os calcis. *Action*, to extend the foot. *Nerve*, internal popliteal.

**Popliteus,**<sup>6</sup> from a depression on the external condyle of the femur, and the posterior ligament of the knee-joint,—into the inner two-thirds of the triangular surface on the shaft of the tibia posteriorly and above the oblique line. *Action*, to flex the leg. *Nerve*, internal popliteal.

**Flexor longus pollicis,**<sup>9</sup> from the lower two-thirds of the shaft of the fibula internally, the interosseous membrane, fascia, and intermuscular septum,—through grooves in the tibia, astragalus and os calcis into the base of the last phalanx of the great toe. *Action*, to flex the great toe. *Nerve*, posterior tibial.

**Flexor longus digitorum,**<sup>7</sup> from the shaft of the tibia posteriorly and below the oblique line, and the inter-muscular septum,—passes behind the inner malleolus in a groove<sup>13</sup> with the tibialis posticus,—into the bases of

the last phalanges of the lesser toes by 4 tendons which perforate the tendons of the flexor brevis digitorum. *Action*, to flex the phalanges and extend the foot. *Nerve*, posterior tibial.

**Tibialis posticus**,<sup>8</sup> by two processes between which pass the anterior tibial vessels, from the upper one-half of shaft of the tibia posteriorly, the upper two-thirds of the shaft of the fibula internally, the interosseous membrane, deep fascia, and intermuscular septa,—passes behind the inner malleolus in a groove<sup>13</sup> with the long flexor, into the tuberosity of the scaphoid and internal cuneiform bones. *Action*, to extend the tarsus, and invert the foot. *Nerve*, posterior tibial.

**Peroneus longus**,<sup>10</sup> from the head of the fibula and the upper two-thirds of its shaft externally, the deep fascia, and intermuscular septa,—passes behind the outer malleolus in a groove with the peroneus brevis, through a groove in the cuboid bone, to the outer side of the base of the 1st metatarsal bone. *Action*, to extend and evert the foot. *Nerve*, musculo-cutaneous.

**Peroneus brevis**,<sup>11</sup> from the middle one-third of the shaft of the fibula externally, and the intermuscular septa,—passes behind the external malleolus in a groove with the long peroneal, into the dorsum of the base of the 5th metatarsal bone. *Action*, to extend the foot. *Nerve*, musculo-cutaneous branch of external popliteal.

FIG. 51.



#### FASCIÆ OF THE FOOT.

**ANTERIOR ANNULAR LIGAMENT**, consists of vertical and horizontal portions, is attached to the lower ends of the fibula and tibia, the os calcis and the plantar fascia. It contains 5 sheaths lined by synovial membranes for the tendons of the extensor muscles, that of the extensor proprius pollicis passing beneath it, as also the anterior tibial vessels and nerve.

**INTERNAL ANNULAR LIGAMENT**, from the inner malleolus to the os calcis, converting 3 bony grooves into canals lined by synovial membranes for the flexor tendons and the posterior tibial vessels and nerve.

**EXTERNAL ANNULAR LIGAMENT**, from the outer malleolus to the os calcis, binding down the peronei tendons in one synovial sac.

**PLANTAR FASCIA**, the densest in the body, divided into a central and two lateral portions, and attached to the inner tuberosity of the os calcis, divides into 5 processes, one for each toe, and several intermuscular septa.

## MUSCLES OF THE FOOT.

**Extensor brevis digitorum**, the only muscle on the dorsum of the foot, arises from the os calcis externally, the astragalo-calcanean and the anterior annular ligaments,—by 4 tendons, one into the 1st phalanx of the great toe, and the others into the outer sides of the long extensor tendons of the 2d, 3d and 4th toes. *Action*, to extend the toes. *Nerve*, anterior tibial.

Muscles on the sole of the foot (19), by layers :—

1st Layer.	3rd Layer.	} Pancoast's Triangle, the lowest in the body.
<i>Flexor brevis digitorum.</i>	<i>Flexor brevis pollicis.</i>	
<i>Abductor pollicis.</i>	<i>Flexor brevis minimi digiti.</i>	
<i>Abductor minimi digiti.</i>	<i>Adductor pollicis.</i>	
2nd Layer.	<i>Transversus pedis.</i>	
<i>Flexor accessorius.</i>	4th Layer.	
<i>Lumbricales</i> (4).	<i>Interossei</i> , 4 dorsal, 3 plantar.	

**Abductor pollicis**,<sup>a</sup> from the inner tuberosity of the os calcis, the internal annular ligament, plantar fascia, and intermuscular septum,—into the inner side of the base of the 1st phalanx of the great toe. *Action*, to abduct the great toe. *Nerve*, internal plantar.

**Flexor brevis digitorum**,<sup>f</sup> from the inner tuberosity of the os calcis, the plantar fascia and intermuscular septa,—into the sides of the 2nd phalanges of the lesser toes by 4 tendons which are perforated for the long flexor tendons. *Action*, to flex the lesser toes. *Nerve*, internal plantar.

FIG. 52.



**Abductor minimi digiti**,<sup>h</sup> from the outer tuberosity and under surface of the os calcis, the plantar fascia and the intermuscular septum,—into the base of the 1st phalanx of the little toe with the tendon of its short flexor. *Action*, to abduct the little toe. *Nerve*, external plantar.

**Flexor accessorius**, by two heads, from the os calcis and the calcaneo-scapoid and long plantar ligaments,—into the tendon of the flexor longus digitorum. *Action*, accessory flexor of the toes. *Nerve*, external plantar.

**Lumbricales** (4), from the long flexor tendons—into the inner side of the second phalanges of the lesser toes. *Action*, accessory flexors. *Nerves*, internal plantar to the two internal, external plantar to the others.

**Flexor brevis pollicis,**<sup>c</sup> *from* the cuboid and external cuneiform bones, and the prolonged tendon of the tibialis posticus,—*into* both sides of the base of the 1st phalanx of the great toe, by 2 portions, of which one blends with the abductor pollicis, the other with the adductor pollicis. *Action*, to flex the great toe. *Nerve*, internal plantar.

**Adductor pollicis,** *from* the tarsal ends of the three middle metatarsal bones, and the sheath of the tendon of the peroneus longus,—*into* the base of the 1st phalanx of the great toe, externally. *Action*, to adduct the great toe. *Nerve*, external plantar.

**Flexor brevis minimi digiti,**<sup>i</sup> *from* the base of the 5th metacarpal bone and the sheath of the tendon of the peroneus longus,—*into* the base of the 1st phalanx of the little toe externally. *Action*, to flex the little toe. *Nerve*, external plantar.

**Transversus pedis,** *from* the under surface of the head of the 5th metatarsal bone, and the transverse ligament of the metatarsus,—*into* the outer side of the 1st phalanx of the great toe, blending with the tendon of the adductor pollicis. *Action*, to adduct the great toe. *Nerve*, external plantar.

**Dorsal interossei** (4), each by two heads *from* the adjacent sides of two metatarsal bones,—*into* the base of the 1st phalanx of the corresponding toe. *Action*, to abduct the toes. *Nerve*, external plantar.

**Plantar interossei** (3), *from* the shafts of the 3d, 4th and 5th metatarsal bones,—*into* the bases of the 1st phalanges of the same toes. *Action*, to adduct the toes towards the median line. *Nerve*, external plantar.

## THE HEART.

**What is the Pericardium?** It is a conical membranous closed sac, containing the heart and the roots of the great vessels. It lies behind the sternum and between the pleuræ, its apex upwards, its base below and attached to the central tendon of the diaphragm. It is composed of an outer fibrous coat, and an inner serous one; the latter consisting of two portions, a parietal layer, lining the inner surface of the fibrous coat, and a visceral layer, which is reflected over the heart and vessels. The serous portion secretes a thin fluid, about one drachm in quantity normally, for the lubrication of its surfaces. The fibrous coat is prolonged on the outer surfaces of the great vessels, except the inferior vena cava, and becomes continuous with the deep layer of the cervical fascia.

**Describe the Endocardium.** It is a serous membrane which lines the inner surface of the heart, forming by its reduplications the cardiac, aortic and pulmonary valves, and continuous with the lining membrane of the great vessels.

**Describe the Heart.** It is a hollow muscular organ, conoidal in shape, placed obliquely in the chest between the lungs, base upwards, apex towards the left and front corresponding to the interspace between the 5th and 6th costal cartilages, one inch inside of and two inches below the left nipple. In the adult its size is about 5 inches by  $3\frac{1}{2}$  by  $2\frac{1}{2}$ , and from 8 to 12 oz. in weight.

**What are the cavities of the Heart?** They are four in number, an auricle and a ventricle on each side of the heart, separated by a longitudinal muscular septum, and indicated on the external surface of the organ by grooves, named from their contiguous cavities, as the *auriculo-ventricular groove*.

**Describe the Right Auricle.** It is larger than the left, can hold about 2 fluid ounces, its walls being about one line in thickness. It receives the venous blood by the superior and inferior venæ cavæ and the coronary sinus, and presents interiorly the following points for examination:—

*Appendix auriculæ*, a conical pouch projecting from the auricle to the front and left, its margins being dentated.

*Openings* of the superior and inferior venæ cavæ and the coronary sinus, the latter having a valve in two segments.

*Foramina Thebesii*, several minute orifices, the mouths of veins from the substance of the heart.

*Tubercle of Lower*, a very small projection on the right wall, supposed to influence the direction of the blood-current.

*Eustachian valve*, at the anterior margin of the inferior vena cava; large in the foetus, to direct the blood to the foramen ovale.

*Fossa ovalis*, a depression on the inner wall, and the situation of the foramen ovale in the foetus.

*Annulus ovalis*, the oval margin of the fossa ovalis.

*Musculi pectinati*, muscular columns on the inner surface of the appendix and the inner wall of the auricle.

*Auriculo-ventricular opening*, communicates with the right ventricle, is oval, about an inch broad, surrounded by a fibrous ring, and is guarded by the tricuspid valve.

**Describe the Right Ventricle.** Its form is conical, its cavity containing about 2 fluid ounces, its apex above the apex of the heart, and it presents interiorly the following: viz.—

*Tricuspid valve*, consists of 3 triangular segments connected by their bases with the auriculo-ventricular orifice, and by their sides with each other, the largest being on the left side.

*Chordæ tendinæ*, delicate tendinous cords which connect the margins and lower surfaces of the tricuspid valve with the columnæ.

*Columnæ carneæ*, muscular columns projecting from the surface of the ventricle, of which 3 or 4, called *columnæ papillares*, give attachment to the *chordæ tendinæ*.

*Semilunar valves*, are 3 in number, and guard the orifice of the pulmonary artery, each about the middle of its free margin has a fibro-cartilaginous nodule, the *Corpus Arantii*, which more perfectly closes the orifice.

*Opening of the pulmonary artery*, at the superior and internal angle of the ventricle, the *conus arteriosus*. It is circular in form, surrounded by a fibrous ring, and is guarded by the semilunar valves.

*Sinuses of Valsalva*, are 3 pouches, one behind each valve, between it and the commencement of the pulmonary artery.

**Describe the Left Auricle.** Its walls are about one line and a half in thickness, its capacity rather less than 2 fluid ounces, has an appendix auriculæ, and receives the arterialized blood from the lungs. It presents the following internally:—

*Openings of the pulmonary veins*, are 4 in number, sometimes 3, as the two left veins frequently end in a common opening.

*Left auriculo ventricular opening*, is smaller than the right one.

*Musculi pectinati*, on the inner surface of the appendix.

*Depression*, corresponding to the fossa ovalis in the right auricle.

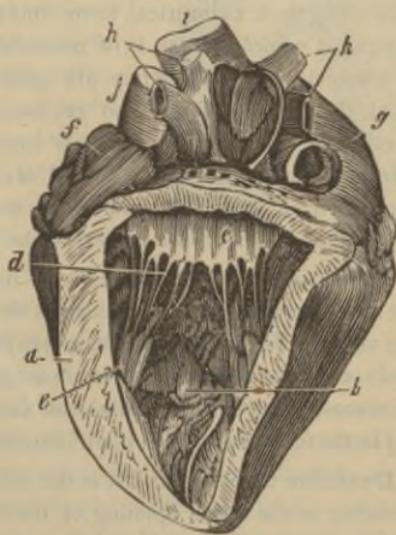
**Describe the Left Ventricle.**

It is longer, thicker, and more conical than the right, projecting towards the posterior aspect. Its walls *a* are the thickest of those in the heart, being twice as thick as those of the right ventricle. Its interior presents the following:—

*Aortic opening*, is small and circular, placed in front and to the right of the auriculo-ventricular, a segment of the mitral valve being between them. It is surrounded by a fibrous ring, and guarded by semi-lunar valves.

*Mitral valve*, *c* consists of two unequal-sized segments, and is attached to the fibrous ring which surrounds the auriculo ventricular opening. Its margins are connected with the ventricular walls by *chordæ tendinæ* *d* and *musculi papillares*.

FIG. 53.



*Semilunar valves*, guard the aortic orifice, and are larger and stronger than those on the right side.

*Sinus aortici*, or sinus of Valsalva, a pouch between each valve and the beginning of the aorta.

*Columnæ carneaë*,<sup>e</sup> are smaller and more numerous than on the right side; the *musculi papillares* are but two in number.

**Describe the structure of the Heart?** The muscular fibres take origin from the four fibrous rings at the auriculo-ventricular and aortic openings. The fibres of the auricles are arranged in two layers, a superficial and a deep one, the latter having looped fibres and annular fibres. In the ventricles the fibres are superficial and deep, the latter being arranged circularly, the former spirally, coiling inwards at the apex of the heart into a whorl-like form, the *vortex*.

### THE ARTERIES.

**What are the Arteries?** Cylindrical vessels which carry arterial blood to the body from the heart. Those going to the lungs with the returning veins, form the *lesser or pulmonic circulation*. The aorta with its branches and the returning veins, constitute the *greater or systemic circulation*. The arteries anastomose or communicate freely with each other everywhere throughout the body, permitting the establishment of collateral circulations.

**Describe the structure of the Arteries.** They are dense, very elastic, preserving their cylindrical form, and are composed of 3 coats, *an internal* or serous; *a middle*, which is of muscular and elastic tissue; and *an external*, of connective tissue. They are generally included in a fibro-areolar investment, the *sheath*, which also encloses the accompanying veins. The larger arteries are nourished by the *vasa vasorum*, blood-vessels which ramify in the external and middle coats; and are supplied with nerves, the *vaso-motor*, derived from both the sympathetic and cerebro-spinal systems, and forming intricate plexuses on the larger trunks.

**What are the Capillaries?** Minute vessels forming a network throughout the tissues of the body between the terminating arteries and the commencing veins. Their average diameter is about the  $\frac{1}{30000}$  of an inch, and their walls consist of a transparent homogeneous membrane continuous with the innermost layer of the arterial and venous walls.

[In the following pages, main branches are in italics, sub-branches in Roman.]

**Describe the Aorta.** It is the main trunk of the systemic arteries, commencing at the aortic opening of the left ventricle of the heart, arching backwards over the roof of the left lung into the thorax, where it descends on the left of the spinal column, and after passing through the aortic opening in the diaphragm, it terminates in the right and left common iliac arteries opposite

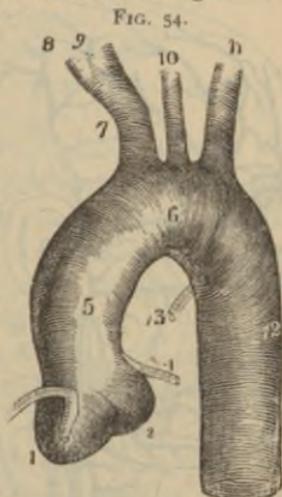
the 4th lumbar vertebra. It is divided into the arch, the thoracic aorta, and the abdominal aorta; and the arch is sub-divided into the ascending,<sup>5</sup> transverse,<sup>6</sup> and descending<sup>12</sup> portions. The upper border of the arch is generally situated about an inch below the upper margin of the sternum. The branches of the aorta are,—

- |                      |                          |                                    |
|----------------------|--------------------------|------------------------------------|
| From the Arch,—      | 2 Coronary. <sup>4</sup> | Left common carotid. <sup>10</sup> |
|                      | Innominate, <sup>7</sup> | Left subclavian. <sup>11</sup>     |
| From the Thoracic,—  | Pericardiac.             | Œsophageal.                        |
|                      | Bronchial.               | 20 Intercostals.                   |
|                      |                          | Posterior mediastinal.             |
| From the Abdominal,— | 2 Phrenic.               | 2 Spermatic.                       |
|                      | Celiac axis.             | Inferior mesenteric.               |
|                      |                          | 8 Lumbar.                          |
|                      | Superior mesenteric.     | Sacra media.                       |
|                      | 2 Supra-renal.           | 2 Common iliac.                    |

**Describe the Coronary arteries.** They are two in number, a right and a left,<sup>4</sup> arise from the aorta behind the semilunar valves and run in the vertical grooves of the heart, the left artery in front, to supply the tissue of that organ.

**Describe the Innominate.**<sup>7</sup> It arises from the summit of the arch of the aorta, is  $1\frac{1}{2}$  inch long, and divides behind the right sterno-clavicular joint into the *right common carotid*<sup>9</sup> and *right subclavian*,<sup>8</sup> these arteries on the left side of the body arising directly from the arch of the aorta.<sup>10 11</sup> It sometimes sends off a *middle thyroid* (artery of Neibauhr) which may arise directly from the arch of the aorta. The innominate is sometimes absent, and not infrequently varies in length from an inch to two or more.

**Describe the Common Carotid.** Arising differently (see above), the two carotids are similarly described, except that the left is longer and deeper than the right one. Their course is indicated by a line drawn from a point midway between the angle of the lower jaw and the mastoid process to the sterno-clavicular articulation. At the lower part of the neck they are separated only by the width of the trachea, and they are each contained in a sheath of the deep cervical fascia with the internal jugular vein externally and the pneumogastric nerve between the artery and vein. On the front of the sheath lies the *descendens noni* nerve (descending branch of the 9th or hypoglossal). The artery lies beneath the inner border of the sterno-cleido-mastoid muscle, and is crossed about its middle by the omo-hyoid muscle and the middle thyroid vein.



It is also crossed *above* by the facial, lingual, and superior thyroid veins, *below* by the anterior jugular vein, and on the left side often by the internal jugular vein. It bifurcates, at the level of the upper border of the thyroid cartilage, into the *external and internal carotids*, of which the internal is the most remote from the median line.

Name the branches and sub-branches of the External Carotid artery.<sup>2</sup> (Fig. 55.) It has 8 branches, as follows, viz.—

*Superior thyroid*,<sup>4</sup> arising below the greater cornu of the hyoid bone.

Muscular. Hyoid. Superior laryngeal.

Glandular. Superficial descending. Crico-thyroid.

*Lingual*,<sup>5</sup> under the hyo-glossus muscle to the tongue.

Hyoid, Dorsalis linguæ. Sublingual. Ranine.

FIG. 55.

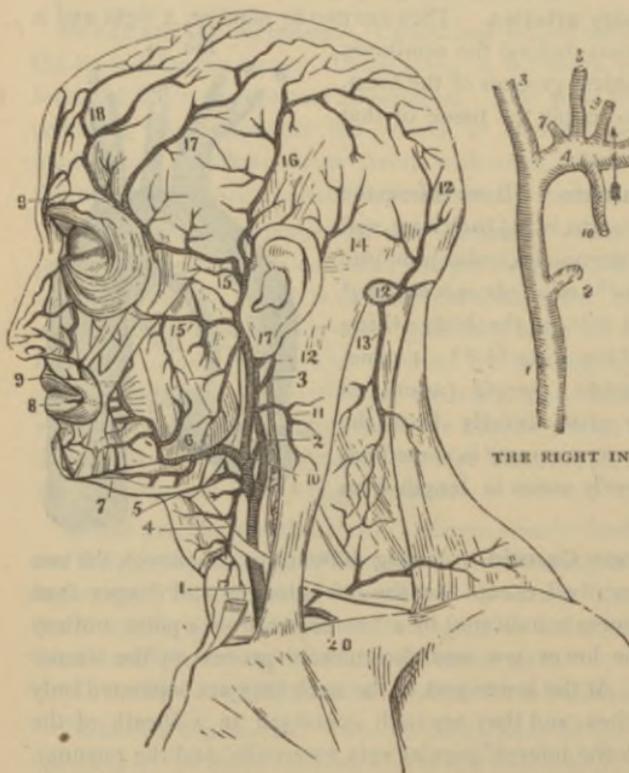
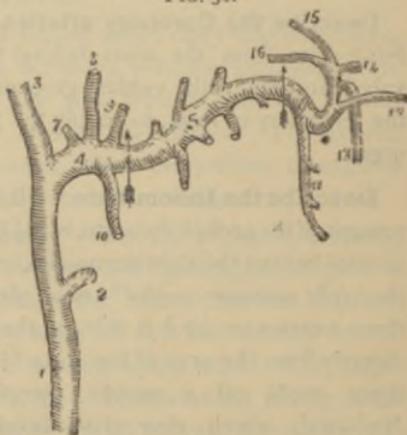


FIG. 56.



THE RIGHT INTERNAL MAXILLARY ARTERY.

*Facial*,<sup>6</sup> crosses the lower jaw at the anterior angle of the masseter.

Ascending palatine.

Submental.<sup>7</sup>

2 Coronary.<sup>8 9</sup>

Tonsillar.

Muscular.

Lateralis nasi.

Submaxillary.

Inferior labial.

Angular.

*Occipital*,<sup>10</sup> lies in the occipital groove of the temporal bone.

Muscular.	Inferior meningeal.	Cranial branches, over
Auricular.	Arteria princeps cervicis. <sup>13</sup>	the occiput.

*Posterior auricular*,<sup>14</sup> ascends under cover of the parotid gland.

Stylo-mastoid.	Auricular.	Muscular.	Glandular.
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*Ascending pharyngeal*, lies on the rectus capitis anticus major.

External branches.	Pharyngeal and meningeal branches.
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*Temporal*,<sup>15</sup> the smallest of the termini of the external carotid, begins in the parotid gland, crosses the zygomatic arch, and divides into anterior<sup>18</sup> and posterior temporal.<sup>16</sup>

Transverse facial. <sup>15</sup>	Middle temporal. <sup>17</sup>	Anterior auricular.
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*Internal maxillary*,<sup>4</sup> the other terminal branch of the external carotid,<sup>1</sup> is divided into three portions, maxillary,<sup>4</sup> pterygoid,<sup>5</sup> and sphenomaxillary,<sup>6</sup> which respectively give off the following branches: (Fig. 56.)

Tympanic, <sup>7</sup> entering the Glaserian fissure.	Deep temporal, ant. and posterior.	Alveolar. <sup>11</sup>
Middle meningeal. <sup>8</sup>	Pterygoid branches.	Infra-orbital. <sup>12</sup>
Small meningeal. <sup>9</sup>	Masseteric.	Descending palatine. <sup>13</sup>
Inferior dental, <sup>10</sup> divides into Incisor and Mental.	Buccal, to the buccinator.	Vidian. <sup>16</sup>
		Pterygo-palatine. <sup>15</sup>
		Spheno-palatine or nasal. <sup>14</sup>

**Describe the Internal Carotid.** It ascends in front of the transverse processes of the three upper cervical vertebræ, and close to the tonsil, traverses the carotid canal in the temporal bone, and after piercing the dura mater by the anterior clinoid process, divides into its terminal branches.

*Tympanic*, enters the tympanum from the carotid canal, and anastomoses on the membrana tympani with the tympanic branch of the internal maxillary and the stylo-mastoid.

*Arteria receptaculi*, numerous small vessels going to the walls of the sinuses, the Casserian ganglion and the pituitary body; one of them, to the dura mater, is called the *anterior meningeal*.

*Ophthalmic*, arises from the cavernous portion, enters the orbit through the optic foramen, terminating at the inner angle of the eye into the frontal and nasal branches. It gives off,—

Lachrymal.	Short ciliary.	Anterior ethmoidal.
Arteria centralis retinae.	Anterior ciliary.	Palpebral.
Muscular branches.	Supraorbital.	Nasal.
Long ciliary.	Posterior ethmoidal.	Frontal.

*Anterior cerebral*, joined to its fellow by the anterior communicating branch, about two lines long.

*Middle cerebral*, in the fissure of Sylvius; divides into three branches, anterior, median, and posterior.

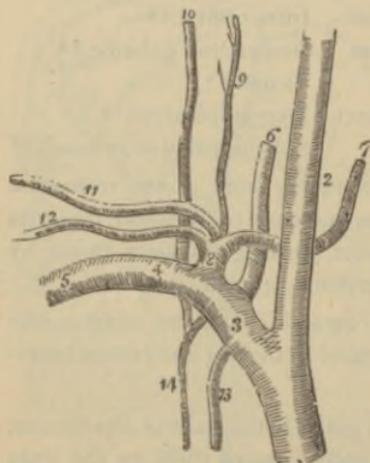
*Anterior choroid*, to the choroid plexus, corpus fimbriatum, etc.

*Posterior communicating*, anastomoses with the posterior cerebral, a branch of the basilar.

**What is the Circle of Willis?** An anastomosis at the base of the brain, between the branches of the internal carotid and vertebral arteries, to equalize the cerebral circulation. The two *vertebral* arteries join to form the *basilar*, which ends in two *posterior cerebral*. These are connected with the *internal carotid* by the two *posterior communicating*. The circle is completed by the connection of the two *anterior cerebral* branches of the internal carotid through the short *anterior communicating* artery.

**Describe the Subclavian.** It arises on the right side from the innominate, on the left side from the arch of the aorta,

FIG. 57.



and is divided into three portions by the scalenus anticus, which crosses it just external to the origin of the thyroid axis, viz.—the parts internal, behind, and external to that muscle. At the outer border of the 1st rib, the subclavian becomes the axillary artery. Its upper border is a little above the clavicle, and it is separated from the subclavian vein by the scalenus anticus at its origin from the 1st rib. Its branches are all given off from its first portion, except the *superior intercostal*, which on the right side arises from the second portion.

*Vertebral*,<sup>6</sup> passing up the neck, through the foramina in the transverse processes of six cervical vertebræ, and enters the skull by the foramen magnum, where it joins its fellow to form the *basilar*.

Lateral spinal branches.

Anterior spinal.

Muscular branches.

Posterior spinal.

Posterior meningeal.

Inferior cerebellar.

*The Basilar*, formed by the junction of the vertebrals, gives off on each side a transverse, anterior and superior cerebellar, and ends in the two posterior cerebral (*See Circle of Willis*).

THYROID AXIS,<sup>8</sup> at once divides into the three following branches.

*Inferior thyroid*,<sup>7</sup> to the thyroid gland, giving off,—

Laryngeal branch.	Œsophageal branches.
Tracheal branches.	Ascending cervical. <sup>9</sup>

*Transversalis colli*,<sup>11</sup> divides beneath the margin of the trapezius into—

Superficial cervical.	Posterior scapular.
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*Suprascapular*,<sup>12</sup> to the shoulder-joint and the dorsum of the scapula, anastomosing there with the posterior- and subscapular.

*Internal mammary*,<sup>13</sup> arises opposite the thyroid axis, descends upon the costal cartilages, and ends at the 6th interval, in the musculo-phrenic and superior epigastric, the latter anastomosing with the deep epigastric branch of the external iliac.

Comes nervi phrenici, or superior phrenic.	Pericardiac. Sternal.	Perforating. Musculo-phrenic.
Mediastinal.	Anterior intercostal.	Superior epigastric.

*Superior intercostal*,<sup>14</sup> gives off branches in the intercostal spaces to the posterior spinal muscles and to the spinal cord.

Profunda cervicis,<sup>10</sup> supplies the muscles of the back of the neck, and anastomoses with the arteria princeps cervicis of the occipital.

**Describe the Axillary.**<sup>5</sup> It is the continuation of the subclavian, extending from the edge of the 1st rib to the lower margin of the armpit muscles, where it becomes the brachial. It has 7 branches, viz.—

*Superior thoracic*, to the pectoral muscles and walls of the thorax.

*Acromial thoracic*, branches are thoracic, acromial, descending.

*Thoracica longa*, to the muscles of the chest and mammary gland.

*Thoracica alaris*, a small branch to the axillary glands.

*Subscapular*, to the inferior dorsum of the scapula. Its branches anastomose with the supra- and posterior scapular.

Subscapular.	Dorsalis scapulæ.	Median branch.
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*Posterior circumflex*, to the deltoid muscle and the shoulder-joint.

*Anterior circumflex*, to the joint and the head of the bone, anastomosing with the posterior circumflex and acromial thoracic.

**Describe the Brachial.** It is the continuation of the axillary from the lower margin of the teres major tendon to its bifurcation into the radial and ulnar, which is usually about one-half inch below the bend of the elbow. The median nerve crosses it from the outside to the inside at its centre.

*Superior profunda*, winds over the arm in the musculo-spiral groove, giving off the posterior articular to the elbow anastomosis.

*Nutrient branch*, enters the nutrient canal.

*Inferior profunda*, to the elbow-joint anastomosis.

*Anastomotica magna*, anastomoses with the posterior articular, inferior profunda, anterior and posterior ulnar recurrent.

*Muscular branches*, to the muscles in the course of the artery.

**Describe the Radial.** It extends from the bifurcation of the brachial to the deep palmar arch, and gives off the following branches respectively, in the forearm, the wrist, and the hand, viz.—

Radial recurrent.	Posterior carpal.	Princeps pollicis.
Muscular.	Metacarpal.	Radialis indicis.
Superficialis volæ.	Dorsales pollicis.	Perforantes.
Anterior carpal.	Dorsalis indicis.	Interosseeæ.

**Name the branches of the Ulnar.** It extends from the division of the brachial to the superficial palmar arch. It has 8 branches, viz.—

Anterior ulnar recurrent.	Muscular.	Deep or communicating
Posterior ulnar recurrent.	Anterior carpal.	branch.
Interosseous { Anterior.	Posterior carpal.	Digital.
{ Posterior.		

**Describe the Palmar Arches.** *The superficial palmar arch* is that part of the ulnar artery lying in the palm of the hand, and anastomosing with the superficialis volæ from the radial, and a branch from the radialis indicis, at the root of the thumb. It gives off 4 branches, the digital, to the sides of the fingers, except the inside of the index finger, which is supplied by the radialis indicis. *The deep palmar arch* is formed by the palmar portion of the radial artery anastomosing with the deep or communicating branch of the ulna. It gives off the radialis indicis, palmar interosseeæ, perforating and recurrent branches.

**Describe the Thoracic Aorta.** It begins on the left of the spine, at the lower border of the 3rd dorsal vertebra, and ends at the aortic opening in the diaphragm directly in front of the last dorsal vertebra. Its branches are as follows:—

*Pericardiac branches*, irregular in number and origin.

*Bronchial*, also vary in number and origin; generally one on the right side and two on the left. They nourish the lungs.

*Œsophageal*, four or five, anastomose on the œsophagus with branches of the inferior thyroid, phrenic, and gastric.

*Posterior mediastinal*, numerous small vessels.

*Intercostals*, usually 10 on each side, each dividing into an anterior and a posterior branch. The *anterior* divides again into two along the adjacent borders of the ribs, supplying the intercostal muscles and anastomosing with

branches of the internal mammary and axillary. The *posterior* divides into a spinal branch going to the vertebræ and the spinal cord, and a muscular to the muscles of the back.

FIG. 58.

**Describe the Abdominal Aorta.** It begins where the thoracic ends, and terminates at the 4th lumbar vertebra in the common iliacs. Its branches are as follows:—

**COELIAC AXIS,**<sup>2</sup> arises opposite the margin of the diaphragm, runs forwards for half an inch and divides into the gastric, hepatic, and splenic arteries, occasionally giving off one of the phrenics.

**Gastric,**<sup>3</sup> supplies the stomach along its lesser curvature, anastomosing with the aortic, œsophageal, splenic and hepatic branches.

**Hepatic,**<sup>4</sup> divides in the transverse fissure of the liver into the right and left branches, to the lobes of that organ; also the—

Pyloric.  
Cystic.

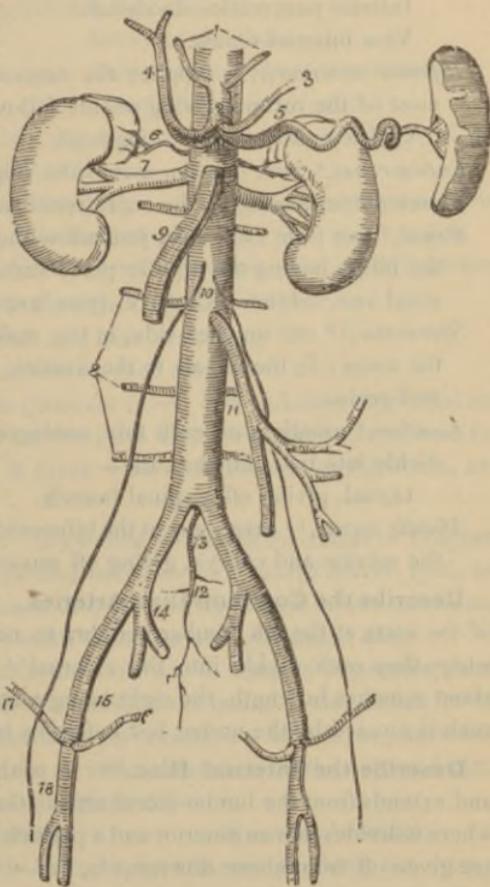
Gastro-duodenalis { Gastro-epiploica dextra.  
Pancreatico-duodenalis.

**Splenic,**<sup>5</sup> the largest branch of the cœliac axis, passes by a very tortuous course to the spleen, giving off the following:—

Pancreaticæ parvæ. Gastric (vasa brevia).  
Pancreatica magna. Gastro-epiploica sinistra.

**Phrenic,**<sup>1</sup> one on each side, but usually only one arises from the aorta, the other springing from either the cœliac axis or the renal artery. They go to the under surface of the diaphragm.

**Superior mesenteric,**<sup>9</sup> supplies the small intestine, cæcum, ascending and



transverse colon. Arising about one-fourth inch below the cœliac axis, it arches forwards, downwards and to the left, giving off—

Inferior pancreatico-duodenal.

Ileo-colic.

Vasa intestini tenuis.

Colica dextra and media.

*Inferior mesenteric*,<sup>11</sup> supplies the descending colon, sigmoid flexure, and most of the rectum, giving off the following branches:—

Colica sinistra.

Sigmoid.

Superior hemorrhoidal.

*Supra-renal*,<sup>6</sup> arise one on each side, opposite the origin of the superior mesenteric, passing to the supra-renal capsules.

*Renal*,<sup>7</sup> one from each side, just below the preceding, pass to the kidney, at the hilum having the middle place between the ureter in front and the renal vein behind. U. A. V. (you 'ave!)

*Spermatic*,<sup>10</sup> one on each side, in the male through the inguinal canal to the testes; in the female to the ovaries, uterus, and the skin of the labia and groins.

*Lumbar*,<sup>8</sup> usually 4 on each side, analogous to the intercostals. They each divide into two branches, the—

Dorsal, giving off a spinal branch.

Abdominal.

*Middle sacral*,<sup>12</sup> arises just at the bifurcation of the aorta; it descends along the sacrum and coccyx, giving off numerous branches.

**Describe the Common Iliac Arteries.** They extend from the bifurcation of the aorta at the 4th lumbar vertebra to near the lumbo-sacral articulation, where they each divide into the external<sup>13</sup> and internal iliac.<sup>14</sup> They are about 2 inches in length, the right being a little longer than the left one, and each is crossed by the ureter, just before its bifurcation.

**Describe the Internal Iliac.**<sup>14</sup> It is about one and one-half inch long, and extends from the lumbo-sacral articulation to the great sacro-sciatic notch, where it divides into an anterior and a posterior trunk. From the anterior trunk are given off from above downwards, the—

*Superior vesical*, the remaining pervious part of the foetal hypogastric artery.

It sends branches to the vas deferens and the ureter; and one, the *middle vesical*, to the base of the bladder.

*Obturator*, through the canal in the obturator foramen to the thigh, where it divides into an internal and external branch. Within the pelvis it gives off an iliac, vesical, and a pubic branch. In one out of 3½ cases this artery arises from the epigastric.

*Inferior vesical*, to the bladder, prostate gland, and vesiculæ seminales. In the female this artery is called the *vaginal*.

*Middle hemorrhoidal*, to the rectum.

*Uterine*, in the female, anastomosing with the ovarian.

*Internal pudic*, the smaller of the terminal branches of the anterior trunk, supplies the external generative organs. Its branches in the pelvis are numerous and small, in the perineum they are—

Inferior hemorrhoidal.	Artery of the bulb.
Superficial perineal.	Artery of the corpus cavernosum.
Transverse perineal.	Dorsal artery of the penis.

*Sciatic*, the other terminal branch, supplies the muscles on the back of the pelvis. Its branches are as follows:—

Muscular branches.	Coccygeal.	Muscular, external
Hemorrhoidal branches.	Inferior gluteal.	to the pelvis.
Vesical branches.	Comes nervi ischiadici.	Articular branches.

THE POSTERIOR TRUNK gives off the following:—

*Ilio-lumbar*, dividing into lumbar and iliac branches.

*Lateral sacral*, superior and inferior on each side.

*Gluteal*, the continuation of the posterior trunk, divides into a superficial and a deep branch, to the glutei muscles, the skin over the sacrum, and the hip-joint. Before dividing it gives a nutrient branch to the ilium, and some muscular branches.

**Describe the External Iliac.** It extends to beneath the centre of Poupart's ligament, where it enters the thigh and becomes the *femoral artery*, lying between the femoral vein on the inside and the anterior crural nerve on the outside—V.A.N. Its branches are, small muscular and glandular, and—

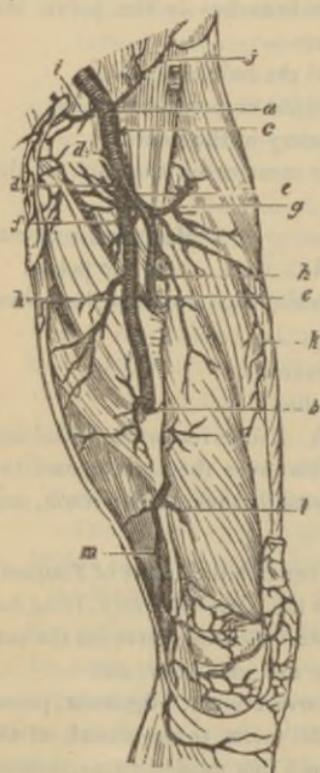
*Epigastric*, which usually arises a few lines above Poupart's ligament, passes between the peritoneum and the transversalis fascia, to the sheath of the rectus which it perforates, and ascends behind that muscle, to anastomose by numerous branches with the terminal branches of the internal mammary and inferior intercostal. It gives off—

Cremasteric.	Pubic.	Muscular branches.
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*Circumflex iliac*, arises opposite to the epigastric, passes along the crest of the ilium to anastomose with the ilio-lumbar, gluteal, lumbar and epigastric arteries.

**Describe the Femoral Artery.** It extends from Poupart's ligament to the opening in the adductor magnus, where it becomes the popliteal artery. Its course corresponds to a line drawn from a point midway between the anterior superior spine of the ilium and the symphysis pubis, to the inner side of the inner condyle of the femur. It lies in a strong fibrous sheath with the femoral vein, but divided from the latter by a fibrous partition. It bisects Scarpa's triangle in the upper part of its course, where it is superficial, and rests on the inner margin of the psoas, which separates it from the capsule of the hip joint. Its branches are as follows;—

FIG. 59.



*Superficial epigastric, c* to the superficial fascia of the abdomen.

*Superficial circumflex iliac, j* to the skin over the iliac crest.

*Superficial external pudic, d* to the integument of the lower abdomen, penis and scrotum.

*Deep external pudic, a* to the skin of the scrotum and perineum.

*Profunda femoris, e* arises posteriorly about one or two inches below Poupart's ligament, and descends to the lower third of the back of the thigh, giving off the following branches:—

Ext. circumflex. *g* Int. circumflex. *f*  
3 Perforating. *h*

*Muscular branches, k* to the sartorius and vastus internus.

*Anastomotica magna*, arises from the femoral in Hunter's canal, and divides into a superficial and deep branch, the latter anastomosing around the knee-joint with the superior external and internal articular arteries, and the recurrent tibial.

**Describe the Popliteal Artery.** It extends from the opening in the adductor magnus to the lower border of the popliteus muscle, where, having passed behind the knee-joint, it divides into the anterior and posterior tibial arteries. Its branches are as follows:—

*Superior muscular branches.*

*Inferior muscular, or Sural.*

*Cutaneous branches.*

*Superior external articular.*

*Superior internal articular. l*

*Azygos articular.*

*Inferior external articular.*

*Inferior internal articular.*

These are distributed around the knee-joint in a free anastomosis.

The azygos branch perforates the posterior ligament of the joint to reach the internal ligaments and the synovial membrane.

**Describe the Anterior Tibial Artery.** It extends from the bifurcation of the popliteal to the front of the ankle-joint, where it becomes the *dorsalis pedis*. It passes between the two heads of the tibialis posticus, over the upper edge of the interosseous membrane and along its anterior surface, resting on

the tibia for its lower one-third. It is accompanied by the anterior tibial nerve close to it externally, and is crossed below by the tendon of the extensor proprius pollicis. Its branches are—

*Recurrent tibial.*    *Muscular.*    *External and internal malleolar.*

**Describe the Dorsalis Pedis Artery.** It is the continuation of the anterior tibial, extending from the front of the ankle-joint to the 1st interosseous space, where it terminates in the *dorsalis hallucis* and the *communicating*. The anterior tibial nerve lies close to its outer side. Its branches are as follows:—

*Tarsæa*, passing outwards along the tarsus.

*Metatarsæa*, giving off 3 interosseæ, and they 7 digital.

*Dorsalis hallucis*, to the great toe and the inner side of the second toe by its 3 digital branches.

*Communicating*, which dips down into the sole of the foot in the 1st interosseous space of the metatarsus, to inosculate with the external plantar; and gives off 2 digital branches to the plantar surface of the great and second toes.

**Describe the Posterior Tibial Artery.** It is a large vessel, extending from the bifurcation of the popliteal along the back of the tibia to the fossa below the inner malleolus, where it divides into the *internal* and *external plantar*. The posterior tibial nerve crosses it a short way below its origin and then lies close to its outer side for the rest of its course. Its branches are as follows:—

*Peroneal*, along the fibular side, giving off the anterior peroneal, muscular branches, and the nutrient artery of the fibula.

*Nutrient of the tibia*, the largest nutrient artery of bone.

*Muscular branches*, to the posterior muscles of the leg.

*Communicating*, a branch to the peroneal.

*Internal calcanean branches*, to the heel and sole of the foot.

**Describe the Internal Plantar.** This artery is the smallest of the terminating branches of the posterior tibial, and passes along the inner side of the foot and great toe.

**Describe the External Plantar Artery.** It sweeps across the plantar aspect of the foot in a curve, the convexity of which is directed outwards and forwards; and at the interval between the bases of the 1st and 2d metatarsal bones it inosculates with the communicating branch from the dorsalis pedis, forming the *plantar arch*, or the *stirrup anastomosis*. It gives off numerous muscular branches, and the—

*Posterior perforating*, 3 small branches passing through the three outer interosseous spaces.

*Digital*, 4 branches supplying the sides of the three outer toes and the outer side of the second toe; its inner side, together with the great toe, being supplied by the *digital branches* of the *dorsalis pedis communicating*.

**Describe the Pulmonary Artery.** It alone of the arteries carries venous blood, which it conveys from the right side of the heart to the lungs. It is only about 2 inches long, and nearly all within the pericardium; arising from the right ventricle in front of the ascending aorta, passing upwards and backwards to the under surface of the arch of the aorta, where it bifurcates, and is connected to the aorta by a fibrous cord, the remains of the ductus arteriosus of the foetus. Its terminal branches are the—

*Right and left pulmonary arteries*, the latter being the shorter of the two; pass horizontally outwards to the roots of their respective lungs, where each divides into two branches, which again and again subdivide to ramify throughout the lung tissue and end in the capillaries of those organs.

#### ARTERIAL ANASTOMOSES.

**Describe the anastomosis around the Shoulder-joint.** It is formed by the following 8 arteries, viz.—

<i>Posterior scapular</i> , br. of transv. colli.	<i>Suprascapular</i> , br. of thyroid axis.
<i>Subscapular</i> , br. of axillary.	<i>Ant. circumflex</i> , br. of axillary.
<i>Dorsalis scapulae</i> , br. of subscapular.	<i>Post. circumflex</i> , br. of axillary.
<i>Infraspinous</i> , br. of dorsalis scapulae.	<i>Acromial</i> , br. of acromio-thoracic.

**What arteries anastomose around the Elbow-joint?** The—

<i>Superior profunda</i> , br. of brachial.	<i>Radial recurrent</i> , br. of radial.
<i>Inferior profunda</i> , br. of brachial.	<i>Recurrent interosseous</i> , br. of posterior interosseous.
<i>Anastomotica magna</i> , br. of brachial.	
<i>Posterior articular</i> , br. of superior profunda.	<i>Anterior ulnar recurrent</i> , br. of ulnar.
	<i>Posterior ulnar recurrent</i> , br. of ulnar.

**What arteries anastomose around the Hip-joint?** They are the—

*Gluteal*, *ilio-lumbar*, and *circumflex iliac*, with the *external circumflex*.  
*Obturator* and *sciatic*, with the *internal circumflex*.  
*Comes nervi ischiadici*, with the *perforating* branches of the *profunda*.

**Name the arteries anastomosing around the Knee-joint.** The—

<i>Descending</i> , br. of ext. circumflex.	<i>Sup. int. articular</i> , br. of popliteal.
<i>Anastomotica magna</i> , br. of femoral.	<i>Inf. ext. articular</i> , br. of popliteal.
<i>Inferior perforating</i> , br. of profunda.	<i>Inf. int. articular</i> , br. of popliteal.
<i>Superior ext. articular</i> , br. of popliteal.	<i>Recurrent tibial</i> , br. of anterior tibial.

**How is the collateral circulation established after ligature of the Carotid or Subclavian?**—By the following anastomoses, viz.—

*Superior thyroid*, br. of external carotid, with the *inferior thyroid*, br. of the thyroid axis, from the subclavian.

*Arteria princeps cervicis*, br. of occipital, from the external carotid, with the *vertebral*, br. of subclavian, and the *profunda cervicis*, br. of the superior intercostal, from the subclavian.

**What is the longest anastomosis in the body?** That between the subclavian and the external iliac by the anastomosis of the *superior epigastric*, br. of the internal mammary, with the *deep epigastric*, br. of the external iliac.

[The circle of Willis has been described on page 106; the palmar and plantar arches on pages 108 and 113 respectively; and the anastomosis on the *membrana tympani* on page 105.]

### THE VEINS.

**What are the Veins?** Vessels carrying blood towards the heart. Their walls are composed of 3 coats, an internal, serous; a middle, muscular; and an external, fibrous. They all carry carbonized or venous blood, except the pulmonary veins, which bring oxygenated blood to the left side of the heart. The deep veins accompany the arteries, generally in the same sheath, and are given the same names. The secondary arteries, as the radial, ulnar, brachial, etc., have each two veins, called *venæ comites*. The superficial veins are usually unaccompanied by arteries, and lie, as a rule, between the layers of the superficial fascia, terminating in the deep veins. Many veins are so irregular in their origin that they cannot be accurately described; they all anastomose with each other much more freely than do the arteries.

**What are Sinuses?** They are venous channels, differing from veins in structure but answering the same purpose. Those of the cranium are formed by the separation of the layers of the dura mater.

**How are the veins divided?** Into the *pulmonary*, *systemic*, and *portal systems*; the latter being an appendage of the systemic, its capillaries ramifying in the liver.

**What veins have no valves?** The *venæ cavæ*, hepatic, portal, renal, uterine, ovarian, cerebral, spinal, pulmonary, umbilical, and the very small veins.

**Name the principal veins of the head and neck.** They are the—

(1). Exterior veins.	(2). Veins of the diploë and cranium.	
<i>Facial.</i>	<i>Veins of the diploë.</i>	<i>Transverse sinus.</i>
<i>Temporal.</i>	<i>Cerebral and cerebellar.</i>	<i>Cavernous sinus</i>
<i>Internal maxillary.</i>	<i>Superior longitudinal sinus.</i>	<i>Occipital sinus.</i>
<i>Temporo-maxillary.</i>	<i>Inferior longitudinal sinus.</i>	<i>Superior petrosal sinus.</i>
<i>Posterior auricular.</i>	<i>Straight sinus.</i>	<i>Inferior petrosal sinus.</i>
<i>Occipital.</i>	<i>Circular sinus.</i>	<i>Lateral sinus.</i>

(3). Veins of the neck draining the above-named.

*External jugular*,<sup>6</sup> terminating in the subclavian vein.<sup>4</sup>

*Posterior external jugular*, opens into the external jugular.

*Anterior jugular*,<sup>7</sup> enters the subclavian vein near the external jugular.

*Internal jugular*,<sup>5</sup> formed by the junction of the two last-named sinuses at the jugular foramen, and uniting with the subclavian vein to form the innominate, at the root of the neck. In its course it receives the facial, lingual, pharyngeal, superior and middle thyroid veins, and the occipital.

*Vertebral*, descends the foramina in the transverse processes of the cervical vertebrae, and empties into the innominate vein.

**Name the veins of the upper extremity.** They are in two sets, superficial and deep. The deep follow the arteries, generally as *venæ comites*, beginning in the hand as *digital*, *interosseous*, and *palmar* veins, they unite in the *deep radial* and *ulnar* which unite to form the *venæ comites* of the brachial artery at the bend of the elbow. The superficial veins lie in the superficial fascia; they are as follows;—

<i>Radial</i> .....	} <i>Median cephalic.</i> <i>Cephalic.</i> }	} AXILLARY VEIN.
<i>Median</i> .....		
<i>Anterior and Posterior ulnar</i> ....		

**Name the principal veins of the thorax.** They are as follows, viz.—

<i>Internal mammary.</i>	<i>Bronchial.</i>	<i>Right azygos (major).</i>
<i>Inferior thyroid.</i>	<i>Mediastinal.</i>	<i>Left lower azygos (minor).</i>
<i>Intercostal.</i>	<i>Pericardiac.</i>	<i>Left upper azygos (minimus).</i>

**What are the Azygos veins?** They supply the place of the *venæ cavæ* in the region where these trunks are deficient being connected with the heart. *The right azygos*<sup>17</sup> begins by a branch from the right lumbar veins usually, passes through the aortic opening in the diaphragm, and ends in the superior vena cava, having drained 9 or 10 right lower intercostals, the vena azygos minor, the right bronchial, oesophageal, mediastinal and vertebral veins. *The left lower azygos*<sup>18</sup> begins by a branch from the left lumbar or renal, passes the left crus of the diaphragm, crosses the vertebral column and ends in the right azygos, having drained 4 or 5 lower intercostals. *The left upper azygos* drains 2 or 3 left intercostals and empties into either of the other two. It is often wanting, its place being filled by the left superior intercostal vein.<sup>21</sup>

**Name the Spinal Veins.** They may be arranged into 4 sets, as follows, viz.—

*Medulli-spinal*, the veins of the spinal cord, which lie in plexus form between the pia mater and arachnoid. They unite into 2 or 3 small trunks near the base of the skull, which terminate in the inferior cerebellar veins or in the petrosal sinuses.

*Venæ basis vertebrarum*, empty into the anterior longitudinal.

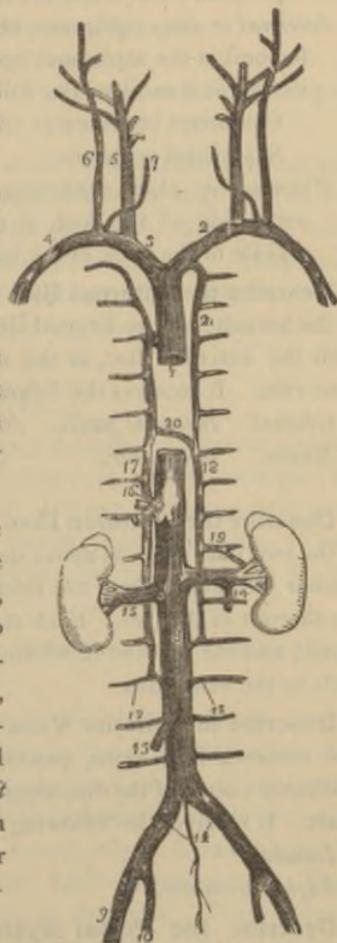
*Longitudinal*, in two plexuses, anterior and posterior, running the whole length of the spinal canal. The posterior join the dorsi-spinal veins, the anterior empty into the vertebral, intercostal, lumbar and sacral veins in their various regions.

FIG. 60.

*Dorsi-spinal*, form a plexus around the spines, processes and laminae of all the vertebrae. They empty into the vertebral, intercostal, lumbar, and sacral veins in their respective regions.

**Describe the Subclavian Vein.** It is the continuation of the axillary, extending from the outer margin of the 1st rib to the sternoclavicular articulation, where it unites with the internal jugular to form the innominate vein. At the angle of junction enters the thoracic duct on the left side of the body, and the right lymphatic duct on the right side. In its course it receives the external and anterior jugular veins and a branch from the cephalic.

**Describe the Venæ Innominatæ.** The two innominate veins are each formed by the union of the subclavian and internal jugular, and unite below the 1st costal cartilage to form the superior vena cava. *The right innominate*<sup>3</sup> is about 1½ inch long, and receives, besides its constituent branches, the right internal mammary, right inferior thyroid, and right superior intercostal veins. *The left innominate*<sup>2</sup> is about 3 inches long, and in its course it receives the vertebral, inferior thyroid, internal mammary and superior intercostal veins of the left side.



**Describe the Superior Vena Cava.**<sup>1</sup> It is a short trunk about 2½ or 3 inches in length, formed by the union of the venæ innominatæ, and receives all the blood from the upper half of the body, terminating in the right auricle of the heart. It is half covered by the pericardium, and receives the vena azygos major and small pericardiac and mediastinal veins.

**Name the principal veins of the lower extremity.** They are in two sets, superficial and deep. The deep are the *venæ comites* of the anterior and

posterior tibial and peroneal arteries, which collect the blood from the deep parts of the foot and leg, and unite in the—

*Popliteal*, which becomes the *Femoral*, and it the *External iliac* in the same manner as the respectively-named arteries.

The superficial veins of the lower extremity are the—

*Internal or long saphenous*, on the inside of the leg and thigh, enters the femoral at the saphenous opening  $1\frac{1}{2}$  inch below Poupart's ligament. In its course it receives the following:—

Cutaneous branches.	Superficial circumflex iliac.
Superficial epigastric.	Pudic. Communicating branches.

*External or short saphenous*, formed by branches from the dorsum and outer side of the foot, it ascends behind the outer malleolus, up the middle of the back of the leg, and empties into the popliteal vein.

**Describe the Internal Iliac Vein.**<sup>10</sup> It is formed by the *venæ comites* of the branches of the internal iliac artery, except the umbilical. It terminates with the external iliac, at the sacro iliac articulation, to form the common iliac vein. It receives the following veins:—

<i>Gluteal.</i>	<i>Internal pudic.</i>	<i>Hemorrhoidal and Vesico-</i>	<i>Uterine and Vagi-</i>
<i>Sciatic.</i>	<i>Obturator.</i>	<i>prostatic, in the male.</i>	<i>inal plexuses in</i> the female.

**Describe the Common Iliac Veins.**<sup>11</sup> They are each formed by the union of the two iliac veins as above described, and unite between the 4th and 5th lumbar vertebræ to form the inferior vena cava, the right common iliac being the shortest of the two. Each receives the *ilio-lumbar*, sometimes the *lateral sacral*, and the left one in addition the *middle sacral vein*, which sometimes ends in the vena cava.

**Describe the Inferior Vena Cava.**<sup>8</sup> It extends from the junction of the two common iliac veins, passing along the front of the spine, through the tendinous centre of the diaphragm, to its termination in the right auricle of the heart. It receives the following veins:—

<i>Lumbar.</i> <sup>12</sup>	<i>Renal.</i> <sup>15</sup>	<i>Phrenic.</i>
<i>Right spermatic.</i> <sup>13</sup>	<i>Supra-renal.</i>	<i>Hepatic.</i> <sup>16</sup>

**Describe the Portal System.** The portal system is formed by the *superior and inferior mesenteric, splenic and gastric veins*, which collect the blood from the digestive viscera, and by their union behind the head of the pancreas form the *portal vein*, which enters the transverse fissure of the liver, where it divides into two branches, and these again subdivide, ramifying throughout that organ, therein receiving blood also from the branches of the hepatic artery. Its contents enter the inferior vena cava by the hepatic vein. The portal vein is about 4 inches long, receives the *gastric and cystic veins*, and is

formed by the union of the superior mesenteric and splenic veins, the inferior mesenteric joining the splenic, which also receives one of the gastric, the other emptying into the portal.

**Name the Cardiac Veins.** They return the blood from the tissue of the heart into the right auricle. They are the—

*Great cardiac vein.*

*Anterior cardiac veins.*

*Posterior cardiac vein.*

*Venæ Thebesii.*

*Coronary sinus*, is a dilatation of the great cardiac vein, receiving the posterior cardiac and an oblique vein from the left auricle.

**Describe the Pulmonary Veins.** They alone of the veins carry arterial blood, beginning in the capillaries of the lungs, forming a single trunk for each lobule, which uniting into a single trunk for each lobe, form two main trunks from each lung which open separately into the left auricle. Sometimes the three lobe-trunks of the right lung remain separate to their termination in the auricle, and not unfrequently a common opening serves for the two left pulmonary veins.

#### THE ABSORBENTS.

**What are the Lymphatics?** They are very delicate, transparent vessels, formed of three coats like arteries and veins, found in nearly every part of the body, except the brain, spinal cord, eyeball, cartilage, tendons, membranes of the ovum, placenta, umbilical cord, nails, cuticle, hair, and bone. They are nourished by nutrient vessels, and have valves, but no nerves, so far as known. They convey *lymph* to the blood.

**What are the Lacteals?** They are the lymphatics of the small intestine, conveying *chyle* therefrom into the blood.

**What are the Lymphatic glands?** Small solid bodies placed in the course of the absorbent vessels, and found chiefly in the mesentery, along the great blood-vessels, in the mediastina, axilla, neck, front of the elbow, groin and popliteal space. The lymphatics and lacteals before entering these glands break up into smaller branches, the *afferent vessels*, which form a plexus in the gland, and pass out as *effluent vessels* to unite again in one trunk. They also contain spheroidal bodies about  $\frac{1}{3000}$  inch in diameter. These glands are named after the regions in which they are situated, as the axillary, inguinal, mesenteric, etc.

**Describe the Thoracic Duct.** It is the main channel for the lymph and chyle from the whole body except the right arm and lung, right side of the head, heart, neck, and thorax, and the convex surface of the liver. It begins in the *receptaculum chyli*, in front of the 2d lumbar vertebra, passes through the aortic opening in the diaphragm, and at the upper border of the 7th cer-

vical vertebra it curves forwards, outwards and downwards, terminating in the left subclavian vein at its junction with the internal jugular.

**Describe the Right Lymphatic Duct.** It is about an inch long, terminating in the right subclavian vein at its union with the internal jugular, and draining the lymphatics of those parts which are not connected with the thoracic duct.

### THE NERVOUS SYSTEM.

**How is the nervous system divided?** Into the *cerebro-spinal*, or nervous system of animal life; and the *sympathetic*, or nervous system of organic life.

**What is the structure of the nervous tissue?** It is formed of two substances essentially different from each other, the *white* or fibrous, and the *gray* or vesicular matter. Chemically these contain phosphorized fat, albumen, and water. A third form, the *gelatinous*, is yet a subject of disagreement among authorities.

**Describe the white nerve-matter.** It is composed of a number of tubes, each consisting of a central *axis-cylinder*, surrounded by the *white substance of Schwann*, and this again enclosed in the tubular membrane, or *nerve-sheath*. The whole arrangement is precisely analogous to that of a submarine telegraphic cable. A bundle of such tubes is invested by a covering, the *neurilemma*, or perineurium, and is called a *nerve*, and is nourished by a minute capillary system of blood-vessels.

**How do nerves terminate?** Sensory nerves end peripherally as plexuses in their end-organs in the tissues. Motor nerves end peripherally in muscles as plexuses, or plates. Their central termination is not yet understood.

**Of what does the Cerebro-spinal system consist?** Of the brain, the spinal cord, the ganglia, and the cranial and spinal nerves.

### THE BRAIN.

**What are the Membranes of the Brain?** The *dura mater*, the *arachnoid*, and the *pia mater*.

**Describe the Dura Mater.** It is a dense fibrous membrane lining the interior of the skull, and forming the internal periosteum of the cranial bones. It is continuous with the *dura mater* of the spinal cord, and is attached to many parts of the base of the skull. It presents the following for examination:—

*Falx cerebri*, an arched process sent into the longitudinal fissure of the brain, contains in its upper and lower margins the superior and inferior longitudinal sinuses.

*Tentorium cerebelli*, a lamina of dura mater supporting the posterior lobes of the brain, and covering the upper surface of the cerebellum. It incloses the lateral and superior petrosal sinuses.

*Falx cerebelli*, projects between the lateral lobes of the cerebellum, from the tentorium to the foramen magnum.

*Pacchionian bodies*, clusters of white granulations situated on the outer and inner surfaces of the dura mater, in the superior longitudinal sinus, and on the pia mater, found only after the 7th year, and of unknown function.

**Describe the Arachnoid.** It is the serous sac which forms the middle membrane, having a visceral and a parietal layer, the latter being reflected over the inferior surface of the dura mater. *The anterior sub-arachnoid space* is the interval between it and the pia mater of the brain at the base, where it is extended across between the two middle lobes. *The posterior sub-arachnoid space* is a similar interval between the hemispheres of the brain and the medulla oblongata. These spaces communicate together across the crura cerebri; and also with the general ventricular cavity, by an opening in the lower boundary of the 4th ventricle; and contain the cerebro-spinal fluid which forms a water-bed for the nervous centres. The sac of the arachnoid also contains a serous fluid in small quantity.

**What is the Pia Mater?** It is the vascular membrane, being supplied by the branches of the internal carotid and vertebral arteries. It covers the surface of the brain, dipping down into all the sulci, and forms the velum interpositum and choroid plexus of the 4th ventricle; and contains lymphatics and nerves.

**How is the Brain divided?** Into the cerebrum, cerebellum, pons Varolii, and medulla oblongata. Its average weight in the male adult is  $49\frac{1}{2}$  oz., in the female 44 oz., of which the cerebrum is about seven-eighths. The extreme weights in 278 male cases were 65 oz. and 34 oz.,—in 191 female cases, 56 oz. and 31 oz.

**Describe the principal Lobes and Fissures of the Cerebrum.** Each lateral half of the cerebrum, or hemisphere, has the following 5 lobes and 8 fissures, besides many of less importance.

*Frontal lobe*, bounded internally by the longitudinal fissure, below by the fissure of Sylvius, and posteriorly by the fissure of Rolando.

*Parietal lobe*, extending down to the fissure of Sylvius, and antero posteriorly from the fissure of Rolando to the parieto-occipital.

*Occipital lobe*, behind the parieto-occipital fissure.

*Temporo-sphenoidal lobe*, lying in the middle fossa of the skull, and bounded in front by the fissure of Sylvius.

*Central lobe, or island of Reil*, lies in the fissure of Sylvius, covered by the frontal and temporo-sphenoidal lobes.

*Longitudinal fissure*, separating the two hemispheres.

*Fissure of Sylvius*, at the base of the brain, extending outwards on each side, and dividing into two branches, an ascending and a horizontal one. It lodges the middle cerebral artery.

*Fissure of Rolando*, on the superior surface, extending from the longitudinal fissure about its centre, downwards and forwards towards the fissure of Sylvius, separating the frontal and parietal lobes.

*Parieto-occipital fissure*, extends from the longitudinal fissure outwards for about an inch between the parietal and occipital lobes. It is better marked in a longitudinal section of the brain.

*Callosal-marginal fissure*, above the gyrus fornicatus on the inner surface of the hemisphere.

*Transverse fissure*, between the middle lobe and the crus cerebri, at the base of the brain. It admits the pia mater to the lateral ventricle.

*Calcarine fissure*, also seen on the inner surface, extending from the lower end of the parieto-occipital fissure outwards to the posterior border of the occipital lobe.

*First temporo-sphenoidal*, below the fissure of Sylvius, on the lateral surface of the brain.

**Name the principal Convolution of the Cerebrum.** The superior and inner surfaces of each hemisphere are formed of convolutions (*gyri*) with intervening furrows (*sulci*) of various depths, both gyri and sulci being formed of gray matter thus arranged to enable it to present a great extent of surface. The convolutions are not uniform in all brains as to arrangement, nor are they symmetrical in the two hemispheres. The most constant are the following:—

*Gyrus fornicatus*, the convolution over the corpus callosum, seen on the inner surface, arching from before backwards.

*Convolution of the longitudinal fissure*, along the edge of that fissure on the superior surface, curving over the front and back of each hemisphere, to the base of the brain.

*Ascending frontal*, lies in front of the fissure of Rolando.

*Ascending parietal*, lies behind the fissure of Rolando.

*Angular gyrus, or Pli courbe*, around the posterior end of the first temporo-sphenoidal fissure.

Many other convolutions are named by writers on the localization of cerebral functions, such as the temporo-sphenoidal, occipital, supra-marginal convolutions, etc. Their names will be found sufficiently explanatory of their several locations. The *cuneus*, *precuneus*, and *paracentral lobule* are names

given to the regions between the calcarine, parieto-occipital, and calloso-marginal fissures, the last-named locality lying in front of the last-named fissure.

**Name the points in view on the inferior surface of the brain.** From before backwards, excluding the cranial nerves, are the following:—

*Longitudinal fissure*, its anterior portion.

*Corpus callosum*, the great transverse commissure of the brain.

*Lamina cinerea*, a thin, gray layer, beneath the optic tracts.

*Fissure of Sylvius*, between the anterior and temporo-sphenoidal lobes.

*Anterior perforated space*, for vessels to the corpora striata.

*Optic commissure*, formed by the junction of the optic tracts.

*Tuber cinereum*, a gray lamina behind the optic commissure, forming part of the floor of the 3rd ventricle.

*Infundibulum*, a hollow process, connecting the pituitary cavity with the 3rd ventricle in the fœtus.

*Pituitary body*, a vascular bi-lobed body, of glandular structure, projects from the infundibulum into the sella turcica of the sphenoid.

*Corpora albicantia*, two round, white eminences, united together; they are the anterior crura of the fornix folded on themselves.

*Posterior perforated space (Pons Tarini)*, for vessels to the optic thalami.

*Crura cerebri*, or cerebral peduncles, connect the cerebrum with the cerebellum, spinal cord, and medulla oblongata; containing the fibres passing to the basal ganglia. They, with the optic tracts, form the boundaries of the *inter-peduncular space*.

*Pons Varolii*, to be described separately. [See page 126.]

**What Ganglia are comprised in the Brain?** Besides the gray matter of the cerebral hemispheres, of the cerebellum, and of the medulla oblongata, there are the following, at the base of the brain;—

Olfactory bulbs.                      Optic thalami.                      Tuber annulare.

Corpora striata.                      Tubercula quadrigemina.

**Describe the Basal Ganglia.** They are as follows, viz.—

*Olfactory bulbs*, are the ganglia of the sense of smell, lie one on each side of the median line, upon the cribriform plate of the ethmoid, and are connected with the hemispheres by the *olfactory tracts*.

*Corpora striata*, the motor ganglia, are situated in the floor of the lateral ventricles, and therefore within the hemispheres.

*Optic thalami*, the sensory ganglia, are in the floor of the lateral ventricles, behind the corpora striata.

*Corpora quadrigemina, or Optic lobes*, 2 nates and 2 testes, lie beneath the posterior lobes, near the union of the cerebrum and cerebellum. They form two single ganglia for vision. [Described under Meso-cephalon.]

*Tuber annulare*, a ganglion in the substance of the pons Varolii, the seat of indistinct sensation probably.

**Name the Commissures of the Brain.** These connecting bands number 19 in all, of which 10 are longitudinal, and 9 transverse in direction, viz.—

*Longitudinal commissures.*

Olfactory tracts.  
 Tænia semicircularis.  
 Crura cerebri.  
 Processes e cerebello ad testes.  
 Peduncles of the pineal gland.  
 Fornix.  
 Infundibulum.  
 Lamina cinerea.  
 Gyrus fornicatus.  
 Fasciculus unciformis.

*Transverse commissures.*

Anterior commissure of 3d ventricle.  
 Middle commissure of 3d ventricle.  
 Posterior commissure of 3d ventricle.  
 Corpus callosum.  
 Optic commissure.  
 Pons Varolii.  
 Fornix, is a transverse commissure as well as a longitudinal one.  
 Posterior medullary velum.  
 Valve of Vieussens.

**What are the Ventricles of the Brain?** They are 5 cavities, each of which is situated as follows:—

*Two lateral ventricles*, within the substance of the hemispheres.

*Third ventricle*, between the optic thalami, on the base of the brain.

*Fourth ventricle*, between the cerebellum and the medulla oblongata.

*Fifth ventricle*, between the two lateral, in the septum lucidum.

*Ventricle of the corpus callosum*, so-called, is merely the space between the upper surface of that commissure and the margins of the hemispheres above (*labia cerebri*).

The *foramina of Monroe* connect the two lateral ventricles with the third; the *iter e tertio ad quartam ventriculum* or aqueduct of Sylvius, connects the third with the fourth.

**Describe and bound the Lateral Ventricles.** They each have 3 *cornua*, the anterior, middle and posterior, and are bounded as follows:—

*Roof*,—the corpus callosum.

*Floor*,—the corpus striatum, tænia semicircularis or horny band of Tarinus, optic thalamus, choroid plexus, corpus fimbriatum, and the fornix.

*Internally*,—the septum lucidum.

*Externally, behind and in front*,—the brain substance.

**What are the parts above-named?** Some, as the corpus striatum, optic thalamus, etc., have been described already, the others are—

*Corpus callosum*, the great transverse commissure, arching backwards to become continuous with the fornix, reflected below, forming the *peduncles* at the entrance of the fissure of Sylvius; and marked above by a depression, the *raphè*, and longitudinal elevations, the *striae longitudinales* or *nerves of Lancisi*.

*Tenia semicircularis*, consists of commissural fibres between the corpus striatum and the optic thalamus.

*Choroid plexus of veins*, is the margin of a fold of pia mater which enters at the transverse fissure, passes up the descending cornu, passes through the foramen of Monroe and as the *velum interpositum* spreads out over the roof of the third ventricle.

*Corpus fimbriatum*, or *Tenia hippocampi*, is a white band, the edge of the posterior pillar of the fornix.

*Fornix*, is a commissure situated beneath the corpus callosum but continuous with it posteriorly, the *septum lucidum* separating them in front. It is of triangular form with the apex in front. Its *anterior crura* curve downwards to the base of the brain, are there reflected, forming the *corpora albicantia*, and end in the optic thalami. Its *posterior crura* pass down the descending horns of the lateral ventricles, as the *hippocampi majores*. The *lyra* is a series of markings on its under surface.

*Septum lucidum*, consists of two layers of white and gray matter, lined by epithelium; is placed vertically between the lateral ventricles, from the raphé of the corpus callosum above to the fornix below. The cavity in its centre is the 5th ventricle.

**Describe the Cornua of the Lateral Ventricles.** The *anterior cornu* curves over the anterior end of the corpus striatum into the anterior lobe. The *posterior cornu* curves downwards and inwards in the occipital lobe, and contains a smooth eminence, the *hippocampus minor*. The *middle cornu* descends into the middle lobe to the transverse fissure at the base of the brain, curving backwards, outwards, downwards, forwards and inwards (B. O. D. F. I.). On its floor are the following:—

*Hippocampus major*, the doubled-in surface of the gyrus fornicatus.

*Pes hippocampi*, rounded eminences at the end of the hippocampus.

*Pes accessorius*, or *Eminentia collateralis*, between the hippocampi, at the junction of the middle and posterior cornua.

*Corpus fimbriatum*, a continuation of the posterior pillar of the fornix.

*Choroid plexus of veins*, a process of pia mater, already described.

*Fascia dentata*, the gray serrated edge of the middle lobe.

*Transverse fissure*, at the extremity of the cornu, extending to the median line, between the hippocampus major and the optic thalamus. It opens at the base of the brain between the middle lobe and the crus cerebri, and admits the pia mater to the middle cornu.

**Describe and bound the Third Ventricle.** It is a mere fissure, situated between the optic thalami in the median line. It communicates with the lateral ventricles above by the foramina of Monroe, and with the 4th ventricle

behind by the *iter e tertio ad quartam ventriculum*. It is crossed by three bands, the anterior, middle and posterior commissures, the middle one being of gray matter, the others of white. In the fœtus its cavity communicates with the 5th ventricle, and through the infundibulum with the cavity of the pituitary body. It is bounded as follows:—

*Roof*,—the *velum interpositum*, and above it the *fornix*.

*Floor*,—the parts comprised in the interpeduncular space at the base of the brain, viz.—the *lamina cinerea*, *tuber cinereum*, *infundibulum*, *corpora albicantia*, and *posterior perforated space*.

*Anteriorly*,—the anterior crura of the *fornix*, and the anterior commissure of the ventricle.

*Posteriorly*,—the posterior commissure, and the *iter e tertio*, etc.

*Laterally*,—the optic thalami and the peduncles of the pineal gland.

**Describe and bound the Fourth Ventricle.** The fourth, or ventricle of the cerebellum, lies between the *medulla oblongata* and the cerebellum. It is considered by some to be a dilatation of the central canal of the spinal cord, and is enclosed posteriorly by the *pia mater*; an opening in which admits the entrance and exit of the subarachnoid fluid from the subarachnoidean space of the brain and spinal cord, and a fold of the *pia mater* called the *choroid plexus*. It also communicates with the 3d ventricle by the *iter e tertio*, etc. Its boundaries are as follows:—

*Roof*,—the valve of Vieussens, and the cerebellum.

*Anteriorly*,—the *medulla oblongata*, and the *pons Varolii*.

*Posteriorly*,—the cerebellum.

*Laterally*,—the *processus e cerebello ad testes*, the posterior pyramids and the restiform bodies of the *medulla oblongata*.

*Floor*,—the posterior median fissure of the *medulla*, the orifice of the central canal of the cord, the *locus ceruleus* and *tænia violacæa* (both of blue color), the *fasculi teretes* (2 spindle-shaped elevations) and eminences of origin of certain nerves.

**Describe the Fifth Ventricle.** It is situated between the two layers of the *septum lucidum*, and therefore between the lateral ventricles. Its roof is formed by the *corpus callosum*, and in the fœtus it communicates with the 3d ventricle by an opening between the pillars of the *fornix*. It usually contains fluid.

**What is the Meso-cephalon?** It comprises the parts which connect the cerebrum with the cerebellum and the *medulla oblongata*, and includes the following structures, viz:—

*Pons Varolii*, a great transverse commissure seen at the base of the brain in front of the *medulla*. Its fibres connect the hemispheres of the cerebellum with each other and the *medulla*.

*Crura cerebri*, or *Peduncles of the cerebrum*, extend from the pons to the corpora striata and optic thalami, and consist of the *peduncular fibres* which pass from the medulla to the ganglia named, and thence upwards to the gray matter of the hemispheres as the *corona radiata*. Each crus contains in its centre a mass of gray matter called the *locus niger*.

*Valve of Vieussens*, is a thin lamina forming the roof of the iter e tertio ad quartam ventriculū, and stretched between the two processus e cerebello ad testes. Its *frenulum* is a ridge descending on its upper part from the corpora quadrigemina.

*Corpora quadrigemina*, or *Optic lobes*, are 4 spherical eminences placed together above the valve of Vieussens, and behind the 3d ventricle beneath the posterior border of the corpus callosum. The anterior pair are called the *nates*, the posterior, the *testes*, and they are connected with the optic thalami and optic tracts by 4 bands, their *brachia*; and with the cerebellum by a white cord on each side, the *processus e cerebello ad testes*. They form two ganglia for the centre of vision.

*Pineal gland*, is a small conical reddish body situated between the *nates*, on which it rests. Its 4 peduncles connect it with the anterior crura of the fornix, and the optic thalami. It is very vascular, and has a small cavity (said to communicate with the 3d ventricle) which contains a viscid fluid, and some concretions formed of the phosphates of lime, magnesia, and ammonia, etc., called the *acervulus cerebri*.

**Describe the Medulla Oblongata.** This ganglion is the upper enlarged part of the spinal cord, extending from the upper border of the atlas to the pons Varolii. Its posterior surface forms the floor of the 4th ventricle, its anterior surface rests on the basilar groove of the occipital bone. It is divided into two lateral halves by the *anterior and posterior median fissures*, and contains gray matter scattered throughout it, from which the cranial nerves from the 5th to the 12th inclusive arise entirely or in part. In it are supposed to lie the centres for the vaso-motor and the cardiac nerves, also centres of respiration, phonation, deglutition, mastication, and expression. On each side it presents the following,—

*Anterior pyramid*, formed by the anterior and lateral columns of the spinal cord.

*Olivary body*, behind the pyramid, from which it is separated by the groove of the hypoglossal nerve. It contains a capsule of gray matter in its centre, the *corpus dentatum*.

*Lateral tract*, continuous with the lateral column of the spinal cord, lies behind the olivary body and in front of the restiform.

*Restiform body*, the posterior lateral portion of the medulla, also called the *fasciculus cuneatus*.

*Posterior pyramid, or Fasciculus gracilis*, the most posterior portion, is formed by the posterior median column of the spinal cord. It diverges from its fellow at the apex of the 4th ventricle and forms the lateral boundary of the *calamus scriptorius*.

**What is the Cerebellum?** It is that portion of the brain situated in the inferior occipital fossæ, beneath the posterior lobes of the cerebrum. It is an oblong flattened ganglion, divided into two lateral hemispheres, and a central portion, the *vermiform process*.

**Name the Fissures of the cerebellum.** They are three in number,—two vertical and one horizontal, viz.—

*Incisura cerebelli anterior.*

*Great horizontal fissure*, from which

*Incisura cerebelli posterior.*

secondary fissures originate.

**Name the points on the surfaces of the cerebellum.** They comprise 15 lobes, 2 commissures, and 3 projections, as follows:—

On the upper surface of each hemisphere,—

*Anterior or square lobe.*

*Posterior or semilunar lobe.*

On the under surface of each hemisphere, from before backwards,—

*Flocculus, Sub-peduncular lobe, or Pneumogastric lobule.*

*Amygdala lobe, or Tonsil*, projects into the 4th ventricle.

*Digastric lobe.*

*Slender lobe.*

*Posterior inferior lobe.*

On the vermiform process are the—

*Lobulus centralis.*

*Monticulus cerebelli.*

*Commissura simplex.*

} superiorly.

*Pyramid.*

*Ūvula.*

*Commissura brevis.*

} inferiorly.

*The Vallecula*, or valley of the cerebellum, is the central depression on its under surface between the two lateral hemispheres.

**Name the Peduncles of the cerebellum.** They are 3 in number on each side, and from below upwards are as follows:—

*Processus e cerebello ad medullam*, to the medulla oblongata.

*Processus e cerebello ad pontem*, connect the hemispheres.

*Processus e cerebello ad testes*, to the cerebrum.

**Describe the Gray matter of the cerebellum.** It occupies the surface of the mass in laminated shape, and is traversed by curved furrows, between the laminæ. A vertical section gives an appearance called the *arbor vitæ*.

*Corpus dentatum*, is a capsule of gray matter in the centre of the white and is open anteriorly. It is sometimes called the ganglion of the cerebellum.

## THE SPINAL CORD.

**Describe the Spinal Cord.** It is that part of the cerebro-spinal axis which is situated in the spinal canal. Its length is about 16 inches, terminating at the lower border of the 1st lumbar vertebra in the *cauda equina*. It is cylindrical in general form, with two enlargements, one in the cervical region, the other in the lumbar. It is composed of gray and white matter, the gray being inside (instead of outside as in the cerebrum), and arranged so as to present a crescentic appearance in horizontal section, joined by a transverse commissure, and forming, by their extremities, the *anterior and posterior horns*, from which regions respectively the anterior and posterior roots of the spinal nerves have their apparent origin.

*Membranes* of the cord are three, as in the brain,—dura mater, arachnoid, and pia mater. The *dura mater* is not adherent to the spinal column, but is connected thereto by fibrous tissue. The *arachnoid* is arranged as on the brain, its sub-arachnoid space being filled with its fluid, for the protection of the cord. The *pia mater* has a fibrous band on each side, the *ligamentum denticulatum*, connecting it to the dura mater by some 20 serrations.

*Fissures*, number 8,—the anterior and posterior median, the anterior and posterior lateral on each side, and the two posterior intermediary in the cervical region.

*Columns*, are 8 in number, four on each side of the cord,—an anterior, lateral, posterior, and posterior median. The *anterior* is continuous with the anterior pyramid of the medulla; the *lateral*, with the lateral column of the medulla; the *posterior*, with the restiform body; the *posterior-median*, with the posterior pyramid.

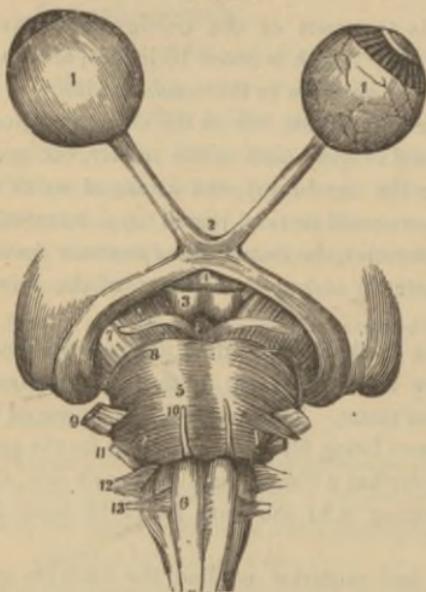
*Central canal, or Ventricle of the cord*, extends through its entire length in the foetus and in some adults, but is usually closed except for one-half inch below its orifice in the floor of the 4th ventricle.

## THE CRANIAL NERVES.

**Describe each Cranial Nerve, stating its function, apparent and deep origin, foramen of exit, principal branches and distribution.** There are 12 pairs of cranial nerves (9 according to Willis), of which those from the 6th to the 12th inclusive have their deep origin wholly or in part from the floor of the 4th ventricle. They are the—

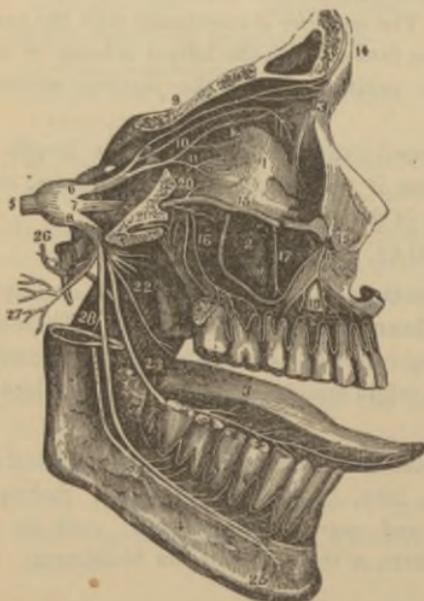
**1st, Olfactory**, nerve of smell,—*arises* by 2 roots from the anterior cerebral lobe and 1 root from the middle lobe, *deeply* from the optic thalamus, island of Reil, corpus striatum, and anterior commissure; *exit* by 20 branches through the cribriform plate, to the Schneiderian membrane. Its bulb is a lobe of the cerebrum.

FIG. 61.



sphenoidal fissure, *to* the superior oblique muscle of the eye.

FIG. 62.



*Frontal*,<sup>9</sup>

*Lachrymal*.<sup>10</sup>

*Nasal*.<sup>11</sup>

**2nd, Optic**, nerve of sight,—*arises* from the optic commissure<sup>2</sup> and tracts, *deeply* from the optic thalamus, corpora geniculata, and corpora quadrigemina; *exit* through the optic foramen *to* the retina.

**3rd, Motoroculi**,<sup>7</sup> motor of the eye, —*arises* from the crus cerebri, *deeply* from the floor of the iter tertio ad quartam ventriculum; *exit*, through the sphenoidal fissure, *to* all the muscles of the orbit except the superior oblique and the external rectus, also *to* the iris.

**4th, Patheticus**,<sup>8</sup> motor of the eye, —*arises* from the outer side of the crus, *deeply* from the valve of Vieussens; *exit* through the

**5th, Trigeminus**,<sup>9</sup> nerve of sensation, motion and taste,—*arises* by two roots,—from the side of the pons *Varolii*,<sup>5</sup> *deeply* from the pyramidal body (motor root), lateral tract of the medulla, the pons, and cerebellum (sensory root). *Exit* of ophthalmic division by the sphenoidal fissure; of superior maxillary by the foramen rotundum; of inferior maxillary division and motor root, by the foramen ovale. The *Casserian ganglion*,<sup>5</sup> is situated on the sensory root at the origin of its three divisions.

**OPHTHALMIC DIVISION**,<sup>6</sup> goes to the forehead, eyelids, lachrymal gland, conjunctiva, iris, ciliary ganglion, and the nose. Its branches are—

**SUPERIOR MAXILLARY DIVISION,**<sup>7</sup> goes to the temple, cheek, lower eyelid, nose, lip, upper teeth, and to Meckel's ganglion, thence to the palate. Its branches are the—

<i>Orbital.</i> <sup>20</sup>	<i>Posterior dental.</i> <sup>16</sup>	<i>Infraorbital.</i> <sup>15</sup> {	Palpebral.
<i>Spheno-palatine.</i>	<i>Anterior dental.</i> <sup>18</sup>		Nasal.
			Labial.

**INFERIOR MAXILLARY DIVISION,**<sup>8</sup> includes the motor branch, and is therefore a nerve of common sensation, motion, and special sense (taste). Its motor filaments go to the muscles of mastication; its sensory to the auditory meatus, to the otic and submaxillary ganglia, the anterior part of the tongue, the cheek, teeth, and the lingualis muscle (sensation). Its branches are the—

<i>Masseteric.</i>	<i>Pterygoid.</i>	<i>Gustatory.</i> <sup>23</sup>	{	Mylo-hyoid <sup>28</sup>
<i>Deep temporal (2).</i>	<i>Auriculo-temporal.</i> <sup>26</sup>	<i>Inferior dental.</i> <sup>24</sup>		Incisor.
<i>Buccal.</i>	<i>Buccal.</i>			Mental. <sup>25</sup>
				Dental.

**6th, Abducens,**<sup>10</sup> motor of the eye,—*arises* from the medulla oblongata, *deeply* from the floor of the 4th ventricle; *exit* by the sphenoidal fissure, to the external rectus muscle of the eye.

**7th, Facial, or Portio dura,**<sup>11</sup> motor of the face, ear, palate and tongue,—*arises* from the groove between the olivary and restiform bodies of the medulla, *deeply* from the floor of the 4th ventricle. *Exit* by internal auditory meatus, through the aqueductus Fallopii, and stylo-mastoid foramen, to the muscles of expression, the tongue, muscles of the ear and palate, etc. It *communicates* with the carotid and meningeal plexuses, the sphenopalatine (Meckel's) and the otic ganglia, the auditory, great auricular, pneumogastric, glosso-pharyngeal and 5th nerves. Its branches are the—

<i>Great petrosal</i> , to Meckel's ganglion.	<i>Posterior auricular.</i>
<i>Small petrosal</i> , to the otic ganglion.	<i>Digastric.</i>
<i>External petrosal</i> , to the meningeal plexus.	<i>Stylo-hyoid.</i>
<i>Tympanic</i> , to the muscles of the tympanum.	<i>Temporo-facial.</i>
<i>Chorda tympani</i> , to the tongue, etc.	<i>Cervico-facial.</i>

**8th, Auditory, or Portio mollis,**<sup>11</sup> nerve of hearing,—*arises* just external to the facial, *deeply* from the floor of the 4th ventricle; *exit* by the internal auditory meatus, to the internal ear. Its branches are the—

<i>Vestibular</i> , to the vestibule.	<i>Cochlear</i> , to the cochlea.
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**9th, Glosso-pharyngeal,**<sup>12</sup> nerve of sensation and taste,—*arises* from the medulla oblongata behind the olivary body, *deeply* from the floor of the 4th ventricle; *exit* by the jugular foramen, to the back of the tongue (taste), the middle ear, the tonsils and pharynx. Branches are—

<i>Tympanic</i> (Jacobson's).	<i>Pharyngeal.</i>	<i>Tonsillar.</i>
<i>Carotid.</i>	<i>Muscular.</i>	<i>Lingual.</i>

**10th, Pneumogastric, or Par vagum,**<sup>12</sup> the auriculo-laryngo-pharyngo-oesophago-tracheo-pulmono-cardio-gastro-hepatic nerve. A nerve of sensation and motion, probably receiving its motor influence from its *spinal* accessory. It *arises* from the medulla behind the olivary body and below the 9th nerve, *deeply* from the floor of the 4th ventricle; *exit* by the jugular foramen, *to* the parts indicated by the above euphonious appellation, supplying *sensation* to the external ear and larynx, *motion* to the other parts. Its branches are the—

<i>Auricular</i> (Arnold's).	<i>Recurrent laryngeal.</i>	<i>Œsophageal.</i>
<i>Pharyngeal.</i>	<i>Cervical and thoracic cardiac.</i>	<i>Gastric.</i>
<i>Superior laryngeal.</i>	<i>Ant. and post. pulmonary.</i>	<i>Hepatic.</i>

**11th, Spinal accessory**<sup>12</sup> to the pneumogastric,—motor nerve,—*arises* by a double origin (1) from the lateral tract of the medulla, *deeply* from near the floor of the 4th ventricle; (2) from the lateral tract of the cord by several filaments, as low as the 6th cervical nerve, *deeply* from the anterior gray horn of the cord. *Exit* by jugular foramen, its spinal portion having first entered by the foramen magnum, *to* the sterno-cleido-mastoid and trapezius muscles, *communicating* with the pharyngeal and laryngeal nerves by its accessory portion in the same sheath with the pneumogastric; also with the 2d, 3d, 4th and 5th cervical nerves by its spinal portion. Its branches are indicated by the above-described distribution.

**12th, Hypo-glossal,**<sup>13</sup> (Nonus or 9th of Willis), motor of the tongue,—*arises* by 10 to 15 filaments from the groove between the pyramidal and olivary bodies of the medulla oblongata, *deeply* from the floor of the 4th ventricle; *exit* by the anterior condyloid foramen, *to* the thyro- and genio-hyoid, the stylo-, hyo-, and genio-hyo-glossus muscles; and by the *descendens noni* branch to the sterno-hyoid, sterno-thyroid, and omo-hyoid muscles. It *communicates* with the pneumogastric, sympathetic, 1st and 2d cervical, and gustatory nerves. Its branches of distribution are the—

<i>Descendens noni.</i>	<i>Muscular.</i>	<i>Thyro-hyoid.</i>
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**What nerves enter the cranium before passing out of it?** The spinal portion of the spinal accessory, and the nasal branch of the ophthalmic. The first enters by the foramen magnum and then leaves by the jugular foramen. The second enters from the orbit by the anterior ethmoidal foramen, and leaves by the nasal slit at the side of the crista galli.

#### THE SPINAL NERVES.

**Describe the Spinal nerves.** There are 31 pairs of spinal nerves, of which the cervical number 8, the dorsal 12, the lumbar 5, the sacral 5, and the coccygeal 1. The first cervical escapes above the 1st vertebra, each of the others below the corresponding vertebra through the intervertebral foramina. Each

nerve arises by *two roots*, an anterior motor root, and a posterior sensory one, the latter having a ganglion on it. These unite, and the nerve then divides into *two branches*, both having motor and sensory fibres. The posterior branches are small and generally unimportant; they supply the muscles and integument of the back. The anterior branches supply the neck, front and sides of the trunk, and the extremities, uniting in various regions to form plexuses from which important nerve-trunks originate.

**How is the Cervical Plexus formed and distributed?** It is formed by the anterior branches of the first 4 cervical nerves, and rests on the levator anguli scapulæ and scalenus medius muscles. Its branches (10) comprise 4 superficial to the integument of the head and neck, and the following deep branches, viz.—

*Phrenic.*      *Communicans noni.*      2 *Muscular.*      2 *Communicating.*

**Describe the Phrenic nerve.** It arises by 3 heads from the 3rd, 4th and 5th cervical, descends across the front of the scalenus anticus, crossing the subclavian and internal mammary arteries, in the middle mediastinum, and is distributed to the inferior surface of the diaphragm. It is often called the internal respiratory nerve of Bell. It sends filaments to the pericardium and pleura, and communicates with the plexuses of the sympathetic in the abdomen.

**Describe the formation and distribution of the Brachial plexus.** It is formed by the union of the 4 lower cervical nerves and the 1st dorsal. The 5th 6th and 7th unite into one trunk externally to the scalenus medius, as also do the 8th cervical and 1st dorsal behind the same muscle. Below the line of the clavicle both these trunks bifurcate; the two adjacent branches unite behind the axillary artery making the *posterior cord*, and the remaining two form the *outer* and *inner cords*, referred to the artery. Each of these cords bifurcates, but the two adjacent branches of the outer and inner cords unite over the artery, to form the *median nerve*, leaving 4 other branches, the *ulnar*, *musculo-cutaneous*, *musculo-spinal* and *circumflex nerves*, the last two being derived from the posterior cord.

THE BRANCHES of the brachial plexus are as follows, viz.—

Above the clavicle are given off 4, the—

*Communicating*, completing the phrenic nerve.

*Muscular*, to the longus colli, scaleni, rhomboidei, and subclavius muscles.

*Posterior, or Long thoracic*, external respiratory nerve of Bell, to the serratus magnus, arising from the 5th and 6th cervical.

*Suprascapular*, from the 1st trunk of the plexus, to the scapular muscles.

Below the clavicle are 12, the—

2 *Anterior thoracic*, from outer and inner cords to the pectoral muscles.

3 *Subscapular*, from the posterior cord, to the subscapularis, teres major, and latissimus dorsi muscles.

*Circumflex*, from the posterior cord, to the muscles and integument of the shoulder, and the shoulder-joint.

*Musculo-cutaneous*, from the outer cord, to the forearm externally, piercing the coraco-brachialis muscle.

*Internal cutaneous*, from the inner cord, to the arm and forearm.

*Lesser internal cutaneous* (nerve of Wrisberg), from the inner cord to the inner side of the arm. Is sometimes wanting, sometimes connected with the intercosto-humeral.

*Median*, from outer and inner cords, passes between the two heads of the pronator radii teres, supplying the pronators, flexors, first 2 lumbricales, and the integument of the thumb, 2½ fingers, and the radial side of the palm. Its branches are all in the palm, the—

Muscular. Anterior interosseous. Palmar cutaneous.

*Ulnar*, from the inner cord, passes between the two heads of the flexor carpi ulnaris at the inner condyle of the humerus, supplying the elbow- and wrist-joints, several muscles, and the palmar and dorsal integument of the little finger and half of the ring finger. Branches—

2 Articular. Cutaneous. Superficial palmar.

Muscular. Dorsal. Deep palmar.

*Musculo-spiral*, from the posterior cord, accompanies the superior profunda artery and vein in the spiral groove of the humerus, and at the external condyle it divides into the radial and posterior interosseous nerves. Its branches are—

Muscular. Cutaneous. Radial. Posterior interosseous.

*The radial* supplies the outer side and ball of the thumb, and the dorsal integument of 2½ fingers.

*The posterior interosseous* supplies all the muscles on the back of the forearm except three, and also sends a filament to the wrist-joint.

**What is the Intercosto-humeral nerve?** It is the lateral cutaneous branch of the 2d intercostal (anterior branch of the 2d dorsal); it pierces the external intercostal muscle and crosses the axilla, joining with a filament from the lesser internal cutaneous (nerve of Wrisberg), and supplying the skin of the upper half of the inside of the arm.

**Describe the Lumbar plexus.** It is formed by communicating loops from the anterior branches of the first 4 lumbar nerves, in the following manner.

From the **FIRST** lumbar nerve are given off the—

*Ilio-hypogastric*, to the abdominal and gluteal regions.

*Ilio-inguinal*, to the inguinal region and the scrotum.

*Communicating loop*, to the second lumbar nerve.

From the SECOND lumbar nerve are given off the—

*External cutaneous*, to the integument of the outside of the thigh.

*Genito-crural*, to the spermatic cord and front of the thigh.

*Communicating branch*, to the third lumbar nerve.

From the THIRD and FOURTH lumbar nerves are given off the following by a branch of origin from each, viz.—

*Obturator*, through the obturator foramen to the external obturator and adductor muscles and the hip- and knee-joints.

*Accessory obturator* (often absent), to the pectineus and hip-joint.

*Communicating*, from the 3d lumbar to the 4th.

*Communicating*, from the 4th lumbar to the 5th.

*Anterior crural*, which descends through the psoas muscle, and beneath Poupart's ligament to the thigh, where it divides into an anterior and posterior division. Its branches are,—

- |                                |                 |
|--------------------------------|-----------------|
| To the iliacus muscle.         | Long saphenous. |
| To the femoral artery.         | Muscular.       |
| Middle and internal cutaneous. | Articular.      |

**Describe the Sacral plexus.**<sup>d</sup> It is formed by the union of the upper 4 sacral nerves *c* with the 5th lumbar and a loop from the 4th, the two latter forming the *lumbo-sacral cord*.<sup>a</sup> It lies upon the pyriformis muscle and gives off the following 5 branches, viz.—

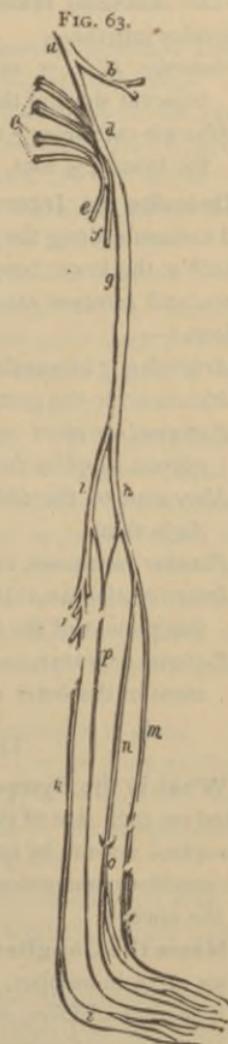
*Superior gluteal*,<sup>b</sup> from the lumbo-sacral cord, supplies the glutei and tensor vaginae femoris.

*Muscular branches*, to the pyriformis, obturator internus, gemelli, and quadratus femoris muscles.

*Pudic*,<sup>e</sup> escapes by the great sacro-sciatic foramen, crosses the ischiatic spine, and re-enters the pelvis by the lesser sacro-sciatic foramen, supplying the perineum, anus, and genitalia.

*Small sciatic*,<sup>f</sup> to the gluteus maximus, and integument of the perineum, scrotum, and back of the thigh and leg.

*Great sciatic*,<sup>g</sup> the largest nerve of the body, and the direct continuation of the sacral plexus, escapes by the great sacro-sciatic foramen, sends an *articular branch* to the hip-joint, *muscular*



branches to the adductor magnus, semimembranosus, semitendinosus and biceps muscles, and terminates in the *external<sup>k</sup>* and *internal<sup>i</sup> popliteal* nerves, generally about the lower one-third of the thigh.

**Describe the External Popliteal nerve.** It passes from the bifurcation of the great sciatic along the outer side of the popliteal space, gives off *articular* and *cutaneous* branches, and about an inch below the head of the fibula it divides into the—

*Anterior tibial,<sup>m</sup>* supplying the extensors, and the integument of the adjacent sides of the great and 2d toes.

*Musculo-cutaneous,<sup>n</sup>* to the peroneal muscles, and the dorsal integument of the inner 4½ toes.

**Describe the Internal Popliteal nerve.** It is the largest of the two, and descends along the middle of the back of the leg, becoming the *posterior tibial<sup>k</sup>* at the lower border of the popliteus muscle, and dividing into the *external* and *internal plantar<sup>l</sup>* below the inner malleolus. Its branches are as follows:—

*Articular,* 3 in number, to the knee-joint.

*Muscular,* to the gastrocnemius, soleus, plantaris, and popliteus.

*External or short saphenous,<sup>p</sup>* formed by a filament from both popliteal nerves, supplies the integument of the little toe and outer side of the foot.

*Muscular,* to the tibialis posticus, flexor longus pollicis, and flexor longus digitorum.

*Plantar cutaneous,* to the skin of the heel and inner sole of the foot.

*Internal plantar,* to the inner plantar muscles, sole of the foot, and the plantar integument of the inner 3½ toes.

*External plantar,* to the external plantar muscles, and the plantar integument of the outer 1½ toes.

### THE SYMPATHETIC NERVE.

**What is the Sympathetic Nerve?** It consists of a series of ganglia situated on each side of the vertebral column, connected together and to the cerebro-spinal system by intervening cords, beginning in the *ganglion of Ribes* on the anterior communicating artery, and ending in the *ganglion impar*, in front of the coccyx.

**Name the Ganglia of the Sympathetic in the Cranium and its vicinity.**

They are 9 in number, as follows:—

*Ganglion of Ribes,* on the anterior communicating artery.

*Ganglion of Laumonier,* on the internal carotid artery.

*Ciliary, or Ophthalmic ganglion,* in the orbital cavity.

*Spheno-palatine (Meckel's) ganglion,* in the spheno-maxillary fossa.

*Otic (Arnold's) ganglion,* under the foramen ovale.

*Sub-maxillary ganglion*, above the sub-maxillary gland.

*Ganglion of Cloquet*, in the incisive fossa, on the naso-palatine nerve.

*Ganglion of Bidder*, below the foramen spinosum, on the middle meningeal artery.

*Ganglion of Bochdalek*, on a branch between the spheno-palatine ganglion and the inferior dental nerve.

**Describe the Ganglia connected with the 5th Cranial nerve.** There are 4 such, each having a motor, a sensory, and a sympathetic root, viz.—

*Ciliary, or Ophthalmic ganglion*, is situated in the orbit, between the optic nerve and the external rectus muscle. Its sensory root is derived from the nasal branch of the ophthalmic, its motor root from the 3rd nerve, its sympathetic root from the cavernous plexus. Its branches are the short ciliary nerves, and are distributed to the ciliary muscle and the iris.

*Spheno-palatine, or Meckel's ganglion*, is a large ganglion situated in the spheno-maxillary fossa. Its sensory root is derived from the superior maxillary, its motor root from the facial by the Vidian and large petrosal, its sympathetic root from the carotid plexus, by the carotid branch of the Vidian. Its branches are the—

Anterior palatine.	Middle palatine.	Pterygo-palatine.
Posterior palatine.	Naso-palatine.	Superior nasal.

*Otic ganglion (Arnold's)*, is situated on the inferior maxillary nerve, immediately below the foramen ovale. Its sensory root is derived from the auriculo-temporal branch of the inferior maxillary; its motor root from the internal pterygoid branch of the same, also from the facial and glosso-pharyngeal by the small petrosal; its sympathetic root from the middle meningeal plexus. Its branches are distributed to the tensor palati and tensor tympani muscles.

*Submaxillary ganglion*, is situated above the submaxillary gland. Its sensory root is derived from the gustatory branch of the inferior maxillary, its motor root from the facial by the chorda tympani, its sympathetic root from the facial plexus. Its branches are distributed to the submaxillary gland, its duct, and the mucous membrane of the mouth.

**Describe the Cervical ganglia.** They are 3 in number on each side, of which the superior is the largest, communicate with each other, and are as follows, viz.—

*Superior cervical ganglion*, lies behind the carotid sheath opposite the 2nd and 3rd cervical vertebræ. Its branches are distributed to the carotid, cavernous, and pharyngeal plexuses, and one of its internal branches is the superior cardiac nerve going to the cardiac plexus.

*Middle cervical ganglion*, on the superior thyroid artery, opposite the 5th

cervical vertebra, and gives off the middle cardiac nerve to the cardiac plexus, also communicating branches.

*Inferior cervical ganglion*, on the superior intercostal artery, between the neck of the 1st rib and the transverse process of the 7th cervical vertebra.

It gives off several communicating branches and the inferior cardiac nerve to the cardiac plexus.

**What are the other ganglia of the sympathetic?** There are on each side of the vertebral column 11 or 12 dorsal ganglia, 4 or 5 lumbar, 5 sacral, besides the single coccygeal *ganglion impar* in which terminates the double chain. Connected with the viscera are many ganglia, from which branches ramify around the arteries in plexuses named from their locations.

**Describe the Splanchnic nerves.** They are 3 in number on each side, and are derived from branches of the six lower thoracic ganglia, as follows, viz.—

*Great splanchnic*, from branches of the 6th to the 10th, connecting with the upper six, and passes through the posterior mediastinum, perforates the crus of the diaphragm, to the semilunar ganglion.

*Lesser splanchnic*, from the 10th and 11th, passes through the diaphragm with the great splanchnic, to the cœliac plexus.

*Smaller or Renal splanchnic*, from the last thoracic ganglion, also perforates the diaphragm, and ends in the renal and cœliac plexuses.

**Describe the Solar plexus.** This plexus, called also the "abdominal brain," is a network of nerves and ganglia, chiefly formed by the splanchnic nerves and the right pneumogastric. It lies behind the stomach, and in front of the aorta and the crura of the diaphragm, surrounding the cœliac axis and the root of the superior mesenteric artery. Its two largest ganglia are the *semilunar ganglia* situated in front of the crura of the diaphragm. From it are derived branches which form *plexuses* over most of the abdominal arteries, as follows:—

<i>Phrenic.</i>	<i>Gastric.</i>	<i>Splenic.</i>	<i>Renal.</i>	<i>Superior mesenteric.</i>
<i>Cœliac.</i>	<i>Hepatic.</i>	<i>Suprarenal.</i>	<i>Spermatic.</i>	<i>Inferior mesenteric.</i>

**Mention some other plexuses of the sympathetic system.** They are very numerous; besides those already mentioned, the most important are the following:—

*Carotid and Cavernous plexuses*, on the internal carotid artery.

*Meningeal plexus*, on the middle meningeal artery.

*Facial plexus*, surrounding the facial artery.

*Cardiac plexuses*, the deep in front of the bifurcation of the trachea, the superficial in front of the right pulmonary artery; the first-named lies behind the arch of the aorta, the latter beneath it.

*Coronary plexuses*, anterior and posterior, accompanying respectively the left and right coronary arteries.

*Aortic plexus*, on the sides and front of the aorta between the superior and inferior mesenteric arteries.

*Hypogastric plexus*, on and between the common iliac arteries; supplying the viscera of the pelvic cavity.

*Inferior hypogastric or pelvic plexuses*, two in number, one on each side of the rectum and bladder. Their branches are the—

*Inferior hemorrhoidal plexus.*

*Small cavernous nerve.*

*Vesical and Prostatic plexuses.*

*Large cavernous nerve.*

*Vaginal plexus.*

*Uterine nerves.*



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