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We have chosen this, because it appears to us to be one of the very best. It is a model for such a work; the several parts being duly connected, related, and managed with a beautiful simplicity and dexterity, like that used by the naturalist. A sort of nomenclatural neatness and conciseness reigns throughout. It is a book that no physician should be without.—N. A. Medical Journal.

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HANDBOOK OF HUMAN ANATOMY, GENERAL, SPECIAL, AND TOPOGRAPHICAL.

TRANSLATED FROM THE ORIGINAL GERMAN OF DR. ALFRED VON BEHR, AND ADAPTED TO THE USE OF THE ENGLISH STUDENT, BY JOHN BIRKETT, FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND, AND DEMONSTRATOR OF ANATOMY AT GUY'S HOSPITAL.

PHILADELPHIA: LINDSAY AND BLAKISTON. 1847.
TO

STUDENTS OF ANATOMY,

THE FOLLOWING PAGES ARE INSCRIBED

BY

THE TRANSLATOR.

London, October, 1846.
THE AUTHOR'S PREFACE.

The "Pocket-book of Anatomy" is intended to afford the Student a short and comprehensive detail of anatomical facts, suited to the practical tendency of the "Medical Encyclopaedia."* It may serve either as an introduction to the study of Anatomy, or for refreshing the memory, more especially of those preparing for examinations. With this view, the relations which Anatomy bears to Physiology, Pathology, and Surgery, have been considered in an especial manner, either tacitly intimated, or expressly mentioned; but critical and useless observations have been, as far as appeared practicable, disregarded.

Our German Handbooks and introductions (especially that of C. A. Bock) have only very lately attempted to appropriate, from the French, the advantages of a clear, summary, and agreeable detail; the author of the Pocket-book also thinks that he might take the latter as a model for his work without derogating from the much-prized German profoundness. We trust we shall not be misunderstood, as though we were going to encourage an unscientific superficiality. On the contrary, we wish that the science were seriously considered, and that the trouble which the mere elements require, increasing, as it does daily, with the growth of materials, may not be unnecessarily enhanced, but applied to that which is really useful.

The science of Physiology and Anatomy has, since the year 1838, received so important an elevation in consequence of Schwann's cell theory, that the author does not hesitate to take it as the foundation of his work, and he chiefly refers for farther study to the admirable work of Henle (Sömmering, Allgemeine Anatomie, ed. Henle).

In the special anatomy, the author, although aiming at the greatest brevity, saw the necessity of frequent repetitions, which, although of use to the Student, are detrimental to the uniformity of the book; which, by the utmost precision in doubtful points, by greater amplitude in some sections, by the statement of numerical determinations, by tabular views, and by the addition of the Topographical portion and the situs viscerum, he tried to give it, and thus to make it preferred to similar pocket-books.

* See Translator's Preface.
TRANSLATOR'S PREFACE.

The following pages have been translated from one of a series of volumes, entitled "The Pocket Encyclopædia of the Medical Sciences," by Dr. von Behr and Dr. Minding, and now in course of publication at Erlangen.

The translator has long experienced, in his daily intercourse with students, the disadvantages under which they labour from the want of a really elementary work on Anatomy,—one which would, by giving a well-defined outline of the subject, lead them to fill up the picture from the book of Nature, or more elaborate and highly finished works. Of such books the Student has, now, as many as he can desire, but their size, beauty, or prolixity, render them better adapted for reference than as class books for their course of study. This translation was, therefore, undertaken in the hope that it might lead to an assiduous and earnest study of the subject in the dissecting-room, and not, with the view of superseding the diligent prosecution of the inquiry by means of dissections,—the only mode in which an accurate and available acquaintance with the structure and arrangement of the organs of the body can be acquired.

To assist the Student, however, in the literature of the science, references have been made at the head of each division of the work, to such monographs in the English language as contain original observations.

The translator has made additions in a few places, which are thus indicated [ ]; and in the Topographical portion he has given such instructions as he considers most suitable for the display, by dissection, of the parts described.

The abbreviations in the body of the work were adopted as consistent with the intention of the book; namely, to embrace as great a number of facts in as small a space as possible.

The marks ′, ″, ‴, express successively—a foot,—an inch,—a line.

The translator does not concur in all the observations made by the author.

Should this translation be found useful to the Student, other volumes of the series will, perhaps, be published.

London, October 1846.
ANATOMY.

"Along with the observation of the living person, the more searching examination which could be carried on in the dead body, and the comparison of various kinds of animals, soon showed that this pursuit was rich in knowledge and interest. Moreover, besides the interest which the mere speculative faculty gave to this study, the art of healing added to it a great practical value, and the effects of diseases and of medicines supplied new materials and new motives for the reasonings of the philosopher."—Whewell. Hist. of the Inductive Sciences.

"The most simple mode of investigating an animal body is first to consider the matter of which it is composed."—Hunter.

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Animal Chemistry:


HANDBOOK
OF
HUMAN ANATOMY.

1. Anatomy (ἀνατίμνειν, to dissect) has for its object a knowledge of the separate parts of organic bodies. Every organismus consists of a series of different parts (organs) associated together with a view to the maintenance and self-preservation of the whole, which, likewise, proceed from the connection of dissimilar structures (tissues). The consideration of the tissues, their form, development, and constituents, belongs to the general part of anatomy ("Anatomy of Tissues," Histologia), a science, for the foundation of which we have to thank Bichat (born 1771, died 1802), and for the farther advance of which we are indebted to the labours of more modern inquirers. A description of the organs forms the particular part, Special Anatomy.

GENERAL ANATOMY.

2. The animal body consists of solid and fluid substances, which, permeating one another, may, by chemical means, be resolved into proximate and ultimate elements, and supply the material base to the forms of the elementary constituents and tissues.

I. CONSTITUENTS OF THE HUMAN BODY.

3. The 17—19 bases which the chemist recognises in the tissues and fluids of the healthy human body, are:—

Oxygen, Hydrogen, Carbon, Nitrogen; Phosphorus, Sulphur, Chlorine, Fluorine; Potassium, Sodium; Calcium, Magnesium, Silicium, Aluminum; Iron, Manganese, Titanium, and (according to Raspail) Arsenic, Copper.

Of these Oxygen, Hydrogen, Carbon, and Nitrogen form the principal mass of the fluids and soft tissues; Lime (as phosphate and carbonate of lime) that of the bones; the rest are found in smaller quantities only. A few of
them are present in a pure state (Nitrogen and Oxygen in the blood, Nitrogen in the intestinal gases), the rest in binary, ternary, and quarternary compounds.

4. Binary, called inorganic compounds:—
1. Water; composes the largest part of all animal fluids, permeates most solid parts, giving rise to their various degrees of softness.
2. Carbonic Acid; in blood, urine, the exhalations from the lungs, and the cutaneous transpiration; in their salts.
   a. Carbonates; of Potassa in Serum.
   b. —— Soda, in Serum, Haematin, Bile, liq. Amnios, Mucus, Sweat, Saliva, Tears; Cartilage, Bone, Teeth.
   c. —— Ammonia, in Urine and liq. Amnios.
   d. —— Lime, in Cartilage, Bones, Teeth, Sand of ear, Nails.
   e. —— Magnesia in grease of the skin.
3. Phosphatic Salts:—
   a. —— Soda in Serum, Haematin, Bile, liq. Amnios, Urine, Sweat, Saliva, Tears; Nails, Cartilage, Muscles.
   b. —— Lime in Bones, Cartilages, Teeth, sand of Pineal gland.
   c. —— Soda and Ammonia in Urine; Blood (Hünefeld).
   d. —— Oxide of Iron in Haematin, Gastric juice, Urine.
4. Chlorine Compounds:—
   b. Chloride Sodium in Blood and Secretions; Brain, Muscles, Bone, Cartilage, Teeth, Pigment of eyes.
   c. Chloride of Potassium in Blood, Crystalline lens, Saliva, Gastric juice, Urine, Milk.
   d. Chloride of Ammonium in Urine, Sweat, Gastric juice.
   e. Chloride of Calcium in Gastric juice.
5. Sulphates:—
   a. —— Potash in Urine, Gastric juice, Cartilage.
   b. —— Soda in Urine, liq. Amnios; Sweat, Bile, Cartilage.
   c. —— Lime in liq. Amnios; Bile, Gastric juice, Hair, Epidermis.
7. Fluoride of Calcium in enamel of teeth.
8. Silica and Oxide of Manganese in Hair.
9. Alumina in enamel of teeth, Bones (?) and white hair (?)
10. Oxide of Iron in Haematin, black Pigment, Lens, and Hair.
11. Oxide ofTitanium in the supra renal capsules. (Rees.)

Ammonia (Nitrogen, Hydrogen) and Cyanogen (Nitrogen, Carbon) do not exist in a free state in the organism, but as compound salts, and even then in excreted substances only (Urine, Sweat, Saliva). Compounds exist likewise of inorganic bases with organic acids.
(See Urine, Milk, Oil, Margaric acid.)

5. How the ternary and quarternary compounds of the elements which constitute the proper organic mass are brought about, has not been, hitherto, ascertained by inorganic chemistry, because it is not possible to analyse them in the common binary compounds, or to compose them from these. The most, besides oxygen, hydrogen, and carbon, consist also of nitrogen, and are
often of exactly similar composition, although very different in their characters. One essential distinction is in regard to the existence of nitrogen, upon which generally depends the rapidity with which they pass into a state of decomposition (become putrid).

We therefore distinguish:

6.

1. **Nitrogenized Substances.**

a. **Albumen**; \([\text{Pr}_{10} + \text{P} \text{S}_2]\), the most diffused of them, is, when dried, yellowish, brittle, soluble in cold water, coagulable by heat, creosote, spirits of wine, and unites insolubly with nitric and tannic acid, Plumb, diacet, alum, Corrosive sublimate, &c. It is found in Lymph, Chyle, Serum of blood, and especially in the Brain.

b. **Fibrin**; \([\text{Pr}_{10} + \text{PS}]\), readily coagulates (within 3—7 minutes), is fibrous, reteform; is present in a soluble condition in the blood, from which it is obtained by whisking it with twigs, coagulated in the muscles. Vegetable acids (and their salts) and caustic alkalis hinder the coagulation. Coagulated fibrin decomposes super-oxyde \([\text{Binaryde}]\) of Hydrogen in water, not albumen; the latter becomes violet with Hydrochloric acid, the former indigo blue.

c. **Casein**; \([\text{Pr}_{10} + \text{S}]\), soluble in water, pale yellow in solution, coagulates (membranous upon milk) by boiling (in flakes), by Alcohol, Acids (particularly lactic), and rennet. It is found in milk, blood, saliva, bile, and pancreatic fluid, lens.

d. **Pepsin**; (discovered by Schwann) \([\text{C}_{48} \text{H}_{32} \text{N}_8 \text{O}_{10} \text{Vogel}]\), in the gastric juice, in the parietes of the gastric glands, and upon other mucous membranes; precipitates by acetate of lead, dissolves with some acid, albumen and fibrin, very readily (digestion); it is very like albumen; loses by coagulating the soluble property; also by bile.

e. **Globulin**; \([\text{Pr}_{15} + \text{S}]\), that is, the envelopes and nuclei of the (microscopic) blood corpuscles, without the coloring matter, insoluble in Alcohol; very like albumen. Is (according to Fr. Simon) Casein united with Häematin.

f. **Spermatin**; in the seminal fluid, is probably only fibrin; is soluble in water, becoming a clear fluid, which does not coagulate by boiling.

g. **Mucus**; consists of the secretion of the mucous glands, the cast-off epithelium of mucous membranes, and usually also of pus; swells up in water, is soluble in strong acids, and precipitated by tannin.

h. **Peculiar matter of tears**; dries in the air to a yellow, insoluble mucus; in acids and heat not coagulable.

i. **Keratin**; \([\text{Pr} \text{S}_2]\), the seemingly homogeneous matter of Epithelium, Hair, Nails, consists of different substances, like e, f, g, the chemical relations of which are not yet singly determined.

[Note. There are great doubts as to the existence of "Protein.”]

2. **Extractive Matters.**

7. Not less diffused than the Protein compounds, is the animal extractive matter, which is particularly obtained from muscular substance (flesh), by
compression and inspissation, and hence called flesh extract. From this is again obtained: Water, Spirit (Osmazome), and Alcohol extract, according as it is extracted with water, spirit, or alcohol. To the materials soluble in water, merely, belong Ptyalin, the principle of saliva, colorless, scentless, and tasteless, soluble in water, forming a slimy fluid, and which is only precipitated from it by Alcohol. It is found only in Salivæ, which changes Starch into Sugar, and Kreatin (Chevreul).

8. 3. Matter yielding gelatin
is produced by long boiling, from cartilages, the cartilaginous basis of bones; from the membranes, tendons, and ligaments, and from the cornea. A solution of gelatin in boiling water becomes, upon cooling, a jelly. We distinguish the proper Gelatin (colla) \([\text{C}_{52} \text{H}_{40} \text{N}_8 \text{O}_{20}]\), which is obtained from the membranes, tendons, ligaments, and the cartilaginous basis of bone, from the Chondrin \([\text{C}_{32} \text{H}_{26} \text{N}_4 \text{O}_{4}]\) which exists in the cartilages of the nose, of the ears, the ribs, articulated cartilages, and the cornea. (Pyine, the basis of pus \([\text{Tritoxoyd of Protein C}_{40} \text{H}_{31} \text{N}_5 \text{O}_{15} + \text{H}_2 \text{O}]\), is said to be, likewise, a gelatinous substance.)

9. 4. Hæmatin, \([\text{C}_{44} \text{H}_{28} \text{N}_3 \text{O}_6 \text{Fe}]\),
the colouring principle of the blood which is contained in the vesicles of the coloured corpuscles suspended in the serum, is obtained by boiling fresh blood, and evaporating it to dryness; the residue is then boiled with Aëther, afterwards with spirit, when the red matter is precipitated in flocculi. In a pure state brownish black; contains Iron (also some oxyde of manganese); is soluble in alkalis. [Hæmatin may be obtained free from iron, as a red Pigment \(\text{C}_{44} \text{H}_{22} \text{N}_3 \text{O}_6\)].

10. 5. Principles of the Bile. (Berzelius.)
a. Bilin, the essential principle of bile, is, in a pure state, when dry, colourless, transparent, not crystallised, bitter to the taste, easily soluble in water, very readily metamorphosed; is decomposed by acids into Fellinic and Cholinic acids, Taurin, Dyslin, and Ammonia. Its reaction is neither alkaline nor acid, but it forms with acids and bases easily soluble compounds.
b. Cholepyrrhin [bilipharin, Simon], colouring matter of bile, is sometimes found as yellow powder deposited in bile, or as concretions in the gall-bladder (gall stones); is bright reddish yellow, tasteless and scentless, contains nitrogen, colours water pale yellow, being a little soluble therein, more so in a ley of caustic potash or Soda, becomes at first bluish by Nitric acid, then green, violet, red, and finally yellow or yellowish brown. The (green) Biliverdin is a product of its metamorphosis by acids.

Mucus from the biliary passages and the Gall-bladder, causes a certain metamorphosis of the bile, is precipitated by Alcohol (also acetic acid).

Bilifulvin, the yellow colouring matter of bile, is a double salt of lime and of soda combined with an [organic] nitrogenous acid.

Extractive matter, Cholesterol, oleate, margarate, and stearate of soda, with some saponifiable fat. Chloride Sodium, sulphate, phosphate, and lactate of soda; phosphate of lime.

[The formulae for the above do not appear to be accurately determined.]

11. 6. Urea and Uric Acid.
a. Urea \([\text{C}_2 \text{H}_4 \text{N}_2 \text{O}_2]\), in the urine (with lactic acid); in ox blood; in the
blood, in disease, and in other fluids. Produced by Nitric acid, and again libera-
ted by means of Carbonate of Baryta. Composition: corresponds with the
cyanoide of Ammonia with Water. Artificially formed by Wohler. Colour-
less, four-sided prisms, or long, silky, shining needles. Spec. grav. = 1·35.
Scentless, it produces neither acid nor alkaline reaction; soluble in any pro-
portion in boiling water. Unites as well with acids as with bases.

b. Uric Acid $[C_{10}H_7N_4O_4]$, in the urine of animals feeding on flesh, in
urinary calculi, and gouty concretions. United with ammonia in the excre-
ments of birds (Guano) and serpents. Forms a light, fine, white powder;
with difficulty soluble in water. Is precipitated from human urine upon
cooling; at first grey, then pale, rosy red; or by the addition of nitric or mu-
ratic acids. Uric acid easily decomposes urea, upon which a substance re-
mains behind which Liebig calls Uric. Uric is one of the most feeble acids;
its salts are little soluble in water. (Colouring matter of urine, an extractive,
mixed with salts, is reddish brown, saltish bitter, urinous odour, soluble in
water and alcohol, is of an amber or brownish yellow, easily decomposes.
decreases when living on vegetable diet.)

II. Non-nitrogenized Materials.

12. Sugar of milk, lactic acid, fats.

1. Sugar of milk, $[C_5H_4O_4 + H_2O]$ saccharum lactis. $\frac{2}{3}$ of the solid con-
stituents of human milk consist of sugar of milk. It may be procured by
evaporation and crystallization from whey, that is, the fluid of milk deprived
of fat and casein. It forms white four-sided prisms. Spec. grav. = 1·543.
Taste slightly sweet, harder than cane sugar, easily soluble in water; changes,
in time, of itself into lactic acid, as well as by rennet; by yeast it passes into
grape sugar and spirituous fermentation.

2. Lactic acid acidum lacticium. $[C_6H_5O_4]$ In all fluids and secretions
of the body, freely united to Potash, Soda, Ammonia, Lime, and Magnesia.
Free in the milk, urine, muscles, and sweat. It is colourless and scentless,
very acid, not volatile like acetic acid, into which it is decomposed by strong
heat; causes albumen and casein to coagulate, and holds phosphate of lime,
the principal element of the bones, in solution. It is a strong acid, separating
acetic acid from its compounds. Most of its salts are soluble in water, and
crystallizable.

3. Fats (Pinguedines) are insoluble in water, in hot spirit and ether they
form soluble compounds of Carburetted Hydrogen with a little oxygen.
Most of them become metamorphosed by strong bases, especially alkalies and
oxyde of lead, into soaps, as the acid contained in them with the base is
transformed into a salt. We therefore distinguish the saponifiable fats from
the unsaponifiable (Cholesterol $[C_{37}H_{52}O_2]$), an element of the blood, of bile
and of neurine, frequently present in gall stones and other pathological secre-
tions,—and Serotin discovered by Boulet in the blood). Fat exists free in
the fibro-cellular tissue and medulla of bones, or united with other substances,
as for example in the milk, the brain, the hair, the cerumen of the ear,
pus, &c.

The base of the saponifiable fats of the human body is Glycerin, $[C_2H_5O_3]$ a substance separated by boiling fat with oxyde of lead; the acids which
unite with that base form the different kinds of fat, Stearic (or tallow) $[C_{58}
H_{68}O_5 + 2 H_2O]$ and Margarine $[2 C_{34}H_{53}O_5 + H_2O]$ acids on the one side,
and Linole (oil) $[C_{44}H_{40}O_4]$ acid on the other; lastly, Butteric $[C_8H_{7}O_3 +
H_2O]$ and Cerebric acids.
The solidity of different fats depends upon the proportional quantity of the above-mentioned substances. A preponderance of Elain renders the fat fluid, such as oils; Margarin constitutes the solid element of lard, whereas human fat is an example; Stearin of suet.

II. Elementary Forms of the Human Body.

a. Elementary parts.

13. The first form from which matter is developed, and which lies as the basis of every organic structure (vegetable and animal), is, according to the general principle first enunciated by Schwann, 1838, the

Nucleated Cell, that is, a microscopical, delicately membranous vesicle, with fluid contents and a minute dark nucleus (Cytoblast) in one of its walls, surrounded by an amorphous, solid or fluid, substance (Cytoblastema or Intercellular substance), out of which the nucleated cell forms itself.

The nucleus is round or oval, rather flattened, yellowish red, smooth or granular, has a diameter of 0'002—0'004'' and probably first arises, as the granules are deposited from the amorphous mass about a central point, are circumscribed and blend together. About the nucleus formed from the mass a membrane is generated, the vesicle of the cell [cell membrane].

14. This process of development may at least be observed in the egg [germ] of vegetables and animals, in the formation and reproduction of certain tissues (for example, the nails and cuticle). Also in the blood, in pus, and in milk, the process is essentially the same. The formation of the elementary granules may be compared with the physical phenomenon, discovered by Ascher-son, namely, that when albumen was brought into contact with fat (oil drops) it coagulated in the form of a membrane, and enveloped them. But the vital and self-dependent progressive development of the nucleated cell is in no degree explained by this.

15. Increase of the Cells. The number of the cells in a tissue in the process of development, increases either by the origin of single new ones independent of one another (e. g., in the hair, nails, inflammatory exudation); or by the development, in the interior of the old and mature, of new secondary cells, to which the contents of the primary cell serve as cytoblastema. (Thus, in the development of the liver, and in pathological growths; e. g., Scirrhous.)

16. Metamorphosis of Cells. As the cells pass through various stages of development, they also present different circumstances in respect to their shape, position, contents, and chemical relations. In some tissues they maintain their independence, at most lying upon one another, and becoming thereby flattened, or
ELectementary Forms.

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17. In most tissues the cells blend together and coalesce. We find remaining,

1. The cavities of the cells unaltered, as their thickened walls blended together (in true cartilage, and osseous tissue), or the parietes impinging upon one another are broken through, so that continuous tubes arise (renal and seminal tubuli, perhaps also capillaries); or,

2. The cavities disappearing, their parietes lying flat together, so that the cells form solid laminae, which appear to be spread out either in a membranous or fibrous form, according to the position.

Here belongs also the coalescing of complex (endogenous) cells [see before], which are transformed into the primitive fibres of the nerves, and the primitive bundles of the animal muscular tissue.

3. The nuclei of the cells elongate, coalesce, and thus form the "nucleus fibres," which, much stronger than the cell fibres, upon which they are found, are distinguished from them, also, by their insolvency in acetic acid. They are either rectilinear, spiral, or like a tendril, according to the position of the nucleus in the cell.

18. As the cells are dislodged from their situation, or become again formed into the homogeneous mass of cytoblastema out of which they arose, intervals are formed which are filled with fluids or air; these are the intercellular passages. They are circumscribed by layers of cells, and appear, after the metamorphosis of the cells into fibres, as canals and cavities (closed and open vascular cavities, lined with mucous membrane), with membranous or fleshy parietes. It is, moreover, a matter of indifference whether the structureless matter which also serves as a uniting medium be solid, as in the bones, or fluid, as in the blood. The conditions for the formation of proper tissues are given with the metamorphoses of the cells and nuclei; in a system of Histologia these must also be received as a basis, and not that, more or less composed of organs, as in the earlier systems. As however the number of facts is yet too small for the complete carrying out of a scientific arrangement, we must for the present observe a greater number of casual successions. In this point of view, therefore, anatomy can lay no claim to the name of a science.

b. Individual tissues.

19. **External membrane, Epithelium.**

The non-vascular and nerveless thin investment which covers
all the surfaces of the body, the external skin, as well as the interior of cavities and canals, is called **Epithelium**. (Formerly this term comprehended the covering of the mucous membrane only.)

It consists of a layer of independent nucleated cells, formed from the organic matter, which the highly vascular surface (matrix) lying immediately underneath it, deposits, and which increases layer by layer.

20. It does not merely serve as a defence to the tunic upon which it exists, but also for the reception and secretion of certain substances. Wounding it gives rise to neither pain nor bleeding.

According to the Elementary parts, three kinds are distinguished. (Henle.)

a. Pavement epithelium. Cells and nuclei roundish, oval, or where lying close to one another, multangular, and conjoined like mosaic. This most frequent variety forms thick layers, and is found upon the internal surface of serous membranes, of the vascular system, upon the mucous membrane of the mouth, the nose, or the globe of the eye. Upon the cornea of the eye it soon becomes dull after death, and appears as a white mucus, whence the dull appearance of the dead eye arises. The salivary mucus, also, consists in great part of this kind.

To this belongs also the Epidermis. See external skin.

b. Cylinder epithelium. Cells of a cylindrical or conical shape, the point of which is directed towards the mucous membrane, arranged like fibres. Nucleus generally between the base and apex of the cone.

They are present in man upon the mucous membranes only. In the alimentary canal they commence at the mouth of the stomach (Cardia), and terminate at the anus; being most distinct in the cylindrical glands of the large intestines. Upon the mucous membrane of the male organs of generation; at the opening of the salivary glands. In the gall-bladder they appear coloured green.

c. Ciliated epithelium is distinguished from the cylindrical simply in the fact of its possessing ciliae at one of its extremities. The ciliae themselves are variously formed. Longitudinal diam. of cell = 0·0015 of a line, the ciliae = 0·0018 of a line.

They exist in man upon the mucous membrane of the respiratory organs, the eyelids, the female organs of generation, and upon the parietes of the cerebral ventricles. It is obtained most readily from the nasal mucous membrane.

**Ciliary motion.** According to Purkinje and Valentin, the discoverers, it is of three kinds:—

1. The cilia more in the shape of an inverted cone, since their apices describe a wider circle than their bases.
2. The whole cilia moves in an undulating manner.
3. The apex curves like a hook.

A low temperature (+5° R.), acetic, strong mineral acids and bile arrest the ciliary motion. The stream of the fluid in which the cilia move is opposed to the direction in which they curve, and generally passes from within to without.

The object of the ciliary movements is not yet ascertained. In diseases, for example, catarrh, the ciliary epithelium is at first thrown off.

are four-sided transparent plates of horn, rounded from before to behind, and from side to side, which are placed upon the dorsal surface of the last phalanx of the fingers and toes. They lie with their lateral edges in a fold of the corium. In the same manner the posterior border, the *root*, the length of which contributes one-fifth to one-sixth the length of the entire nail. The root extends about two lines deep into the fold, and is likewise surrounded above and below by the corium. The remaining portion, the *body* of the nail, is only united on the inferior surface with the corium; its anterior edge, the point of the nail, quite free.

22. The epidermis turns up at the root of the nail towards the fold of skin, without going deeper into it. By scalding the epidermis is loosened from the corium, and the nail with it.

23. The bed of the nail, *matrix unguis*, is the fold before mentioned, and the surface of the cutis which is covered by the nail. It determines the shape of the nail; is smooth above, below striated like the cutis. The striæ consist of elevated ridges which pass from before to behind, and upon which are placed cylindrical papillæ. The striæ become stronger towards the point of the nail and appear through, but the nail itself does not consist of parallel longitudinal fibres. Anteriorly the matrix is richer in vessels than at the root of the nail, where even a whitish semilunar mark (*lunula*) appears, whilst the rest of the nail is pale red.

The tissue of the nails is only distinguished from that of the Epidermis by its hardness and brittleness, which depends upon Phosphate of Lime (Lauth). It consists of flat, dry, non-nucleated cells, which, deposited in layers and spread out like a membrane, form plates, which run longitudinally. Corresponding to the *Rele Malpighi* of the Epidermis, we may here also remark a soft and white layer, particularly in young children. In old people indented, undulating transverse striæ appear upon the nails, particularly of the toes.

The nails are first distinguishable in the fifth month of fetal life by their firmness, but even in the third month the fold fixes their limits.

The growth of the nail takes place from the *matrix*, and the old parts are pushed forwards by the younger, from the roots. They may reach the length of two inches. In many diseases (*e.g.*, Typhus) they fall out, in others (as *Phtisis pulmonalis*, *Plica Polonica*) they become thickened and curved. After falling out, the surface of the matrix becomes covered with a thin horny layer, which is always more thickened over the recess of the *lunula*.

24. Granular Pigment,

improperly denominated black pigment, is, like the preceding, a nerveless and non-vascular tissue, for which the highly vascular membranes upon which it appears serve as a matrix.
25. It exists to the greatest extent among the coloured races, especially negroes, the entire surface of whose bodies is covered with it. It here lies between the cutis and rete Malp. of the epidermis. It is not black, but dark brown, and thus gradually proceeds even into yellowish. Among the Caucasian tribes it is especially found in the eye on the posterior surface of the iris. Moreover, also in the healthy state about the female nipple, on the skin of the scrotum, of the great labia, and of the anus, in the Bronchial glands; in pathological conditions, as Freckles, and in scirrhous growths.

The pigment tissue consists of globular, multangular, or tubular, elongated cells (pigment cells) in which the coloured particles lie (pigment corpuscles). The pigment from the internal surface of the Choroid coat of the globe of the eye is the best for examination.

The cells are destroyed by putrefaction, and are soluble in acetic acid; the pigment granules pass out, as extremely small, flat points, which, only when they are heaped together, present a yellowish red and brownish appearance. They are only soluble in caustic Potash, and become changed in colour by Chlorine.

The ashes of the Pigment consist of muriate of soda, lime, phosphate of lime, and oxide of iron. The purpose fulfilled by the Pigment in the skin cannot be decided; in the eye it serves to protect it from too strong light. Pigment is wanting in the eyes as well as in the hair of Albinos.

26. Hairs, Pili s. Crines,
are thin, hard, elastic, and thread-like cylinders of various colours. Non-vascular and without nerves like the foregoing tissues, they must, however, on account of their more complicated structure, be considered as more highly organised. They are also nourished by a highly vascular basis, which is regarded as an inversion of the cutis.

The whole external surface of the body is covered with larger or smaller hairs, with the exception of the palms of the hand, the sole of the foot, the lips, the superior eyelid, the foreskin, Glans penis, and Clitoris.

Structure. The roots of the hair lie deeply in the cutis, surrounded by the hair follicle, and seated with the soft club-shaped bulb upon the germ of the hair (Pulpa). The body or shaft of the hair projects beyond the surface of the body, and terminates in a free point.

In the shaft two substances are distinguished:

a. The Cortex, is transparent and smooth, striated longitudinally, fibrous, especially towards the roots. The transverse stripe, which are observed upon it, consist of encircling scales, which may be detached by the action of Sulphuric Acid.

b. The medullary substance is wanting at certain points in coarse, and sometimes altogether in fine hair. It consists of small globules, resembling fat drops, is dark, and never found in the point of the hair. Diameter
0-017 of a line. The length, thickness, and shape of the shaft vary considerably with individuals and in different parts of the body. The free extremity is frequently split.

The hairs of the head are generally cylindrical, frequently also flat and very curly (woolly hair of Negroes).

The beard and pubic hairs, those of the axillary fossa, of the eyebrows, the entrance to the nose and the ears, are oval (upon transverse section).

The root of the hair, bulb (head of the hair according to Henle), bulbus pilii, is soft, viscous 1—2 lines long, below thick and hollow, containing a tenacious substance, in which cell nuclei lie (as in the rete Malpighi); farther upwards, surrounded by transverse fibres, which connect firmly together the longitudinal fibres; the superior extremity is uninterruptedly connected with the shaft of the hair. The Medulla by degrees loses itself below.

Outside the shaft of the hair the sheath of the root passes from the bulb, which immediately continues into the Epidermis, of which it is only an inversion, just as

The Hair follicle (folliculus pilii) is an inversion of the Corium. This consists of fibres of areolar tissue, and terminates blindly, with a process above (Pulpa), upon which the hair bulb is seated. It possesses nerves and vessels, pain and blood, therefore, on wounding. Into it open the smallest sebaceous (gland of the hair follicle) glands. (See, under Cutis.)

Characters. Hairs become electrical by rubbing, and attract moisture both from the air and body. They are therefore soft and shining in perspirable, and brittle in dry skins.

Chemical. Hair consists of fat and Keratose substance, the former probably coming from the medulla, the latter from the cortex. Boiling alcohol draws out the fat containing the colouring matter, Elaine. It is acid; red in red, and greyish green in dark hair. Nitric acid dissolves the hair, chlorine bleaches and makes it glutinous. In the ash we find some oxide of iron, oxide of manganese, and silex, together with sulphate, phosphate, and carbonate of lime.

Growth. Hairs grow out of the highly vascular follicle, and are renewed, like the nails, by deposits from below. The cut off point is not again restored, but the piece immediately next to it is pushed from below forwards; the point is also the first part generated. The first development appears after the third month of fetal life; even before birth the entire body is covered with woolly hair (lanugo), which at a later period falls off.

With puberty the beard and pubic hairs are developed, the hair in the axilla, glandulare, and on the chest.

Note. The skin of the head produces most hair (≈ 293 on ½ a line square), more fair than brown, and more brown than black. The hair follicles generally lie in twos and threes in regular lines, for which a fixed point, e.g., the crown of the head, serves as a centre.

In old age the roots of the hair become knotty; the shaft, from deficiency of oil, grey; and the hair falls off. White hair is also found on Albinos.

Note. Hair is sometimes found abnormally upon the mucous membrane of the eye, in the gall bladder, in the ovaries [and in the thorax. Preparation shown to me by Dr. Munk. Trans.]
where throughout the body, serving partly as a uniting, partly as an enveloping medium for the organs and their elements. It possesses a fibrous interlacement, is very elastic and translucent, and by boiling is metamorphosed into Gelatin (?)..

**Structure.** Uniting tissue consists of long and probably solid fibres, which, held together by amorphous blastema, and generally united into white bundles, become transparent by acetic acid. Dark spiral filaments, which are not made transparent by acetic acid, wind themselves in a serpentine arrangement about each bundle, and are probably developed from nucleus fibres, just as those of the first from fibres of the cell vesicle.

29. We distinguish two kinds of uniting tissue:

1. Amorphous. It is loose and fills up the intervals between the organs and their parts, for example, between the lobes and lobules of the liver; it lies in great masses under the Cutis, and forms cells, in which air and fluid may collect, or in which fat vesicles are deposited. Vessels and nerves traverse it in larger or smaller numbers. Burdach calls the uniting tissue which envelopes the exterior of organs atmospheric (thus the subcutaneous areolar tissue), and that which enters into the organ parenchymatous.

2. Figurate. It forms membranes, bladders, cords, and discs; is fibrous, and the more even and brilliant the thicker its tissue. Of it we may distinguish two kinds:

a. Not contractile, uniting tissue (fibrous or tendinous).

1. Tendons. They are very dense and strong, little elastic, and long resist decomposition and chemical influences; they contain 0·62 water. Where tendons pass over bones, a loose uniting tissue with coarse meshes surrounds them (Synovial sheaths), in which a glairy clear fluid is contained (Synovia).—The tendons (sinews) are adherent to the muscular fibres, from which they are only prolonged, and to which they are firmly attached by uniting tissue.

2. Ligaments, ligamenta, are quite similar to tendons, but generally flat. To this class belongs the round ligament (lig. teres), which assists in maintaining the head of the femur in the acetabulum; the membrana obturat. of the thyroid or oval foramen of the oss innominatum and the memb. interrossea form a transition towards the fibrous membranes. The elastic and interarticular ligaments of the vertebral column do not belong to this class. (See Syndesmology).

3. Ligamentary discs. [Interarticular cartilages, Glenoid ligaments.] Very strong, and therefore formerly enumerated with the cartilages which, moreover, are less elastic. They are intended to prevent the pressure of two cartilaginous surfaces upon one another, on which account they are also invested with Synovial sheaths. Tendinous fibres, which pass off from the borders, are attached to the articular capsules or cartilages. Ligamentary Discs are found in the articulations of the jaw and knee; in the superior eyelid (tarsus, the so-called cartilage), around the articular fosse of the acetabulum and scapula (labra cartilaginea).

4. Fibrous membranes. To this class belong:

The external coverings or case of many viscera, serving as a defence for the Parenchyma, or for the attachment of muscles, e. g., the Sclerotica of the eye, the Albügsinae of the testis, Dura Mater of Brain and Spinal cord, the covering of the pericardium, of the kidneys, ovaries, spleen, clitoris, and urethra.

The tendons of the muscles attached are interwoven with them. Their tissue consists of separate fibres, or of more or less interlaced bundles. They are covered with epithelium.
The tendinous expansion of the Diaphragm.
The *membrana tympani*.
The valves in the heart, the veins, and in the lymphatics.
The neurilemma, that is, the envelope which surrounds the nerves.

The *fasciae*. They are developed from the amorphous layers of uniting tissue like membranes, and envelope the muscles passing into the intermuscular ligaments, and from these into the periosteum (*ligament, Cruciate*), or into the tendons of muscles (*fasc. rect. abdominis*).

*Periosteum* (membrane covering the bones), and *Perichondrium* (that covering the cartilages). They surround the bones and cartilages externally, and are attached to these, from the first, by the extremely numerous vessels connected together by areolar tissue, of which they consist. In the cavity of the bones the periosteum is with difficulty separated from the epithelium lying upon it.

5. *Tunica propria* of the intestinal canal, of the gall and urinary bladders, the pelvis of the kidneys, the ureters, &c., is a peculiar membrane (*T. nervæ, vascułosa*) of uniting tissue, which lies between the muscular layer and mucous membrane; shining white; almost inseparably connected, externally, with the uniting tissue of the muscles; internally, with that of the mucous membrane.

6. Serous membranes. They serve as the boundaries of cavities inside the body, and are generally quite closed. Henle makes a distinction between true, that is, such as are covered on the outside with (pavement) epithelium, and false, in which it is wanting.

To the false belong the *Burseæ Mucöse* of muscles, tendons, and membranes; these are closed sacs, filled with watery or viscose fluid, which lie between muscles and bones (*capsule synoviales*).

The true serous membranes consist of a layer of Epithelium (generally pavement, only in the tubes of the Uterus ciliated), and of fibrous uniting tissue, which approaches at one time fibrous, at another time elastic tissue. The separation of the subserous uniting tissue is, almost in all cases, only artificial.

They not only serve for lining cavities, but also as the envelopes of the organs which lie in them. But it is not essential that they should be, everywhere, entirely closed. (The peritoneum of the female is open at the extremities of the Fallopian tubes.)

To this class belong: Plura and Peritoneum, Pericardium, Arachnoidea, Tunica Vaginalis. They lie in the cavities as sacs, the external surface of which is attached by plain uniting tissue, partly to the walls of the cavities, partly passing over upon the organs, which forms a sort of inversion of it; the internal surface is smooth, covered with pavement epithelium, and secretes a thin, watery, albuminous fluid, *Serum*.

The sacs form folds, ligaments, and rete, particularly at the places where the vessels and nerves are allowed a free thoroughfare to the organs enveloped by them. The vessels and nerves become, therefore, covered by uniting tissue and epithelium, but they do not perforate the serous sacs.

The serous membranes do not pass merely into fibrous, but also into mucous membranes (*e. g.*, mucous membrane of the tympanic cavity).

7. The vascular membrane of the brain (*Pia Mater*), and that of the eye (*Choroidea*), that is, a membranous uniting tissue as a support for vessels which nourish another organ. *Pia Mater*, like *periosteum*, is firmly connected with the brain, into which its vessels penetrate, and consists of loose bundles. *Choroidea* resembles the Corium, which serves as a Matrix for the Epidermis.
It is dense, strong, and smooth, and only made adhesive by the black Pigment which it deposits.

Vessels and nerves of figurate, non-contractile unifying tissue. Vessels which not only go through, but belong to the unifying tissue itself, are found in small numbers in the strong structures (tendons, fibrous membranes); in larger in the serous, the proper, and vascular membranes. Moreover, the quantity of the vessels in one and the same membrane differs according to position (e.g., the synovial membrane is more highly vascular at that part where it covers the fibrous articular capsule, than upon the cartilage).

Nerves are not found in the tendons (therefore they are not sensitive); such as are found in the fibrous membranes do not probably terminate in their substance. Whether nerves passing to serous membranes remain in them, is also still doubtful, although it is a fact that peritonitis or pleuritis is very painful.

b. Contractile unifying tissue, that is, such as contracts upon irritation. To this class belong:

1. The external skin, Cutis and Corium (which see).

2. Tunica dartos (see Splanchnol.), the wrinkled, reddish membrane on the posterior surface of the Scrotum, of fibrous tissue, which consists of a network of longer meshes, since the longitudinal bundles of unifying tissue anastomose. (Septum Scroti consists of fibrous and common unifying tissue.) It is remarkable for its vascularity and contractility, without muscular fibres.

3. The tissue of the Corpora Cavernosa, of the penis and Clitoris, of the corpus Spongiosum urethra, consists of a dense network of very extensible, but strong, flattened, or roundish bundles of unifying tissue. A fibrous sheath envelopes and separates the two cavernous bodies. From it (tunica Albuginea) larger or smaller laminae and septa extend inwards into the above-mentioned network: each lamina is provided with a blood-vessel.

4. The contractile tissue of the longitudinal and circular fibrous coat of the veins and lymphatics (which see).

The movement of the contractile tissues is not the consequence of a merely physical elasticity. The external skin, when it contracts, becomes thickened, shortened, and sinks in; the openings of the hair follicles therefore pass out (goose-skin), the hair stands on end. The same with the nipple.

The Scrotal skin lies in transverse folds, when the longitudinal fibres of Tunica Dartos contract.

The Penis shrinks up, becomes harder and firmer, and the blood retires, when the cavernous tissue contracts.

The development of uniting tissue takes place from nucleated cells, as may be demonstrated, which, according to Schwann, become pointed in two opposite directions, and in this manner form spindle-shaped fibres, from which finer ramifications pass off.

Uniting tissue is very readily regenerated; its lost substance is replaced by a scar (cicatrix), which in loose parts is more firm, in tendinous less so.

The fluid (serum) which we find in uniting tissue, is no secreted product from it, but is the fluid of the blood which penetrates the parietes of the vessels therein, and so much the sooner collects together the looser it is (e.g., in dropsy of the scrotum, about the ankles, &c.)
In like manner, the fat is still less a secretion of the uniting, but, a proper tissue.

30. The Adipose Tissue,

has only of late been recognized as an independent tissue, particularly by Gurlt, whilst formerly, misled by the appearance of the fat vesicles in the cellular interspaces of the uniting tissue, we were accustomed to regard the latter as the organ for the secretion of the fat. But even the divided portions of fat, surrounded by uniting tissue, have their own proper cells separated from it.

Distribution. The fat tissue appears connected together like a membrane, especially in the uniting tissue under the corium, as the most inferior layer of which (fat membrane, Panniculus adiposus) it is considered; more abundant in children and women than in the aged and men; in greatest quantity under the sole of the foot and on the mammary gland. Less perfectly formed and more collected together in masses it presents itself in the orbits, and as marrow in the medullary cavities of the cylindrical bones. Accumulated immoderately in all the usual places, general corpulency results; in separate or uncommon regions it is present, as lipoma (fatty tumour).

Structure. The fat tissue consists of cells, in which a dropping fluid, the fat, is contained. The cell is, inside the body, oval and smooth, becomes irregular on cooling, angular or flat. Diam. = 0.018 of a line to 0.056. Their surface refracts light strongly, the edges are bright silvery white when light falls upon them. The vesicle is very delicate; in its wall an oval nucleus generally appears (even two). The cell becomes smaller, and is entirely soluble in acetic acid.

Development. Fat forms and becomes consumed very quickly, probably in consequence of the fat-cells being dissolved (especially in dyscratic diseases and after blood-letting), and the fat taken up by the lymphatics and carried into the blood.

31. Elastic Tissue, tela elastica,

is when of some thickness yellow; elastic but fragile, closely allied to the uniting tissue; does not change into Gelatin by boiling (Berzelius), is insoluble in concentrated acetic acid, soluble in dilute sulphuric acid, and is precipitated from the solution by Infus. of Galls, but not by ferro-cyanide of Potassium.

Distribution. The Elastic appears in connection with other tissues, but also independently, combined as membranes and flat ligaments, in—
1. The yellow ligaments of the vertebral columns: Lig. flavum, obturatoria atlantis.
2. The ligaments and membranes of the Larynx, the Trachea, and the Bronchi.
3. The elastic fibres of the Oesophagus, in the cutis, many fasciae and serous membranes.
4. The external (not central) coat of the arteries (and veins?). See Angiology.

The fibres of this tissue are strongly serpentine, like the nucleus fibres of uniting tissue (both insoluble in acetic acid); or curved and curled, of an S shape (in the lig. flavum); or anastomosing with parallel, neighbouring fibres (in the arterial coat). The fibrous appearance is not so distinct as in the structures consisting of uniting tissue. It is commonly mixed up with uniting tissue; the purest is presented by the yellow ligaments.

Few vessels are found therein; nerves, probably, not at all.

Uses. Connection of bones, for the boundary of cavities, envelope of muscles, the last being assisted in their performance by the very extensible elastic tissue.

32. Cartilage tissue.

Cartilage, cartilagines, χόρδατα, are smooth, firm, elastic and flexible, more or less brittle parts, of a milk blue, even yellow, colour, of spec. grav. = 1·15; consisting of a homogeneous basement substance, between which vesicles are scattered, or even fibres are found. We accordingly distinguish:

1. True cartilages, that is, such as consist of homogeneous basement substance, containing cavities and cells with (from 1 to 4) nuclei, but seldom cells containing fat. They are covered with a strong membrane of uniting tissue, Perichondrium which contains vessels, on their free surfaces. To them belong,
   a. The Nasal.
   b. Cartilages of the respiratory organs (except, cc. Santorini, arytenoid, epiglottis, corpuse. triticea, and lig. hyothyreoid. lateralia).
   c. Rib cartilages and cartilage of proc. xiphoideus.
   d. Articular cartilage (except the ring around the cavitat. glenoidal, and the condylus-maxill. inferior).

The rib cartilages break transversely very easily, and incline to ossification, whilst in them, as in the thyroid cartilage, fibres become developed, which are at first pale, later yellow and stiff. They lie close together in bundles, and receive the cartilage cavities between them. Thus arises the transitional form into

2. Fibro-cartilages, cc. fibrose. Their basement substance consists of darker, harsher, and stronger fibres than are present in the true cartilages; they are more flexible (do not break so easily), and more yellow, containing nucleated cells holding fat (hence an inclination to be transformed into fat). To them belong:

Ligg. intervertebralia, Synchondroses, Ear cartilages, Epiglottis, cart. Santorini, and Wrisbergii, cart. tubae Eustacii, c. interarticular. of the sterno-clavicular articulation, the Meniscus of the maxillary articulation. The so-called fibro-
ELEMENTARY FORMS.

33

cartilaginous mass in the space between Petrous, Sphenoid, and Occipital bone (foram. lacerum anterius) consists of pure uniting tissue.

Chemical. The principal element of cartilage is Chondrin, which arises after boiling true cartilages from fifteen to eighteen hours, and false, which is well supplied with cartilage cells, for forty-eight hours. Cartilage contains about three-fourths water, nevertheless it does not readily decompose. Salts: Carb. Soda (most); Sulphate of Soda, Chlor. Soda, phosph. Magnes.; some oxyd of Iron.

Vessels and nerves. Most cartilages are without vessels, but in connection with highly vascular bones and synovial capsules. From out of the Perichondrium vessels pass into the (true) cartilages, e. g., the ribs. Also the Synchondroses (Symphysis pubis, &c.) are said to contain vessels during pregnancy. In the ossification of the thyroid, rib, and fetal cartilages new vessels form. The articular cartilages never ossify, but become rough and degenerate; in consequence, the immediate ends of the bones grow together (Ankylosis). Cartilage is not sensitive, possessing no nerves.

Upon bone cartilage, see Osteology.

33. Nutritious Juice

consists of a fluid portion, Plasma, and of a solid, the microscopical corpuscles which are suspended in the former in great numbers. Plasma (lig. sanguinis et lymphæ) is a homogeneous mass which at death divides into a fluid (serum) and a coagulable portion which forms by enclosing the corpuscles, the blood or lymph clot, coagulum (Cruor Placenta).

The corpuscles pass through, in a short time, several stages of development, like the Organisms, to the maintenance of which they contribute. As the last stage, as modifications (certainly only imaginary) of the nutritious juices, we must consider those which are designated by the expression Blood, Chyle, and Lymph.

The analogy between the Plasma and Cytoblastema, the corpuscles and nucleated cells, has already been referred to.

34. 1. Chyle, Lymph.

1. Chyle. This is the milky fluid formed as the result of the digestion of nutritious substances in the intestines, and taken up from them by the lymphatics (lacteals). It immediately takes its course with the lymph, which very soon unites with it, through the large lymphatic trunks, and thus passes into the sanguineous system.

The Chyle at the commencements of the lymphatics [lacteals] (where it is not, however, even more free from lymph) has a milk-white colour, which depends upon fat globules, and does not coagulate. It contains besides

the fat (C. H. Schultz), very small, generally round corpuscles (nuclei of blood corpuscles?), which increase the more the fat diminishes; the relative quantity of fibrin and albumen is smaller than in lymph.
35. 2. Lymph is the fluid of the lymphatics, flowing into the
system of blood-vessels, formed from the surplus of the blood
plasma and the destruction of the particles of organs.

A thin fluid, colourless, sometimes yellowish and lastly red; alkaline reac-
tion, and saltish taste. Contains larger corpuscles which, round and smooth,
are rather larger than the blood corpuscles (see after), of about 0·002 to 0·005
of a line diameter; their shell soluble in acetic acid, the nucleus insoluble;
and smaller, that is, nuclei without cells; the Plasma of lymph contains fibrin
which coagulates of itself, after ten to fifteen minutes, into a lymph coagulum
which encloses, partly, the corpuscles.

The Serum consists of 92 to 96 parts water, albumen, alkaline
salts, and oxide of iron. The small lymph corpuscles, cell-less
nuclei, are metamorphosed into blood discs, but not so the perfect
lymph globules.

36. 2. Blood, Sanguis,
a bright red fluid in those vessels called arteries, a dark red in the
veins, of 1·052 to 1·057 sp. grav. (at + 15° R.), [65° Fahr.],
and saltish taste, easily decomposes. Living blood consists of
fluid (Plasma) and blood corpuscles.

Out of the vessels the blood coagulates after 5 to 7 minutes,
and separates into a firm portion (coagulum, Placenta), and into a
fluid (Serum); the coagulum contains the coagulated fibrin,
and the (red) blood corpuscles, the yellow serum, the albumen,
and the salts of the blood.

1. Blood corpuscles. Coloured and colourless are now dis-
tinguished.

a. The coloured, singly yellow, in heaps appearing red, are very smooth
and slippery; in the human subject flat, round, of 0·0025 to 0·0032 of a line
diam. (broad), and of 0·0008 to 0·0012 of a line diam. (thick); very elastic,
soft and heavier than the plasma. A nucleus (as we see in the blood cor-
puscles of the frog, which are four times as large) is rarely or never observed
in those of man.

The substance of the nucleus is fibrin (J. Müller, Fr. Simon). The case
is very sensitive, swells out in water and principally in less concentrated
fluids than the Serum; shrinks together in concentrated solutions, and is
soluble in acetic acid.

Inside the case we find a viscous fluid, in which, probably, the colouring
matter, soluble in water, is contained (Haematin and Haemaphæin), which
amounts to about 0·55, and may be abstracted by alcohol. The Globulin
(Berzelius) is also a part of these contents, probably albumen with phosphate
of lime. The cases of the blood corpuscles have not yet been chemically
examined alone.

Cruor (not to be confounded with Haematin), blood red, is the term given
to the mixture of the cases with their contents.

b. The colourless blood corpuscles are somewhat larger than the coloured;
they possess a nucleus, and are more frequently present in the serum than in
the blood coagulum. They are developed from the Chyle and Lymph corpuscles, and are metamorphosed into coloured blood corpuscles, without nuclei.

2. Blood Plasma, the fluid element of the blood, contains, dissolved in water:
   a. Fibrin, more in males, in pregnant women, and in inflammations, particularly of the lungs.
   b. Albumen, more in females than in males.
   c. Fat, in indefinite quantity; the greater the quantity, so much the more white the serum.
   d. Extractive matters.
   e. (Peculiar smelling substance, which is especially brought out by sulphuric acid, and may serve to distinguish between animal and human blood.) (Barruel.)

Oxide of iron is found in the blood in very indefinite quantity, only. Bile, urea, as well as sugar also, are found probably only in diseased blood.

Although the composition of the healthy blood differs according to the age, sex, &c. of man, there always remains, nevertheless, a certain relative proportion of the elements before quoted. F. Simon gives the following proportions as the result of an analysis of healthy venous blood.

1000 parts of blood consist of:

<table>
<thead>
<tr>
<th>Element</th>
<th>Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>791.900</td>
</tr>
<tr>
<td>Solid residue</td>
<td>208.100</td>
</tr>
<tr>
<td>Fibrin</td>
<td>2.011</td>
</tr>
<tr>
<td>Fat</td>
<td>1.978</td>
</tr>
<tr>
<td>Albumen</td>
<td>75.590</td>
</tr>
<tr>
<td>Globulin</td>
<td>105.165</td>
</tr>
<tr>
<td>Hæmatin</td>
<td>7.181</td>
</tr>
<tr>
<td>Extractive matter and salts</td>
<td>14.174</td>
</tr>
</tbody>
</table>

The arterial blood contains less solid elements, less fat, albumen, hæmatin, extractive matters, and salts. The blood also of ven. porta., that of the hepatic veins, &c., present each again particular differences.

Coats of vessels, see Angiology.
Muscular tissue, see Myology.
Tissue of nerves, see Neurology.

37. Tissue of Glands.

Glands, glandulae, was the name formerly given to all soft, roundish, highly vascular organs, with or without excretory ducts. They are organs of the most different sizes, which take away certain substances from the blood, for the purpose of conducting them (as such or metamorphosed) either immediately to the surface of the body, or first into cavities, where they become mixed with their contents. They are therefore divided into membranous and vascular glands.

1. Membranous, or glands of mucous membranes, possess a
cavity which constantly, or at times, is in communication by canals or immediately with the surface of the body. The most simple are round vesicles (cells) clear as water, of 0.01 to 0.03 of a line diam., formed of a structureless membrane, with granular contents and closed, lying in the substance of the mucous membrane, without elevating it. Similar, but larger, are the gl. tartariceae of the gums, gl. agminatae and solitariae of the small intestines and the egg in the ovary. They open at times. We therefore distinguish simple (gl. simplices, cryptae) and compound glands (gl. compositae), and among these gl. conglomeratae, which form a mass, with one or few excretory ducts, and gl. aggregatae, which only lie close together, and possess separate excretory ducts. Forms of glands:

a. Glands like blind sacs consist of a series of vesicles opening into one another, the first of which is closed, whilst the last opens upon the mucous membrane or into an excretory duct. The shortest are the glands of Lieberkühn in the small intestines, filled with viscid granular contents; they are longer upon the large, particularly in the rectum. More in clusters, but unarranged, appear the gl. pylorica (gastric fluid glands), the gl. Meibomiana of the eyelids, and the glands of the caruncula lacrimalis. Wound up like a ball of thread, convoluted: sweat glands of the skin and the ceruminous of the ear.

b. Glands in the form of a bunch of currants, racemose; are so composed, that single vesicles are united into one lobule with a common excretory duct. The primary lobules are associated together by uniting tissue into larger secondary, and these into tertiary, which all communicate by the common trunk of the entire gland only. The whole gland possesses a more or less condensed covering of uniting tissue, never a serous. These racemose glands are distinguished from one another, only, by their mass, size, and the ramifications of their excretory ducts. The lacrimal, mammary, and prostate glands are remarkable, since in them a common excretory duct is wanting, and the mass of several gland lobules appears joined together. Besides these and the accumulated (gl. conglomerata) Tonsilae, to this class belong the small mucous glands of the lips and cheeks, of the palate, tongue, and esophagus; of the Larynx, Trachea, Bronchi, gl. Brunneriana of the small intestines, the mucous glands of the Vagina; the salivary glands, the Pancreas; gl. Cowperi and Bartholiniana.

c. Reteform glands consisting of tubes (therefore gl. tubulosae), which, like the blood-vessels, are united by anastomoses into a network, and never or rarely terminate blindly, being, besides, many times convoluted. Their excretory ducts open into bladder-like receptacles for the secretions (as in the liver). To this class belong the kidneys and testicles. They are surrounded by a fibrous membrane, which in the last sends septae inwards, so that the lobules may be distinguished.

The vessels of the glands are very numerous. In the Liver, Kidneys, and Testicles they pass in and out at the Hilus; in the rest of the glands they are distributed from different points upon the surface, since they follow the uniting tissue between the lobes, lobules, and tubules.

Nerves form plexuses upon the arteries, and accompany these into the interior of the glands.
2. Vascular glands. These are the Thyroid and Thymus glands, Spleen and Caps. supra renales. They are soft, round, or lobulated, pale or dark red, without excretory ducts. In the thyroid and thymus glands small cavities are found filled with a milky fluid. The parenchyma consists, in all, of granules which fill up the spaces between the vessels. They are, proportionably, not superabundantly, provided with blood and lymph vessels. In the spleen and supra renal capsules the vessels quickly pass into capillary ramifications, without marked anastomoses. In the supra renal capsules a greater abundance of nerves prevails. It is pretended that their function consists in producing a change in the composition of the blood; of what kind is unknown.

With these may be classed the Lymphatic glands, which consist of a convoluted arrangement of Lymphatic vessels passing uninterruptedly through them (*vasa afferentia* and *afferentia*). The alteration effected in the blood and lymph as they pass through them is even still doubtful.

SPECIAL ANATOMY.

38. General cutaneous covering of the body.

The external surface of the body is invested by a compound membrane, which, at the openings of the internal surface, turns inwards, and lines the open cavities, as mucous membrane.


It invests the whole of the outer surface of the body, is itself covered externally with the epidermis (see Epithelium). internally with loose uniting tissue, and consists of a very filamentous, interwoven uniting tissue, with glands, nerves, and vessels: this is the Corium.

1. *Epidermis*, cuticle, is a connected, nowhere perforated, more or less strong layer of pavement epithelium. Its usual thickness measures one-twentieth of a line, but in the palm of the hand and under the sole of the foot equals \( \frac{1}{3} \) to 1 line. In life colourless and diaphanous, it becomes in death white and transparent: is little elastic, but brittle, curling up together when detached from the cutis, peels off, especially in cutaneous eruptions, and rises in blisters on the application of heat. It does not decompose; it is coloured by sulphuric acid, brown, by nitric, yellow, by hyd. chloric, not at all, by nitrate of silver, first milky white, then greyish blue, by hyd. chlor. of gold, purplish red. Caustic alkalies dissolve it. Elements:—keratin equal to 0·94, gelatin equal to 0·5, lactic acid, sulphate, phosphate of potash and lime.
The unevenness of the epidermis depends upon that of the corium which is found underneath it. There are elevations, grooves and fossæ, from the last of which hair, sweat or fat, with which the cuticle is constantly saturated, appears. By boiling, the epidermis easily separates, especially in the palm of the hand or sole of the foot, into an external and an internal layer. The internal layer (rete Malpighii), improperly regarded as a peculiar membrane, is softer, but not essentially different from the external layer, into which, by degrees, it passes; its reteform appearance arises from rearing out the nervous papillæ of the corium, otherwise it is granular, whilst the external layer appears striated. In the Negro the rete Malpighii is, likewise, nothing else but this internal layer with black pigment adherent to it.

2. Corium, true skin, is a soft, at the same time strong, dense, and very extensible organ, of a red colour and variable strength; thickest in the surfaces of the foot and hand, stronger in the male than in the female, and very delicate on the eyelid and the glans penis. Upon its external free surface we observe folds, especially in places which are subject to extension (in the palm of the hand, upon the dorsum of the fingers, on the foreskin). Other folds are formed by means of the muscles, which act upon the skin (e.g., on the forehead). These, in time, remain constantly (as wrinkles), like the folds which arise upon the abdomen, in consequence of the greater extension, after pregnancy and dropsy; in old age they arise from the loss of the fat.

The skin is moveable by proper cutaneous muscles (in man on the face and in the hand only); by a very fatty, as well as expanded uniting tissue in the form of a membrane (fascia superficialis). See Myology.

The external skin is both an organ of touch and of secretion, by means of the tactile papillæ, arranged in rows, upon the linear elevations, the sweat and sebaceous glands, and the glandules of the hair follicles found in the depressions between them.

a. Tactile, sensitive papillæ, Papillæ cori, consist of closely compressed fasciculi of uniting tissue, in the interior of which a vascular and nervous loop passes. (The nerves do not terminate like a hair-pencil or club, but are reflected, and return to the surface of the skin.) The Papillæ lie in the uppermost layer of the Corium, covered by the Epidermis, which fills up, partly or entirely, the depressions between them, and therefore gives to the skin either a grooved or even appearance. We distinguish filamentous and club-shaped papillæ. The finer they are, so much the more crowded they stand, and the more sensitive is the skin (e.g., on the inner surfaces of the fingers, in the sole of the foot, on the nipple, the lips, glans penis, and clitoris).

b. Sebaceous follicles, folliculi sebacei, spread over the whole surface of the body (with the exception of the palm and sole), found especially at the points of transition of the external skin into the mucous membrane. The larger open immediately upon the skin, namely in places devoid of hair (e.g., the glans penis, the nymphæ); they do not consist, probably, of simple follicles, but must be enumerated with the racemose glands; the smallest lie in pairs on either side of a hair follicle, and open immediately into it. These last consist of small fat cells which lie dispersed in round heaps of 0.007 of a line in diameter. They contain an oil, the grease of the skin, sebum cutaneum, which makes the skin and hair pliable. To the glands of the hair follicles belong also, probably, Eichhorn’s lymph spaces of the cutis.
SPECIAL ANATOMY.

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c. Perspiratory glands, *organa sudoripara*, consist of a blind tube, which reaches downwards deeply into the cutis as far as the layer of fat (where it is convoluted), and opens with a spiral excretory duct, which is lined with pavement epithelium, like a funnel upon the surface of the skin. Their openings (pores) are placed in the grooves between the Papillae. [On the ridges. *Trans.*] They secrete a fluid filled with mucous corpuscles and epidermis scales. Similar in structure are the Ceruminous glands of the ear, the cells and contents of which, however, are different; their secretion contains fat vesicles.

40. II. Mucous membrane, *Membrana mucosa*.

It lines the internal cavities, since it penetrates, as the immediate continuation of the Cutis, at the external openings into the interior, passes through the whole digestive canal, and covers the respiratory organs, glands, urinary and genital organs. It is soft, like velvet, plentifully supplied with vessels and nerves, thicker or thinner, according to situation, greyish white or red, and particularly strongly developed at the external openings. It consists, like the Cutis, of Epithelium and a peculiar membrane of uniting tissue, which is connected to a muscular layer by more or less strongly developed uniting tissue (*tunica nervea*). One or more of these layers are lost as they proceed. The epithelium is thinner and more slimy (as the so-called *rete Malpighii* occupies the surface), the uniting tissue is more delicate, e. g., in the intestines, unites with the fibrous periosteum, where the mucous membrane lies upon bones (when the muscular layer is lost); or is remarkable for elastic fibres in the Trachæa and the Bronchi.

Like the external skin, it is beset with projections (folds, valves, villi, and papillæ) and depressions (sulci and fossæ).

a. The folds are for the purpose of increasing the superficialies in the interior of canals and cavities, where absorption, secretion, or sensation is the object; and may, after removing the muscular coat, be drawn out (*plīce Kerkring*, in the intestines, *columnæ rugarum* in the Vagina, &c.).

b. The papillæ are also present, especially in places which are designedly very sensitive to touch, e. g., the lips, gums, tongue, palate, labia externa, vagina.

c. The villi are present upon the mucous membrane of the small intestines only; they resemble the filamentous papillae, but contain (instead of vascular and nervous loops), lymphatic rete, which have vascular rete spun all round them.

d. The fossæ are the openings of the mucous glandules, *folliculi mucosi*. The simple mucous glandules are not always closed follicles (*gl. solitariae* and *Peyerianæ*), over which the mucous membrane, with its villi, passes. When open, they appear to be inversions of the mucous membrane. To the class of glands with blind sacs belong the dispersed *gl. solitariae*, the amassed *gl. Peyerianæ*, *gl. Lieberkühnianæ* in the small intestines, the closed *gl. tartaricæ* in the gums, and the glands for secreting the gastric juice in the pylorus; to the
racemose, the glands of the lips, cheeks, tongue, oesophagus, larynx, &c., *gl. Brunneriana* of the small intestines, &c.

We may distinguish three separated tracks of the mucous membrane.

1. The digestive and respiratory mucous membrane commences in common at the mouth, continues into the excretory ducts of the salivary glands, upon the nose, through the lacrymal canals, and punctæ upon the fibrous coat of the eye, through the *tuba Eustachii* upon the cavity of the tympanum; it then passes on the one hand from the Pharynx through the Larynx to the Trachea and Lungs, on the other through the oesophagus to the stomach and intestines.

2. The mucous membrane of the genital and urinary organs is more separated in the female than in the male. The urinary mucous membrane, commencing from the external opening of the genitals, terminates in the excretory ducts of the kidneys, and continues in the male through those of the Prostate, into the seminal vesicles, ducts, and testicles. In the female the genital mucous membrane goes from the Vagina into the Uterus and tubes, and opens freely into the abdomen, where the serous cavity of the peritoneum communicates with it.

3. The mucous membrane of the mammary gland commences at the nipple, and terminates in the closed extremities of the milk ducts.

*Division of Special Anatomy.*

1. Osteology treats of the bones.
2. Arthrologia (syndesmologia), of the connection of the bones.
3. Myologia, of the muscles.
4. Splanchnologia, of the viscera and organs of the senses.
5. Angiologia, of the vessels.
6. Neurologia, of the nerves.
"The frontispiece represents Galen contemplating the skeleton of a robber who, being killed by a traveller, had his bones picked in two days by vultures. This opportunity he mentions as a piece of good fortune, though he had seen another skeleton which was accidentally washed out of a burying place, by the overflowing of a river, besides one which was shown in a public school at Alexandria, which he thought was worth the trouble of any one to go on purpose to study."—CHESELDEN. Osteographia.
THE BONES.

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41. THE BONES, Ossa, òetea,

are hard, dry bodies, of various shapes. United into a moveable framework, which serves as a point of support to the rest of the organs of the body, they form, on the one hand, cavities for their protection, and, on the other, levers to approximate separate organs towards one another, which are set in motion by peculiar contractile organs, the muscles.

Chemical analysis resolves the osseous mass into the following constituents, abstractedly of the fat, the vessels, &c., found in bone:

1. Cartilage, the essential, organic part of bone tissue. It consists of cells, contains cavities and tubules, and is only distinguished from permanent cartilage by the fact that the bone earth is deposited in it, and condenses it. It is obtained by macerating bone in dilute hydrochloric acid. It is soft, flexible, elastic, soluble in a warm solution of Potash, and converted into gelatin by hot water.

2. Bone earth, which is especially phosphate and carbonate of lime, with some Magnesia and Fluoride of Calcium.

The proportion of cartilage is about 0.33; of the bone earth, 0.67. The relative proportions differ, however, according to age, health, and the bones themselves.

Figure of the bones. Three forms are described:

1. Long, or cylindrical; 2. Flat; 3. Short, or thick bones.

1. Long bones, ossa cylindrica, possess a large cavity, occupied by a few cells, and filled with fat and vessels. Externally they are surrounded by compact substance, and they generally serve as levers. The centre part is called body, diaphysis; the extremities, apophyses, are covered with cartilage, and are of the same construction as the short bones.

2. Short bones, consisting of a spongy mass, formed of delicate osseous laminae connected together: subs. spongiosa, which on the surface is closely compressed, and thus surrounded by a smooth but thin osseous layer, the cortical portion (subs. corticalis); as the bones of the carpal and tarsal articulations.

3. Flat bones enclose a thin layer of spongy substance, diploe, between two closely approximating planes of solid cortical substance. They form cavities.

42. Texture of the Bones.

The spongy and cortical substances consist of narrow cylindrical canaliculi, medullary canals [canals of Havers], which form a network, and when they take a determinate course give a fibrous appearance to the bone. They open on one side upon the external surface, on the other side into the cavity of the bone or the
cell-shaped interspaces (medullary cells) of the spongy substance, and contain a loose, vascular areola tissue with numerous fat cells, the marrow of the bone, medulla ossium. The narrowest, from 0.005 to 0.002 of an inch in diameter, lie immediately upon the external surface of the bone. The medullary canals are surrounded by from four to twelve concentric

Osseous plates, lamella, which take a wavy course, and are perforated by short fibres, or by rectangular, narrow canaliculi, the calcigerous tubes. Between the lamellae in the homogeneous basement tissue of the osseous cartilage, clear spots, or corpuscles having dark edges, are disposed; these are the Bone corpuscles, lacunae, oval, disc-like cavities, filled with granular matter, from which, in a stellate manner, there pass off on all sides the Calcigerous canals, extremely delicate tubules, with numerous ramifications, in which the osseous matter or lime is found as a fine white precipitate.

Membrane of Bones. The external surface of bones is covered by Periostium, and this again by Epithelium, in the cavities of the nose ciliated; but the articular extremities terminuated by cartilage are uncovered, and therefore uneven. Here the medullary canals terminate in blind extremities.

Internal membrane of Bones, Memb. Medullaris, is nothing but the outer surface of the delicate areolar tissue which attaches the medullary matter loosely to the internal surface of the osseous tubes.

Vessels. In the periosteum a close vascular rete is placed, the fine (artificial) ramusculi of which enter the medullary canaliculi by the innumerable openings in the cortical substance, again interlace with one another, and anastomose with the vascular rete of the cavity of the bone or medullary cells. This receives its blood from larger vessels, art. nutritæ, one of which enters through a large foramen nutritium about the middle of each (tubular) bone. The first nourish the substance of the bone; the last the medulla. The venous blood is returned partly by vena nutritæ which accompany, at least, the large art. nutrit. partly through peculiar canals, which are found in the diploe of the flat bones. From these canals the thin-walled, valveless veins pass out into the periosteum. They cannot be injected from the arteries.

Lymphatics are demonstrated in the medulla, but not yet, with certainty, in bone.

The existence of nerves is upheld by the sensation accompanying inflammation of the medulla. The bone substance itself is without sensation.

[The periosteum is supplied, plentifully, with nerves. Trans.]

43. Development of bone, Osteogenesis.

In the embryo a solid cartilage at first appears, cartilago formativa, seu ossescessns, which consists of a mass of homogeneous cells, in the centre of which are formed the medullary canaliculi, surrounded by capillary vessels. In the parietes of the canaliculi, and in the lamellæ, the lacunæ, and calcigerous canaliculi appear, and after that the deposit of lime commences, at first in the cartilaginous substance, next in the canaliculi; but it is undecided whether or not the earthy matter is chemically united with
the cartilage. Ossification commences in the cylindrical and in
the flat bones which appear in pairs, from the centre spreading
outwards towards the extremities and surfaces; in the azygos
and short bones, vertebrae, e. g., in two or several symmetrical
points, puncta ossificationis. It is earliest in the clavicle, sec-
ond month of the embryo, and jaws, latest in the os pisiforme,
sixth to twelfth year. Sutures arise by the meeting together of
ossified parts which, as cartilage, were separated, e. g., in the
skull. Many foramina and canals are in the commencement
bounded by several separate pieces, e. g., foram. magnum
canal. spinalis. The extremities of the cylindrical bones are in
the cartilaginous state separate from the central portion for some
time after birth, and unite at last into one bone.

Abnormal osseous development frequently appears in tendons and cartilages,
in the ovary, on the sternum, on the bones much used, &c.

44. Particular parts of the Bones.

The skeleton is but a system of vertebrae; the bones must there-
fore be regarded as more or less perfect or metamorphosed ver-
tebrae. As in these, so in other bones, we find a body and con-
necting parts; the former, serving generally for the attachment of
muscles and ligaments, encloses cavities and passages; the latter,
particularly assisting in the formation of joints.

1. Articular portions. a. Elevations, smooth, covered with
cartilage:—
   1. Head, caput, capitulum, a segment of a sphere upon a small neck (collum).
   2. Condyle, condylus, semi-oval. Hereto also belongs the processus, process
      (pr. obliquus).

b. Depressions; smooth, covered with cartilage:—
   1. Glenoid cavity, a smooth fossa (e. g., of the Scapula).
   2. Cotyloid cavity, cup-like, deep, circular (e. g., of the hip bone).

2. Elevations for the attachment of muscles and ligaments:—
   1. Projections, tuber, tuberositas, protuberantia, tuberculum, zygoma, trochanter.
   2. Spine (sharp-pointed), spina (spina tibiae, ilei, processus spinosus).
   3. Crest, crista, broad, long.
   4. Lines, linea (long, narrow), e. g., linea semicircularis, l. aspera.
   5. Process, processus, e. g., pr. Mastoideus, styloid, pterygoid, transversus.
   6. Branch, ramus (thick, long).

3. Depressions, not assisting in the formation of joints:—
   1. Fossa, fovea (flat); the entrance wider than the floor; e. g., f. parietalis
      lacrymalis.
2. Inlet, *sinus*, a cavity with a narrow opening, e. g., *sinus Maxillaris*; cells, *cellulae*, similar, but smaller.
5. Impression, *impressio*.

4. Perforations:
1. Hole, *foramen*; hiatus (small).
2. Fissures, *fissura* (long and narrow).

45. **Conjunction of the Bones.**

I. Immoveable conjunction, *synarthrosis*. The edges of the bones rest against each other, and are joined by sutures. The edges grasping one another from opposite sides by indentations, form a true, but when merely overlying each other, a false suture.

a. True suture, *sutura vera*.—We distinguish:
   1. *S. dentata*, where the indentations are simple, long and vertical, like teeth; e. g., the sagittal suture.
   2. *S. serrata*, when they are simple but oblique, like a saw; e. g., the coronal suture.
   3. *S. limbosa*, when the principal indentations are provided with small lateral ones; e. g., the lambdoidal suture.

b. False suture, *sutura spuria*.
   1. *S. Squamosa*, scale suture; the rough edge of one bone overlying that of the other.
   2. *Harmonia*; the rough edges merely meeting together.

**Gomphosis** is that conjunction in which the teeth extend in a wedge-like manner into the cavities of the indented edge.

II. Moveable conjunction.

a. Close conjunction—*amphiarthrosis*. The bones coming immediately in contact or connected by ligaments, can only glide a little on one another, e. g., the carpal and tarsal bones. The junction at the pubes, called *symphysis*, is effected by cartilage and ligaments; the union of the hip bones, *synchondrosis*, by the interposition of cartilage alone.

b. Peculiar articular conjunction, *diarthrosis*, *articulatio*.
   1. Hinge, angular joint, *ginglymus*.—Formed by two (long) bones placed at an angle, the one describing with the other an obtuse, right, or acute angle.
   2. Rolling or rotatory joint, *rotatio*, *s. trochoideas*.—One bone moving upon a surface lying parallel to it in a semicircle or less, e. g., radius and atlas.
   3. Ball and socket joint, *enarthrosis*.—The movement is free in all directions, circular; e. g., hip joint.
   4. Free joint, *arthrodia*.—The articular head is not deeply fixed in the articular cavity, as in the one above, but moves upon the articular surface; e. g., shoulder joint, thumb.
I. The Head, caput.

The twenty-two bones of the head may be divided into two classes; the bones of the cranium, of the skull, ossa cranii, 7, and the bones of the face, ossa faciei, 15.

A. Bones of the skull, ossa cranii.

a. The Azygos bones, in the central line.

Os basilare, the foundation bone, consists of:

1. Os occipitalis, the occipital bone.

Position: at the posterior, inferior part of the head, immediately above the vertebral column.

Figure: a shallow shell placed vertically, with a horizontal portion, united by a ring.

Portions: pars occipitalis; 2 partt. condyloideae; p. basilaris.

Between which, for. occ. magnum.

Junctions: with six bones: two parietal, above; two temporal, laterally and below; one sphenoid, before; and Atlas, beneath.

a. Pars occipitalis, the upright shell; below, passing into the condyloid portions, is itself limited by the foramen magnum, and united above to the parietal bones, sut. lambdoidalis, below, to the mastoid portions of the temporal bones, additamentum sut. lamb.

1. The external or posterior surface; convex, presents, extending from the foramen magnum upwards, the crista and spina occipitalis externa (for the lig. Nuchae); laterally, from the crest, the linea semicircularis inferior (for the musc. rectus capitis post. maj., obliquus sup.), and superior (for the m. occipital, et trapezii).

2. The internal, anterior surface; concave; divided into four fossae, two superior, fossae cerebri; two inferior, fossae cerebelli. In the centre, the protuberantia (spina), interna seu cruciata (for torcular Herophilus); perpendicular; crista interna (for falx cerebelli) to the foramen magnum; horizontal: linea transverse (for tentorium cerebelli), with the sulcus transversus (for the sinus transversus).—Above the protuberance ascends the sulcus longitudinalis superior, generally on the right side.

b. Partes condyloideae, articular portions; on either side of the for. magnum anteriorly.

1. Inferior surface; convex, elliptical, smooth; rests upon the processus obliquus, super. of the Atlas. Behind, the condylus. fossa condyloidea post., frequently perforated by the for. poster., for an emissar. Santorini; laterally; fossa cond. ant. with the foram. cond. ant., (for the lingual or hypoglossal nerve); externally; the processus, (for the rect. capt. lateralis musc.), and incisura jugularis, which forms with the petrous bone—the for. jugulare, the opening for the commencement of the jugular vein.

2. Superior, cerebral surface; concave; exhibits the processus anonymus; foram. condyl. ant. et post., their internal openings; and a part of the sulcus transversus.

c. Pars basilaris, base or cuneiform process; azygos, in the centre before the for. magnum, behind the sphenoid bone and united with these.
1. Inferior surface, slightly ascending forwards, rough (for attachments of musc. rect. cap. ant. major et minor), forms the bony roof of the pharynx; presents the spina basilaris seu pharyngea (for the m. constrict. pharyng. superior).

2. Superior surface, ascends obliquely forwards and upwards; smooth; forms fossa basilaris, for medulla oblongata; at the sides, narrow grooves for the sinus petrosi inferiora.

3. Anterior surface, joins with the sphenoid bone; the posterior sharp surface forms the anterior boundary of the for. magn.; the lateral borders are in contact with the petrous bone.

Borders and Angles. The two superior borders form, with the posterior of the Parietal bones, the Lambdoideal suture; instead of the obtuse angles in which they unite, in the new-born child we find the lesser fontanelle, fonticulus triangularis; in the place where the Occipital, Parietal, and Mastoid portion of temporal meet together the posterior lateral Fontanelle, later the ossa Worm-iana; generally about one inch lower, the for. mastoideum (for emissar. Santorini).

Texture. The internal osseous table is very fragile, particularly thin and translucent at the inferior part in the fossae cerebelli. In the condyloid and basilar portions the spongy tissue predominates.

Development. Four points of ossification; one for the shell, which appears first; two for the articular, one for the basilar portion.

Foramen magnum occipitale, the great occipital foramen, serves for the passage of the spinal cord with its membranes, the vertebral and spinal arteries, and the accessory nerves of Willis.

48. 2. Os Sphenoidem, sphenoid bone.

Position: in the anterior and middle part of the base of the skull.

Figure: irregular, something like a flying bat; formed of a central portion, body, with four horizontal large and small wings, and two vertical processes directed downwards.

Junction: with all the cranial bones, and with the following bones of the face: Vomer, ossa zygomatica, palatina, and maxillaria superiora.

A. Body the most central, cuboid portion, containing two cavities separated by a partition, sinus sphenoidales, which are closed in front by two triangular bones, ossicula seu cornua Bertini, and only connected by one small opening with the posterior Ethmoidal cells. The body presents 6 surfaces:

a. Superior, cerebral surface, Sella turcica, s. equina, s. epippium, Turkish saddle. From before to behind:

1. A slight depression for the Nerv. Olfactorii.

2. A transverse groove leading to the foramina Optica, (for the Chiasma or commissura Nerv. Optica.)

3. A four-sided fossa, fossa pituitaria (for the Hypophysis cerebri), properly the sella turcica.

4. Process. clinoides medii, on the anterior, posteriores, on the posterior border of the saddle.
5. **Clivus**, the back of the posterior border of the saddle (for Pons Varolii).

b. 2 lateral surfaces, with Sulcus Caroticus (for the internal carotid artery); Ala Magnæ.

γ. Anterior, with crista sphenoidal, (for the lamina perpendicular of the Ethmoid bone).

δ. Inferior, with rostrum sphenoidale (for the Vomer), and commencement of the canal, pterygopalatinus.

ε. Posterior, unites with pars basilar. occipit.—orifice of Vidian canal.

b. Small wings, *ala parva* s. Processus ensiformes, triangular, flat, narrow, transverse processes springing from the anterior superior surfaces of the body with two roots. Connected with pars orbitalis ossis frontis.

Superior surface is covered by the termination of the anterior cerebral lobe. Posterior border separates the anterior lateral cranial fossa from the middle.

Processus clinoid. anter.; foramen opticum (for the optic nerve and ophthalmic artery).

Fissura orbitalis superior, the fissure between the great and small wings (for the nerv. oculomotor, trochlearis, ophthalmicus, abducentis, and for the Vena ophthalmica cerebralis and facialis).

c. Great wings, *ala magna*, quadrangular, broad processes projecting from the sides of the body, with three surfaces and borders.

Surfaces:

1. Internal, superficies cerebrales, concave, forms with the temporal bone the centre fossa of the Basis Cranii. From before to behind we see; foram. rotundum (for nerv. maxillar. sup.), for. ovale (for nerv. maxillar. inf.); for. spinosum, (for art. meningeum media.)

2. External, superficies temporalis, divided by a transverse crest into two portions, a superior, the temporal fossa (for the musc. temporalis), and an inferior, fossa zygomatica (for the musc. pterygoideus externus). On the last the inferior opening of the foram. ovale and spinosum; Process. spinosus s. spina angularis (for m. malleus ext.).

3. Anterior, superf. orbitalis, a quadrangular plate, forms the largest portion of the external wall of the orbit. The superior edge unites with the frontal bone; between the inferior border and the upper jaw—the fissura orbital. inferior (for Ven. ophthalmica facialis, nerv. infra-orbitalis and subcutaneous male).

Borders.—The three surfaces meet together in a superior broad margin, which unites with the frontal bone. The orbital and cerebral surfaces unite in a sharp, free, internal border, which assists in forming the fissura orbital. super. The orbital and temporal surfaces in the anterior superior which joins with the malar bone, and in the anterior inferior which, free and sharp, assists in forming the fissura orbital. infer. The temporal and cerebral surfaces form the posterior superior border which unites with the squamous portion of the temporal bone, and the oblique posterior inferior border which terminates with the spina angularis behind the foramen spinosum.

d. Processus Pterygoidei, palatine wings, descend perpendicularly from the body, one on either side, lying in the upper half free behind, and in the inferior close to the upper jaw and palate bones. Above in their root the horizontal Canalis Vidianus. On the anterior convex surface a furrow (sulcus pterygoideus), which forms, with one upon the Palate bone, the Canal. pterygo palatinus. The posterior surface concave bounded by two wings; Ala externa (for the muscle pterygoideus externus), Ala interna with a hook, hamulus pteryg. (for the circumflexus palati mollis). Between the wings, above the ossa pteryg.
SPECIAL ANATOMY.

(for the musc. pteryg. intern.,) below the Incisura pteryg. (for the reception of the processus pyramidalis of the palate bones). Sometimes there is a sinus pteryg. where the ala extern. and interna meet together with the Corpus sphenoid., and it is connected with the Sinus sphenoidal. (Mayer.)

Foramen pterygo-spinosum (seu interruptum, Fäsebeck) is formed by a lamella of bone, or a ligament between the proc. spinos. alae magne and the ala externa proc. pteryg. (for the ganglion oticum of Arnold).

Texture of the Sphenoid. The compact osseous tissue predominates. The cavities in the commencement consist of spongy bone, which, by degrees, is absorbed.

Development. In the fetus the small wings and a portion of the body are separated, even up to the ninth month, from the rest of the bone (in lower animals during life, the anterior and posterior sphenoids).

Eight points of ossification. Deposit of bone first commences in the large wings from the fortieth to the forty-eighth day. The Cornua Bertini unite with the body of the sphenoid about the fifteenth to the eighteenth year, the basilar portion in the eighteenth to the twenty-fifth year.

49. 3. Os Ethmoideum, s. cribriforme, sieve bone.

Situation: in the central line of the anterior part of the base of the skull, before the sphenoid, between the frontal bones, or rather the orbital plates of the frontal bone, and behind the nasal bones.

Figure: that of a cube, consisting of thin bony plates.

Portions: 1. Central, lamina cribrosa with the lamina perpendicularis.

2. Lateral, two labirinthi.

1. Lamina cribrosa, perforated plate, horizontal, quadrangular.

a. Superior surface, looks into the skull; from its centre a narrow, triangular process ascends perpendicularly, the Crista Galli (for the falx cerebri), with two projections on its anterior border (process. alares); here is the foramen-cocum. On the sides and behind the crista, the numerous foramina cribrosa (for the nerves of smell); a groove on either side, sulcus pro nerv. olfactorio.

b. Inferior surface, the uppermost wall of the nasal cavity, which is divided into two by the vertically descending lamina perpendicularis. The vertical plate anteriorly lies against the nasal spine of the frontal bone and the nasal bones; behind upon the crista sphenoidal, below upon the Vomer and nasal cartilage.

Borders: a. The anterior border of the cribiform plate unites with the frontal bone.

b. The posterior, with the crista sphenoidalis.

2. Labyrinthus, the lateral portions extend directly downwards from the cribiform plate, one on either side of the septum nasi, appear externally as a thin plate (lamina papyracea), in the orbitis, internally in the nasal cavity (lamina nasalis). Between the two plates lie the cells (sinus Ethmoidales).
THE BONES.

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a. The papyraceous plate, bounded above by the frontal bone, incisura ethmoidales (foramina orbitalia); before by the lacrimal bones, below by the upper jaw, behind by the palate and sphenoid.

b. The nasal plate is divided by a horizontal fissure into a superior (posterior) shell (concha Morgagni), and a central (concha media), and larger. Both externally concave. Sometimes there are three shells or conchae.

c. Sinus seu cellulae ethmoidales, with a transverse septum passing through.
   a. Anterior, cell. lachrymala, opening with the frontal sinuses, below the middle concha (Infundibulum, meatus nasalis medius). Larger and more numerous than
   b. Posterior, cell. palatinae; opening, with the sphenoidal cells, below the superior concha; they are separated from the sphenoid bone by the Cornua Bertini. The cells are lined with a delicate periosteum and ciliated epithelium, not mucous membrane.

From the anterior cells, on the inferior anterior border of the papyraceous plate, a hook passes off, Process. uncinatus, which unites with the concha inferior.

Conjunctions of the ethmoid with thirteen bones:—frontal, sphenoid, the inferior turbinate, upper jaw, nasal, lacrimal, palate bones, and Vomer.

Development. Ossification commences at the fifth month, first in the papyraceous plates, then in the conchae; in the sixth to the twelfth month after birth, in the Crista Galli and lamina perpendicularis, the most anterior part of which, septum mobile of the nose, remains during life cartilaginous. The cribriform plate is first completely ossified in the second to the third year, the cells are first developed completely in the fifth to the sixth year; in the mature foetus the external and internal lateral walls lie close to one another.

50. 4. Os frontale, s. coronale, forehead bone.

Situation. At the most anterior part of the skull over the face.

Shape: of a shell; the superior, larger and vaulted portion, p. frontalis, vertical, the inferior, partes orbitales, horizontal.

Conjunctions with twelve bones; two parietal, one sphenoid, one ethmoid, two nasal, two malar, two lacrimal, two superior maxillary bones.

a. Pars frontalis, forming the forehead, perpendicular and gently vaulted, unites at its superior border (m. coronalis) with the parietal bones, in the coronal suture; the inferior edge limits the horizontal part anteriorly.—Two surfaces.

1. External, convex, with the frontal suture in the first year, a frontal prominence, tuber frontale, the centre of ossification on either side; under this the arch of the eyebrow, arcus supercilares (for the musc. corrugator supercilii); between them the triangular smooth surface Glabella, and below them margins supraorbitalis, superior border of the orbit (for the m. orbiculares palpabrae), with Incisura or foramen supraorbitale (for the nerv. art. and ven. supraorbitalis), and externally Process. zygomaticus (uniting with the malar bone), above Crista frontalis, and in continuation linea semicircularis (for the musc. temporalis).

2. Internal, concave surface; besides the elevations and depressions for the
convolutions of the brain and the Pacchionian glands, the *Sulci arteriosi* (for *Arteria meningea anterior*); in the central line: *crista frontalis interna*, the commencement of the *sulcus longitudinalis* (for *sinus long. superior*), and *foramen cecum*, a blind, sometimes open hole (for *falx cerebri*).

Conjunctions: above with the Parietal bones, below with the great wings of the Sphenoid, laterally with the malar bones.

b. *Partes orbitales*, orbital portions, horizontal, the superior walls of the orbits, separated by the *Incisura ethmoidalis*, in which the Ethmoid lies.

1. Inferior surface, triangular, concave, in the orbit. Towards the nose; *fossa* or *spina trochlearis* (for *musc. obliq. superior*); externally *fovea lacrymalis* (for the lacrymal gland).

2. Superior surface, convex, uneven, in the cranial cavity, supporting the inferior surface of the anterior cerebral lobes.

3. Borders. The internal forms with the annexed Ethmoid bone, *foramina ethmoidalia* (for *Nerv. Art. et Ven. ethmoid.*), and lies anteriorly upon the Lacrymal bone; the external unites with the malar bone, laterally; with the great wing of the Sphenoid, behind.

c. *Pars nasalis*, nasal portion, short, thick, immediately below the Glabella, between the orbital portions, beneath excavated in a horse-shoe shape into an *Incisura nasalis* with a projecting spine, *spina nasalis* (for the nasal bones and upper jaws), on the sides of which are the openings of the frontal cavities, *sinus frontales*.

The frontal sinuses, only completely developed after the age of puberty, lie between the two tables of the frontal portion, from the inferior margin of which they ascend to the frontal eminences; they are divided by a septum into two, sometimes several unequal spaces, and open with the anterior ethmoidal cells immediately below the middle nasal turbinate bone. They are lined with periosteum and ciliated epithelium.

Development. It begins in the second month of fetal life with two lateral centres of ossification, in the *arcus superciliaris*, which in the first year are associated by a suture (*sutura frontalis*), which for some years continues diminishing. It sometimes exists during the whole life. The cavities appear in the first year, and by degrees enlarge even up to old age.

**b. The cranial bones occurring in pairs.**

51. 5. *Ossa parietalia, s. bregmatis*, vertex bone.

Two quadrangular, flat, externally convex, internally concave bones; broader before than behind; united together by the sagittal suture; forming the highest part of the cranial vault; one on either side of the central line, two surfaces, four borders, four angles.

Surfaces:—

1. External, convex, smooth, vaulted in the centre, *tuber parietale*, the centre of ossification; terminal point of the greatest transverse diameter; below this the *linea semicircularis*, the concave boundary line of the *planum semicircularis*, which is above convex (for the *musc. temp. and fascia temporal*).
2. Internal, concave, with elevations (*juga cerebralia*), *impressiones digitae* and *sulci arteriosi* (for the *arteria meningea media*), passing from the inferior angle. In the centre *fossa parietalis*.

Borders:—

1. The superior *margo sagittalis*, the longest, very thick, dentated; presents upon the concave surface a half groove which forms with the other half groove upon its fellow bone the *Sulcus longitudinalis*. *Foramen parietale* (*f. emissarium Santorini*).

2. The inferior, *margo squamosus*, the shortest, concave, sharpened off, unites with the squamous portion of the temporal bone (*Sut. Squamosa*).

3. The anterior, *m. coronalis*, toothed, forms with the frontal bone the *coronal suture*.

4. The posterior, *m. lambdoideus*, long indentations, unites with the occipital bone.

Angles: The two superior are right (*ang. frontalis* and *occipitalis*).

The anterior inferior, *ang. sphenoidalis*, pointed, long, with the *sulc. arteriosus*.

The posterior inferior, *ang. mastoideus*, obtuse, with *sulcus lateralis* *s. transversus* (for the transverse sinus).

The two parietal bones unite anteriorly in an extended, posteriorly in a right angle.

Conjunctions, with: *os parietale, frontis, occipitis, temporum, sphenoidideum*.

Texture. On the external and internal surfaces, compact, bony tissue, between the two, diploe. The thickness of the parietal bones diminishes from above to below. In the diploe there are many veins. (Hence danger from fractures.)

Development. Ossification commences in the *tuber parietale*, at first in the twelfth week; the angles are developed the last (hence the fontanelles).

52.


Situation: one on either side of the skull, below the parietal, before the occipital, behind the sphenoid, at the base and at the sides of the cranium.

Shape: irregular. Parts from behind forwards. Mastoid, squamous and petrous portions.

Conjunctions with 5: 3 cranial, 2 facial bones, parietal, occipital, sphenoid, superior and inferior maxillary bones.

1. *Pars squamosa*, scale like, the anterior, superior, shell-formed portions of the bone, the thinnest of the whole cranium, on its outer side.

a. External surface, convex, with grooves (for *Art. temporal. profund.*), and the temporal fossa (for *mus. temp.*). *Processus zygomaticus* *s. ansa capitis* (for *mus. masseter*), forms the zygomatic arch with the process of the (os mala); between its two roots, the *cavitas glenoidalis* (the articular cavity for the head of the lower jaw); the superior, two-armed, associated with the inferior in the *tuberculum articulare* (for the *ligam. lateral. extern.*). The proper anterior articular cavity is separated from the posterior by the *fissura Glaseri* (*Chorda tympani, Musc. malleus externus, Art. et Ven. tympanica*).
b. Internal surface, at the superior part a distinct horizontal *sulcus arterialis*.

c. Circumference. Three-fourths of a circle, free, above, upright; the internal border behind cut off obliquely, where it unites with the cranial bone; before united with the Sphenoid.

2. Pars Mastoidea, nipple-like portion behind the squamous, and deeper, separated from it above by a deep incision, *incisura parietalis*; below by the petrous portion (with the external auditory meatus). In the thickness of the bone are placed the *sinus s. cellule mastoidea*, into which we may pass from the cavity of the tympanum. They are covered with delicate periosteum and pavement epithelium, not mucous membrane.

a. External surface, convex, rough, presents below and before the proc. mastoideus (for the *musc. sternocleido-mast.*, *splenius capitis*, *retrahentes auricula*); hence inwards, *incisura mastoidea* (for the *musc. digastricus*); still deeper and parallel a small incision (for *musc. trachelo-mastoide*); backwards, for mastoideum (for *emissarium Santorini*), and sometimes Art. meningea posteriora.

b. Internal surface, concave, with the broadest portion of the *fossa sigmoidea* (continuation of the *sulcus transversus*), the internal opening of the foram. mastoideum.

c. Circumference very thick; dentated; anteriorly, united in the pointed *Incisura parietalis* with the parietal; behind, thick and uneven, with the occipital bone.

3. Pars Petrosa, s. os petrosum, petrous bone, pyramidal, trilateral, lies obliquely from without inwards and from behind forwards, looking with the base outwards, with the apex towards the cranial cavity. Very solid, but brittle; it encloses the organ of hearing.

a. Basis, between proc. zygomatic. and mastoid, presents *Meatus auditorius externus*, the external auditory canal, behind the *cavit. glenoidalis*, oval, in the centre narrower than at its extremities (in the foetus, instead of it, a ring, annulus tympani).

b. Apex, obtuse, the exit of the *Canalis caroticus* and part of the foram. *lacerum anterius*; externally, *tuba Eustachii*; above that, *canal. tensoris tympani*.

c. Surfaces. Inferior, from without to within; *Processus styloideus*, twelve to fifteen lines long, sometimes moveable, always in animals; backwards, *foramen stylo-mastoideum* (for *facial nerve* and *stylo-mastoid artery*), the inferior opening of the *Canal. Fallopia*. Inwards from the styloid process; *fossa jugularis* (for the *bulbus Ven. jugularis*); the anterior half of the *foram. jugularis*. s. *lacerum posterius* (for the Nervi glossopharyngeus, vagus et accessorius, ram. jugularis Nervi sympathici et Vena jugularis interna), with the *Vallecula s. fossula petrosa* (for the Gangl. petrosum, Nervi glossopharyngei); in which the inferior opening of the *Can. tympanicus*; before the fossa jugularis the entrance to the *Canalis Caro'irus* (for the Cat. interna et ramus caroticus nerv. sympathici); [from the Carotid Canal, foraminia lead into the *Tympanum*.] Upon the septum, between *fossa jugularis et canal. caroticus*, the narrow entrance to the *Aqueductus Cochlea*.

d. Anterior (internal) surface. This is the posterior wall of the central cranial fossa, with *Hiatus Canalis Fallopiae* (for the *Nerv. Vidianus superficialis*) in the centre; anteriorly and externally to this the superior opening of the *canal. tympanicus*; posteriorly, *eminentia arcuata* of the superior semicircular canal of the Labyrinth of the ear. A groove (for the *sinus petrosus*
superior) upon the upper edge, margo petrosus; at the apex a semilunar depression (for the gangl. Gasserii).

e. Posterior surface. This is the anterior wall of the posterior cranial fossa. Here, we see the Meatus auditorius internus; it is short, three lines long, directed obliquely forwards and outwards; at the base divided by two cross lines into four portions; in the superior anterior, apertura intern. canal. Fallopiae (for nerv. facialis); above and behind, the funnel-shaped, fossa vestibuli superior; below and behind, the fossa vestib. inferior; below and before, fossa cochlea; these three, with their lamina cribrosa (for the nerv. acusticus and vasa auditoria interna). Immediately above the meatus a fissure or blind foramen for the reception of the Dura mater; an eminence of the inferior semicircular canal of the Labyrinth; half an inch posterior, the aqueductus vestibuli concealed behind an osseous lamella.

f. Borders. The superior (vide d.); the inferior and internal extends from the apex to the Incisura parietalis, where it blends with the superior, unites with the pars basilaris of the sphenoid and with the os occipitis. The inferior external lies close to and unites with the great wing of the Sphenoid. The anterior and free border forms the posterior half of the foram. lacerum anterius (which is an interval between the Petrous, Sphenoid, and Occipital bones filled up in the fresh state with fibro-cartilage).

Canalis Fallopiae (for the nerv. facialis), leads from the internal auditory meatus over the Vestibule transversely outwards, turns (geniculum) at the Hiatus canalis Fallopii backwards, passes horizontally over the fenestra ovalis beneath the horizontal semicircular canal to the posterior wall of the tympanum, curves itself once more, and descending vertically, makes its exit at the foran. stylomastoideum. With the tympanum it is connected by the canal. chord. tympani, by the canal of the eminentia papil(ari)s which, like the canalic. mastoides, passes off from the vertical portion.

Canaliculus Mastoideus (for ram. auricularus nerv. Vagi) commences with two small openings in the fissure between the external auditory meatus and mastoid process, and terminates, singly, close to the canal. chordae tym. in the canal. Fallopiae.

Canalis tympanicus (for the nerv. tympanicus of the gangl. petrosum) runs from the vallecula upon the floor of the tympanum, continues as a groove upon the promontory, and again opens as a canal between can. Fallopii and can. tensor tympani, close to the hiatus upon the anterior surface of the Petrous bone.

Development. Five points of ossification; the first in the squamous portion in the second month of embryonic existence; the second in the pyramid; the third is the ring around the tympanum, annulus tympani, which in many animals continues as a distinct bone during life, in the embryo lies at the commencement almost horizontally, and is open above; the fourth in the mastoid portion; the fifth in the Styloid process. The zygoma, at birth, is little, the external auditory canal not all developed, the articular cavity therefore almost flat; the mastoid process also is not developed until late; the Labyrinth and ossicula auditus are completely formed.

53. Of the Cranium in general.

By the union of the seven bones, now described, with one another by means of peculiar sutures, a tolerably closed shell is formed of an egg shape above, but somewhat flattened below and upon the sides. In it the Brain is contained.
54. 1. Sutures, Suturæ Cranii.

In a newly born infant a suture passes in the central line of the skull from the superior angle of the occipital, to the root of the nose on the frontal bone. This is

1. The Sagittal, s. sagittalis, between the Parietal bones, with which in the adult,
2. The frontal, s. frontalis, unites.—This long suture is anteriorly, upon the crown of the head, crossed by a transverse suture, the
3. Coronal, s. coronales, which unites the parietal with the frontal bones, and is behind bounded by the
4. Occipital, s. lambdoidea, which joins the parietal and occipital bones together. To this last is added the almost rectangular
5. Mastoid suture [additamentum suturæ lambdoidealis], uniting the Occipital and Parietal bone, a portion of it, with the mastoid portion of the temporal. From this (from the Incisura parietalis), anteriorly, proceeds the arched
6. Squamous, s. squamosa, between the parietal and squamous portion of the temporal bone. Lastly, below the frontal bone an irregular transverse suture passes, the
7. Transverse, s. transversa, connecting together the cranial and facial bones.

These sutures, which unite the edges of those portions of the bones which become ossified at a later period, continue incomplete even for some time after birth, and therefore present at the angles, where most of the borders meet together, unossified intervals, which are not completely closed until the fourth year, the

55. 2. Fontanelles, foniculi.

In the middle line of the skull:—
1. Fonticulæ Major, the large quadrangular fontanelle between the superior angles of the Frontal and Parietal bones.
2. Fonticulæ Minor, the smaller fontanelle, triangular, with the base directed towards the occipital; the apex towards the parietal bones, where the Lambdoideal impinges upon the Sagittal suture.

On either side of the skull lies a fontanelle, fontic. lateral, above and behind the mastoid process of the temporal bone, in that place where at a later period the parietal meets with the temporal and occipital bones. In this place we frequently meet with the so-called Wormian bones, ossa tririquetra; the number, size, and position of which are never constant; they must be regarded as isolated, unessential points of ossification. Sometimes a triangular bone is found at the superior angle of the lambdoideal suture, representing even the apex of the occipital bone itself.

56. 3. Form and Measurement.

The shape varies with the Diameter of the skull, both according to age, sex, and varieties in the Race.
1. Longitudinal Diameter; from the for. cæcum to the occipital protuberance = 5 inches.
2. Transverse Diameter between the bases of the two petrous bones = 4½ inches.
3. **Vertical Diameter** from the anterior border of the *for. magnum* to the centre of the *s. sagittalis* = \(3\frac{1}{2}\) inches.

The circumference is in children proportionally greater than in adults; in the male sex and in the Caucasian Race larger than in the female and other Races.

The circumference of the skull stands in an inverse relation with that of the face. Vide the facial angle of Camper.

57. 4. The Cranial cavity, *cavum cranii*.

a. Basis: rests upon the Atlas; contains three terrace-like gently descending fossæ, *fossæ cranii*.

1. Anterior, most elevated, but the smallest, supports the anterior cerebral lobes, is formed of:—

   Ethmoid, Frontal, and the lesser wings of the Sphenoid bone:
   
   Presents, anteriorly, *for. caecum*, Crista Galli, and *c. frontalis interna* (for *Falx cerebri*).

   In the centre, *foramina cribrosa* (for olfactory nerves): posteriorly, *for. Optica* (for *Optic nerve* and *Ophthalmic artery*); *Proc. clinoid. anter*.

   The sharp posterior border, before the *fossa Sylvii* and *sinus Ophthalmicus*.

2. Central, supporting the middle cerebral lobes and base of the great brain, formed by the greater wings and the body of the sphenoid, by the squamous and the petrous portions of the temporal bones: posterior limit: *Anguli Petrosi* and the posterior edge of the *Sella Turcica*;

   Presents, in the centre, the *Sella turcica* (for the Hypophysis, [*pituitary gland*], *Infundibulum*, circular sinus of *Ridley*: with, *proc. clinoid. medii* (for the commissure of the *Optic nerve*); *proc. clinoid. poster* (for the corpora *mamilaria*); next the *sulcus caroticus* (sinus *cavernos.*, carotis); for. *lacerum anterior*.

   At the sides, anteriorly, *Fissura orbitale superius* (for *nerv. oculomotor*, *trochlearis*, ram. *ophthalmic*, *n. trigemini*, *n. abducens*, ven. *ophthalmica*).

   Farther backwards, for. *rotundum* (for *nerv. maxillar. superior*).

   Externally, for. *ovale* (for *n. maxillar. inferior*);

   *for. spinosum* (for *art. meningea med.)*; and

   *hiatus canal. Fallopie*, and for. *tympanicum*.

3. Posterior, the lowest, but largest (for the *cerebellum* and *Medull. Oblongata*).

   Formed, by the Petrous and Mastoid portions of the Temporal bones and by the *Os occipitis*.

   Bounded, before by the *anguli petrosi*, behind by the *sulcus transversus*; presents in the middle line, anteriorly, *fossa basilaris* (for *Pons Varolii*, *medulla oblongata*); has therein, *foram. magnum* (for *Spinal cord* and *n. access. Willisi*, the *art. spinal. and vertebrali*), *foram. condylolidea anterioria* (for *nerv. Hypogloss*);

   Posteriorly, *spina and crista occipit. int.* (for *Falx cerebelli*, torcular *Herophili*);

   At the sides, anteriorly, *for. jugulare* (for the *nerv. glossopharyng. vagus*, accessorius *Willi.*, and *nena jugularis*), with the termination of the *sulc. transversus* (for *sinus transversus*);

   More externally and above, *meatus auditorius intern.  (for nerv. facialis and acusticus, and Aquæduct. Vestibuli)*;

   Lastly; *lineæ transverse* (for tentorium *Cerebelli*), with *sulcus transversus*.

b. The Cranial arch, *fornix*, the smooth roof above the convex surface of the brain; formed of frontal, parietal, and occipital bones.
Presents, in the central line, Salcus longitudinalis (for the longitudinal sinus), extending from the Spina frontalis interna to the Eminencia cruciata. On the sides the sulci arteriosi and cerebral impressions. Here, as upon the external surface, the sutures, already mentioned, may be seen. The brittle, hard, bony tissue on the internal surface of the fornix is called the vitreous table, lamina vitrea.

4. External surface of the skull; it is covered with pericranium (periosteum); presents (the sutures, ut sup.). Besides these:
   a. Vault; linea semicircularis, one upon either side, from the central frontal eminence to the spina occipital. externa.
   Tubera frontalia, parietalia.
   b. On the basis:
      1. Anterior half: Pars nasalis, process. orbitales, occipitales;
      2. Posterior half: Spina and Crista occipit. extern., Proc. condyloid., Pars basilaris. Lin. semicircular. inferior, Occiput, Fossa condyloid. poster., Foramen lacerum posterius s. jugulare; Foramen lacerum anterius, with Sulcus carotic. and Tuba Eustachii, to which point all the sutures of the posterior half of the basis Cranii proceed.


c. At the sides: the mastoid region, foramin. mastoid., meatus auditor. extern., cavitas gelenoidea, root of the Proc. zygomatic, os temp.  
Fossa temporalis, temporal fossa, is the name given to the space between the lateral part of the skull and the zygoma, which below passes into the zygomatic fossa, is occupied by the temporal muscle and formed by the temporal bone, ala magna of sphenoid, malar, superior maxillary, and frontal bones, and bounded below by the zygomatic arch; above, by the lin. semicircularis.

58. B. Ossa faciei, Bones of the face, 14.

   a. Those occurring in pairs.

59. 1. Ossa maxillae superioris, 2. Upper jaw-bones.

   Position: anteriorly in the face, below the orbits.
   Shape: irregular, almost cubical, short; Body with 4 processes.
   Conjunctions with: Frontal, Ethmoid, and Sphenoid bones, and with all the bones of the face except the lower jaw.

1. Body, hollow, bounded by four surfaces.
   a. Anterior, facial surface, planum faciale, is bounded above by: Margo infraorbitalis, the inferior border of the orbit, for m. orbicular. palpebrarum and levator labii superioris; underneath this, foramen infraorbitale for nerv. art. and ven. infraorbitale; within this the ant. alveolar foramen for ant. dental nerve; and fovea maxillaris s. caninus, for m. lev. anguli oris.
   b. Posterior, temporal surface, arched, with: Tuber maxillare; foramin. alveolar. poster., leading to a canal running along the floor of the antrum, for nerv. art. and ven. alv. post.
   c. Superior; orbital surface triangular, with: Sulcus and canalis infraorbitalis, for nerv. art. and ven. infraorbitalis, which opens upon the facial sur-
face; *margo externus, posterior*, free; between it and the larger wings of the sphenoid bone—*fissura orb. inferior*.

d. Internal, nasal surface, with the opening of the *antrum Highmori*, before it *Crista turbinalis inferior*, for the inferior concha in the formation of the lacrymal canal; *sulcus pterygo-palat.,* helping to form *canal. pteryg.-pal.,* at the posterior part.

*Sinus maxillaris s. antrum Highmori*, pyramid-shaped, with very thin superior, orbitar, and inferior walls, particularly over the sockets of the Canine and first Bicuspid teeth, connected with the *sin. pterygoid. and jugal.* Its irregular opening contracted by the inferior nasal concha, Palate and Ethmoid bones to a small foramen opening beneath the inferior turbinate bone. It is lined with a delicate periosteum and ciliated epithelium, not mucous membrane. (Henle.)

2. Processes: a. *Proc. nasalis s. frontalis*, internal, superior process, with an external surface, for *m. levator lab. super. alaeque nasi;* and an internal, concave, on which are *lineae turbinate s. transverse,* for the middle and inferior nasal concha; further, the anterior border unites with the nasal bone, the posterior thick border with a groove, *sulcus lacrymalis,* which continues into the *Canal. lacrymal.* The apex lies in the fissure of the frontal bone.

b. *Proc. zygomaticus,* external superior process unites with the malar bone.

c. *Proc. alveolaris,* the process for the sockets of the teeth, that is, the inferior thick border of the upper jaw, contains eight cells for teeth, *alveoli,* with projections and depressions; at the point of union of the two upper jaws, *Spina nasalis anterior;* behind that, the *Canalis incisivus,* for the *nerv. naso-palatin.* Scarpe, and *arteria sphenopalatin.,* leads from the nasal into the buccal cavity; the *foram. incisivum* is sometimes double.

d. *Proc. palatinum,* palate process; this, the horizontal roof of the mouth and the floor of the nose, unites internally with the palate process of the other side, behind with the horizontal portion of the palate bone; thence arise the *sutura palatina* and *cruciata,* and *Crista nasalis,* for the *Vomer* upon the upper surface.

Tissue of the upper jaw. Spongy substance is only present in the alveolar and malar processes. The entire bone is very light.

Development. The first point of ossification appears from the 35th to the 55th day of embryonic existence in the alveolar process. A centre of ossification is probably found in the position of the intermaxillary bone of mammalia, *Os incisivum* (Hare lip an arrest of the development of this bone); likewise one for *canalis infra-orbitalis.*

At birth the upper jaw is very small; nevertheless the antrum of Highmore is already present.

60. 2. *Ossa Palatina,* Palate bones, 2.

Situation, at the posterior part of the nasal cavity, and behind the palate processes of the upper jaw, before, and in, the *Pterygoid processes* of the Sphenoid.
Figure: a right angle, consisting of a horizontal palate portion, and a narrow vertical plate.

Conjunctions: with one another and with the upper jaws, the sphenoid bone, the inf. Turbinate and the Vomer.

1. Pars horizontalis; a. Superior surface, which forms the floor of the nasal cavity, with the Crista nasalis for the Vomer.
   b. Inferior surface, which forms the buccal cavity; hard palate, with spina nasalis posterior, for m. levatores uvulae. The internal border forms the sutura Palatina, the anterior, sut. cruciata.

2. Pars ascendens, thin, quadrilateral, longer and broader than the plate before described, from the external border of which it ascends on the nasal wall of the upper jaw, even to the orbit.
   1. Internal surface presents, the linea transvers. s. crista turbinalis media and inferior, for the inferior and middle turbinate bones.
   2. External surface lies anteriorly on the upper jaw, behind on the pterygoid process; presents Sulcus palatinus, a part of the Canal. pterygo-palatinus, for art. and nerv.

3. Processes: a. Proc. pyramidalis, triangular, external and posterior, lies in the incisura pterygoid. of the Sphenoid. On it two canals; Can. palatinus extern. and intern. between fossa sphen-maxillar. and palate, for nerv. and art. palatin.— Above:
   b. Proc. orbitalis; triangular, looks with its superior surface into the orbit, lies with the external, behind on the upper jaw, with the internal on the papyraceous plate of the Ethmoid. Behind it, inclining backwards:
   c. Proc. sphenoidalis, to the Body and the cornua of the sphenoid.
   Between the processes b and c, and the body of the sphenoid, the Foram. sphenopalatinum, for the nervi nasales, art. et ven. sphenopalatina, leads from the fossa sphen-maxillar into the nose.

Development. The first osseous nucleus appears about the 40th to the 50th day at the point of junction of the processes. The orbital process is yet wanting at birth.

61. 3. Ossa Malaria s. jugalia, s. zygomatica, Malar, Cheek bones, 2.

Situation: at the superior lateral parts of the face, externally upon the upper jaws.

Shape: an irregular quadrangle, consisting of a body and three processes.

Conjunctions with: Frontal, sphenoid, sup. maxillary and temporal bones.

1. Body, with 3 surfaces and 3 borders; contains sometimes a cavity, the size of a bean, sinus jugalis (Mayer), especially in Mongolians and Malays, which is connected with the Antrum of Highmore.
   a. External, facial surface, convex, for musc. orbicularis palpebrarum, zygomaticus major et minor; it presents foramen zygomatic. anterius, sometimes several; this is the commencement of the canal. zygomat. anter.
   b. Internal, orbital surface; this is the anterior part of the orbit; externally
it presents, for. zygomatic. anter., which is the end of the Canal. zygom. anter., for the n. subcutaneous max. ; a groove leading to for. zygomat. poster., the commencement of the Canal. zygomat poster.

c. Posterior, temporal surface, hollowed out for musc. temporalis, presents the end of the canal. zygom. poster., namely, the for. zygom. poster. for the n. zygomaticus s. temporalis.

2. Processes:
   a. Pr. frontalis, the superior, unites with the Frontal, and behind with the Sphenoid bone.
   b. Pr. temporalis, unites with the process of the temporal bone to form the zygomatic arch arcus zygomaticus, for the musc. masseter.
   c. Pr. maxillaris, triangular, broad, and little projecting, unites with the Pr. zygomat. of the upper jaw.

Formation. The malar bone consists almost entirely of compact bony tissue; spongy tissue is only found at the anterior inferior border.

Development begins early from one central point about the 50th day of foetal life. At birth the orbital margin is sharp, and it is not rounded until later.

62. 3. Ossa Nasalia, Nasal bones, 2

Situation: next to one another, sometimes united, beneath the frontal, between the two nasal processes of the sup. maxillary bones; oblique from above and behind, to below and before.

Shape: a long quadrangle, above, narrow and thick, below, broad and thin.

Conjunctions: with Frontal, Superior Maxillary, Ethmoid bones and Nasal cartilages.

1. External, cutaneous surface, covered by the musc. pyramidalis nasi, flat, somewhat convex, with a large, and several smaller foramina for the Vasa nutritia.

2. Internal surface, the anterior portion of the nasal cavity, presents grooves for vessels and nerves, the nerv. Ethmoidalis.

   b. Inferior, supporting the lateral cartilages of the nose, between them a foramen for a nerve filament and arterial twig, nerv. Ethmoidalis.
   c. Internal, forms with the bone of the other side the crista nasalis, for the lamina perpendicularis of the Ethmoid, and above for the spina nasalis, of the Frontal bone.
   d. External, longer than the last described, unites with the nasal process of the upper jaw bone.

Development: from one osseous centre, commencing at the end of the 2d month of foetal life. The nasal bones are completely formed at birth, but not the cartilages.
4. *Ossa lacrymalia s. unguis*,

Lacrymal bones, 2.

Situation: at the anterior part of the nasal wall of the orbit, between the nasal process and the orbital surface of the superior maxillary before the os planum of the Ethmoid, beneath the frontal bone.

Shape: quadrangular, flat, small, like a finger-nail; translucent, thin.

Conjunctions: with the Superior Maxillary, the Ethmoid, Frontal and Inferior Turbinate bones.

1. External, orbital surface, divided by the *crista lacrymalis* with the *hamulus lacrymalis*, into an anterior grooved half, which forms a part of the *fossa lacrymalis* with the groove on the *proc. nasalis* of the superior maxilla, and a posterior half.

2. Internal surface, presents a groove which forms a portion of the middle nasal chamber; and covers behind the *cellula ethmoidales anteriores*.

Structure. The most brittle of the bones; consisting of compact substance.

Development. One osseous centre at the 4th month. At birth most completely formed.

5. *Ossa Turbinata s. Conchae inferiores*,

Inferior Turbinate bones, 2.

Situation: at the lowest part, on the external wall of the nasal cavity, beneath the Ethmoid bone.

Figure: twisted, shell-like. More pointed behind than before.

Conjunctions: with the Superior Maxillary, Palate, Ethmoid and Lacrymal bones.

1. Internal surface, convex, looks towards the septum of the nasal cavity, and sometimes touches it.

2. External surface, concave, looks towards the Superior Maxillary bone, and forms a portion of the inferior nasal chamber.

3. Borders: a. The superior, unites with the nasal process of the Sup. Maxillary bone; behind with the Palate bone. It presents from before to behind.

   1. *Proc. lacrymalis*, united at the apex with the Lacrymal, at the sides with the upper jaw bone; forms, with the *proc. nasal* of the Sup. Maxillary bone, the *can. lacrymalis*.

   2. *Proc. Maxillaris s. auricularis*, hooked, contracts the opening of the *Antrum Highmori*, to the inferior border of which it is attached. Behind this a small border, for the Palate bone.


b. The Inferior free border, in the centre thicker than at the extremities, is *more or less* distant from the nasal septum.
THE BONES.

Structure: compact bony tissue, but porous; many canals for nerves and veins.
Development: one ossific nucleus in the centre, about the 5th month after birth.

65. b. Azygos Bones of the Face.


Situation: in the centre of the nasal cavity, forming the posterior part of the septum.
Figure: flat, angular. Portions: 2 surfaces, 4 borders.
Conjunctions with: Sphenoid, Ethmoid, both Superior Maxillary and Palate bones, and the cartilage of the nasal septum.

1. Surfaces, with small grooves for vessels and nerves, covered with mucous membrane.
b. Inferior, *palatinus, maxillary*, the longest, unites with the *crista nasalis* of Sup. Maxillary and Palate bones.
c. Anterior, *m. ethmoidalis*, unites with the *lamina perpendic.* of the Ethmoid, below with the cartilage.
d. Posterior, *m. gutturalis*, free, thin, sharp, inclining from above and behind to below and before, separates the posterior openings of the nasal cavity, *choane*.

Structure: the Vomer consists of 2 very thin plates of compact bone, the upper separated more than the lower.
Development: begins below, with the 3d month of fetal life, and is only completed in the 12th year. Ossification proceeds from without inwards, so that for a long time a groove exists between both plates for the reception of the Sphenoid and Ethmoid bones.

66. 7. **Maxilla inferior, Mandibula**, Inferior, lower or under jaw.

Situation: at the inferior region of the face.
Shape: of a horse-shoe, parabolic.
Portions: a central horizontal *body*; 2 lateral vertical ascending *rami*.
Conjunction: with the temporal bones.

1. Body, curved like an arch, consists originally of two pieces of bone which unite anteriorly in the central line, to form an arch, the chin, *mentum, ýīvōn*.
Note. In many animals a *suture* exists in this place; in Serpents a moveable articulation. The chin of animals never forms an *arch*, but always an *angle*.
a. External surface, presents: Spina mentalis externa. To the outer side of this foramen mentale, which is the exit from the Canal. alveolaris, for Nerv. Art. et Ven. alveol. inferior.

b. Internal surface, presents: in the centre, Spina mentalis interna, on either side processus geni, four tubercles, sometimes surfaces, the two superior for the genio glossi, the two inferior for the Genio-Hyoidei muscles, and a ridge the Mylo-hyoid for the mylo-hyoides muscle; above this a superficial fossa corresponding to the Sublingual, and one below to the Submaxillary gland. In the centre also a nutritious foramen.

c. Superior border, limbus alveolaris inferior, behind, thicker than before, presents: sixteen sockets, alveoli, for sixteen teeth with elevations, Juga alveolaria, for the levator menti and incisivi muscles.

d. Inferior border, base, thick with an anterior lip for the musc. triangular., quadratus menti et platysmamyoides, and two posterior surfaces for the anterior bellies of the m. digastricus.

2. Rami, ascend at a right angle, in the adult, angulus maxill. infer., from the body, and terminate in the temporal fossa by two processes.

a. Surfaces. 1. External, flat, rough, for musc. masseter, anterior to which, sometimes, a very slight groove, for art. facialis. 2. Internal, also rough, for m. Pterygoid. intern., with foram. maxillae, poster., for inferior maxillary or dental nerve. To the borders of the foramen is attached the lig. lateral. intern., and close to it is the Sulcus mylohyoides, for the nerv. mylohyoid.

b. Borders: posterior, for Parotid, and below for attachment of Stylo maxillary ligament. Anterior, grooved; the ridge or continuation of the linea obliqua extern. et intern.

c. Processes:

1. Anterior, Proc. coronoideus, triangular, the apex free, for musc. Temporalis.

2. Posterior, Proc. condylloideus, articular process, unites in the Glenoid cavity with the os Temporum. It presents the neck, Collum Condyli and the fossa for the musc. Pterygoid. extern. Between the two processes: Incisura semilunaris seu sigmoidea, for nerves and vessels.

Structure. Compact, bony tissue, on the surfaces, in the interior Diplœ. The canal for the nerves and vessels of the teeth follows the linea obliqua interna, communicates in this course by one foramen, two, with the alveoli, divides in the region of the Bicuspides teeth into two short canals, one of which opens at the foramen mentale, the other passes as far forwards as the first incisor tooth. Lying at the inferior border, before the appearance of the teeth, they are associated together, and the canal. alv. inf. always moves upwards as age advances, or, rather bone is developed beneath it, and thus it appears to ascend.

Development. Next to the clavicle the earliest perfectly formed bone; in mammals, it presents even in the 2d month one osseous centre upon either side for the body. Soon after birth the two halves unite together. In the new-born infant the lower jaw is very small, the angle still obtuse, the alveolar processes broad. In old age the alveolar processes disappearing after the teeth have fallen out, the lower jaw becomes smooth, thick, and again small.
67. Appendage. Os Hyoïdeum, s. linguale, tongue bone.

Position: free in the neck, above and before, between the tongue and the larynx, horizontal.

Shape; a Parabola like the Greek letter upsilon υ.

Conjunctions; by ligaments with the temporal bones and the thyroid cartilage. Parts: 1 body, 4 cornua.

1. Body, basis, the horizontal, anteriorly convex, central portion, is upon the
   a. Anterior surface, divided by a cruciform projection, a trace of the tongue bones of animals, into a superior and inferior half.
   b. Posterior surface, excavated, concave, separated by fibrous tissue from the epiglottis.
   c. Inferior border, for musc. Hyo-thyroideus.
   d. Superior border, for ligam. suspensor. linguae and lig. flavum s. hyo-thyroideum.

Terminations, covered with cartilage, for the reception of the great Cornua.

Attachment of muscles; to the Transverse lines, Mylo-hyoideus, above that genio-hyoideus; to the Superior half: digastricus, hyoglossus, stylo-hyoideus; to the inferior half: sterno-hyoideus, omo-hyoideus, and the thyreo-hyoideus.

2. Great Cornua, longer than the body, ascend from before backwards and upwards, for Kerato-(Hyo-)glossus, Kerato-pharyngeus (part of middle constrictor); capitulum, for ligam. hyothyroideum laterale, at the apex.

3. Lesser Cornua, or corpuscula triticea, like a grain of wheat, situated obliquely upwards and outwards at the point of junction of the great Cornua with the Body, for the musc. Chondro-glossus (part of Hyo-glossus) and Chondro-pharyngeus (a portion of Constrict. Med.); unites with the Proc. Styloideus by the ligam. suspensorium, sometimes ossified; it is connected with the great cornua and the body.

Development: proceeds slowly from five ossific points, from the termination of foetal life; it commences in the great cornua.

The Cavities of the Facial region.

68. 1. Orbitæ. Orbital cavities, 2.; for the organs of sight and lacrymation.

Figure: an obtuse, quadrilateral pyramid, the base directed forwards and outwards, the apex backwards and inwards; the axes of both would cross behind the sella turcica.

1. Base, formed by four borders, with four angles, Frontal, Nasal, Temporal, Malar.
   a. Margo supraorbitalis, with foram. sometimes Sulcus supraorb., formed by Frontal bone;
   b. M. orbitalis externus, with foram. zygomatic., by malar bone, and malar or external angular process of frontal;
   c. M. infraorbitalis, with for. infraorbitale and anterior dental foramen, by the malar and sup. Maxillary bones;
SPECIAL ANATOMY.

d. *M. orbitalis internus,* by nasal process of *super, Maxillary* and internal angular process of *Frontal bone*; immediately behind is the little *Lacrimal* bone. The circumference is narrower than the cavity behind it.

   a. Superior, the roof, formed before by the frontal, behind by the lesser wing of the Sphenoid bone, presents: an external angle, *fovea lacrimal,* for the *lacrymal gland*; an internal, *fovea, s. Spina Trochlearis,* for the tendon of the *m. obliqu. superior,* posteriorly, the suture between the Frontal and Sphenoid bones.
   b. Inferior, floor, inclined *outwards* and *downwards,* formed by *marg. orbitale* of the malar, *facies orbit.* of the upper jaw, and behind by the *Proc. orbitalis* of the Palate bone; with, *Canal. infraorbitalis,* bounded externally by the *fissur. orbital. inferior.*
   c. External wall, formed by the great wing of the Sphenoid and the Malar bones, with: *Fissura orbitale inferior* below, *fissura orbit. superior* behind, and an oblique groove upon the malar bone leading to the *superior or posterior malar canal,* for the temporal twigs of the nerve.
   d. Internal, formed by Lacrymal, Ethmoid, and the small wing of the Sphenoid bone. On this wall there are two vertical sutures; *Fossa lacrymalis,* and entrance to the *Canalis lacrymalis, Foram. Ethmoidalis, Spina s. fovea Trochlearis,* for the cartilaginous loop through which the *tendon* of the *m. obliq. superior* passes.

3. Apex, above, and internal, *foramen opticum;* below, the *Fissura suppra* and *infra orbitalis* and *fossa Spheno-maxillaris* meet together.

Connected with: 1. The cranial cavity, by the *foram. opticum,* *Fissur. orbital. superior* and *foram. ethmoid. post.*

2. The nasal cavity, by the *foram. ethmoidalis ant.* and *canalis lacrymalis.*

3. The Temporal and Pterygo-palatine fossa by the *fissur. orbital. inferior* and *canalis zygomatic. superior s. posterior.*

69. 2. **Cavitas nasi,** nasal cavity,

consists of two principal cavities lying close together, and separated by a septum or partition, situated between and below the two orbits, and bounded above by the horizontal plate of the ethmoid; below, by the united superior maxillary and palate bones, open before and behind, and covered with a mucous membrane, *Membr. Schneideri.* It is formed of fourteen bones.

1. Anterior opening, pear-shaped, *Apertura pyriformis,* formed by the superior maxillary, and nasal bones, which have attached to them the lateral nasal cartilages.

2. Posterior opening, *Choanae narium,* quadrangular, rather longer than broad, divided by the Vomer; formed, laterally, by the *Pterygoid processes;* above by the Sphenoid and Palate bones; below by the Palate bones; looks towards the Pharynx.

maxillary, and Palate bones, with the continuation of the cartilaginous septum Mobile; is generally curved or twisted; forms the internal wall.

4. Walls: a. superior, concave, formed by the Nasal bones, the nasal spine of the os frontis, by the Ethmoid, with foramina Cribrrosa, in the centre; by the Sphenoid behind.

b. Inferior wall, broader, not so long, posteriorly deeper; formed by the Proc. palatinus, of the Sup. Max., and the horizontal portion of the Palate bones; presents, canal. incisivus.

c. External wall, very irregular, formed by: Ethmoid, Lacrymal, Palate, Sup. Maxillary and the Inf. Turbinate bones; presents from above to below.

1. The superior Turbinate bone or Concha;

2. The superior nasal chamber, and on its posterior part the

3. Foramen sphenoplatinum, and the openings of the superior Ethmoidal and Sphenoidal cells.

4. The middle Turbinate bone or Concha, and middle chamber with the opening of the sin. maxillaris, and the anterior Ethmoidal and frontal cells.

5. The inferior Turbinate bone and the inferior chamber, with the opening

6. of the Canalis Nasalis.

Connection: with the Frontal, Ethmoid, Sphenoid, Superior Maxillary, Orbital, Buccal, and Cranial cavities; the last by the foramina Cribrrosa.

70. 3. Cavitas oris; Buccal cavity, mouth,

formed by the Superior Maxillary, and Palate bones, the Sphenoid and Inf. Maxillary; contains the tongue, teeth, glands, and buccal mucous membrane.

1. Superior wall, palatal vault, palatum durum; formed by: the Sup. Maxillary bones, proc. palatini, the Palate bones, proc. horizontal; and Sphenoid, proc. Pterygoid; presents: sutura cruciata, with the point, where 5 bones meet together, namely, 2 Superior Maxillary, 2 Palate bones, 1 Vomer; foramen Incisivum; the openings of the can. pterygo-palatinus and the 2 Palatini; Sulcus Palatinus close to the alveolar border, for the posterior palatine nerves and vessels.

2. Anterior and lateral walls; formed by: the Alveolar processes with the teeth of the jaw bones; presents: on lower jaw, Spina mentalis interna, proc. geni, for musc. genio-hyoidei and genio glossi; linea obliqua, or mylo-hyoidea, under this, the fovea pro gland. submaxill, over it, fovea pro gland. sublingual; sulcus mylo-hyoideus and foram. maxillare internum.

Connections: with the nasal canal by the can. incisivus, with fossa sphenop-maxillaris by canales palatini.

71. 4. Malar fossa, fossa zygomatica.

Situation: below the zygomatic arch, separated from the fossa temporalis by the crista transversa of the Sphenoid bone.

Formed by: Sphenoid, Superior and inferior maxillary bones.

1. Superior wall, formed by the inferior surface of the Ala Magna of the Sphenoid bone.
2. Anterior, by the *tuber maxillar. sup.*
3. Internal, by the *ala extern. proc. pterygoideus.*
4. External, by the *ram. maxillaris inferior.*
5. Posterior and inferior walls are deficient.

On either side, in the depth between the *Superior maxillary, pars perpendicular,* of the palate and proc. pterygoideus of the Sphenoid bone, belonging to the above described fossa, is situated, the

72. *Fossa Spheno-maxillaris s. pterygo-palatina,*
the Pterygo-palatine fossa.

Position: *behind* the Orbital, *beneath* the Cranial, *above* the Buccal, *close* to the Nasal cavities; *internal* to the fossa *zygomatica.* Contains: *arteria maxillaris interna,* and the 2d division of the 5th nerve, and *Meckel’s Ganglion.* Five foramina lead to this fossa;

a. Above and behind: *foram. rotunda Vidianum, pterygo-palatinum*
   b. Internally: *foram. spheno-palatinum*
   c. Below: the superior opening of the *Can. palatin. post.*

Connection with: the orbit, by *fissur. orb. infer.;* the nose, by *for. spheno-palat.;* the mouth, by *canal. pterygo-palat. and palatini;* the cranial cavity, by *foram. rotund. and Vidianum.*

73. Facial angle.

*Angulus facialis Camperi* is formed, by drawing a perpendicular line from the *inferior Incisor teeth,* in the middle line, to the most prominent portion of the *Frontal bone,* and an oblique from the same place to the *external auditory meatus.* It measures in Europeans 80 to 85°, in Negroes 70°. The more pointed the angle proves, so much the more the animal conformation preponderates.

74. Vertebral column, back-bone, *columna, s. spina vertebrarum s. rachis.*

Extends from close beneath the cranium as low down as the *os coccyx* which forms its inferior extremity; contributes to form the Thoracic, Ventral, and Pelvic cavities; is gently curved, of an undulating figure, and contains an osseous canal, for the spinal marrow.

Constituent parts: a. *True vertebrae, 24; Cervical portion, 7; Thoracic or Dorsal, 12; Abdominal or Lumbar, 5.*
   b. Sacrum, 5 false vertebrae blended together.
   c. Coccygis, 4 false vertebrae blended together. These two together form the *Pelvic portion.*

75. 1. *True vertebrae, vertebrae verae.*

7 Cervical vertebrae, *v. cervicales;* 12 Thoracic or Dorsal, *v. dorsales;* 5 Ventral or Lumbar, *v. lumbales.*
Figure: ring-shaped. Parts: Body, Arches, Processes; 1 Spino- nous, 2 Transverse, 4 Articular.

Connection; the 1st cervical vertebra with the skull, and with the 2d cervical vertebra, the 2d with the 3d, and so forth; the 5th Lumbar vertebra with the Sacrum; the 12 Dorsal, besides, with the ribs.

Position: one above the other.

a. Body, corpus, centrum, is the anterior, thickest, and most essential part of a vertebra; it presents above and below slightly concave surfaces covered with cartilage, for its junction with the vertebral body lying above and below it, is anteriorly convex; on the sides, evenly excavated and grooved; behind, concave and perforated by foramina, for vessels. This posterior surface forms with the

b. Arch, arcus [neural arch (Owen)], which springs from its posterior lateral parts, the vertebral foramen, foram. spinale s. medullare, which is triangular in almost all Vertebrae, and serves as a passage for the spinal marrow. The notches, incisurae, on the superior and inferior borders of every arch, form, the two together, an intervertebral foramen, foram. intervertebrale, for art. and nerv. spinal, upon each side.

c. Processes, processus, seven in number.

1. Muscular processes, proc. musculares, three to each vertebra;
   a. Processus Spinosus, one Spinal process [Neural spine, (Owen)], behind in the centre of the arch; its root almost forked; its point, apex, freely projecting into the back, for the lig. interspinos. apicum, and the Extensor muscles of the trunk.

b. Processus transversi, two transverse processes, horizontal, one on each side between the body and arch projecting outwards, for lig. intertransversaria; and the obliquely ascending or descending cervical and dorsal muscles.

2. Articular processes, proc. articulares s. obliqui, two superior, two inferior, spring laterally from the arch, behind the transverse processes, project out above the plane of the vertebral body; are tipped with cartilage, and associated, the two of the one, with the two of the other vertebra.

76. Differences between the Vertebrae of the three regions.

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<tr>
<td><strong>Body</strong></td>
<td>Small, insignificant; the superior surface concave from without to within, laterally provided with elevated margins, which fit into corresponding depressions upon the sides of the body of the vertebra immediately above; inferior surface slightly convex.</td>
<td>Larger, higher; superior and inferior surface flat, heart-shaped; upon either side two half articular surfaces for the head, capitulum, of the ribs; on the eleventh and twelfth one whole one only.</td>
<td>As large again as the cervical, about one-third larger than the dorsal; superior surface concave, oval.</td>
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<tr>
<td><strong>Foramen Spinale</strong></td>
<td>One, very wide, triangular.</td>
<td>Narrow, more wedge-shaped.</td>
<td>Broad, triangular.</td>
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<tr>
<td><strong>Incisura intervertebralis</strong></td>
<td>Superior and inferior. The inferior deeper than the superior.</td>
<td>The same.</td>
<td>The same.</td>
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<tr>
<td><strong>Proc. spinosus</strong></td>
<td>Short, thick, forked at the point; inferior surface grooved, for the vertebra immediately below, during extension, almost horizontal.</td>
<td>Long; apex blunt, tuberculous; directed downwards and overlaying one another in an imbricated manner.</td>
<td>On the sides flat; the apex expanded into a crescentic enlargement; horizontal behind.</td>
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<tr>
<td><strong>Proc. obliqui</strong></td>
<td>Short, oval, flat; the superior oblique, 45° directed upwards and backwards, the inferior downwards and forwards.</td>
<td>Small; the superior directed backwards and outwards, the inferior inwards and forwards; almost perpendicular.</td>
<td>Strong; quite perpendicular; the superior concave directed inwards and backwards; the inferior convex outwards and forwards.</td>
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<tr>
<td><strong>Proc. transversi</strong></td>
<td>Broad; at the base perforated by foram. vertebræ, for the art. vert., above grooved, for the v. cervicales.</td>
<td>Stronger; longer; horizontal; directed backwards, terminating roundly, and with an articular fossa, for tuberculum costae.</td>
<td>Thin; narrow; flat from before to behind; on the same plane as the ribs; hence, proc. costiformis.</td>
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The most particular characters by which to recognize the different vertebrae, immediately, are:

1. Cervical vert.—Foram. vertebræ; the extremity of the proc. Spinosus.
2. Dorsal vert.—Articular surface upon the body; articular fossa on the proc. transversus.
3. Lumbar vert.—The want of those characters peculiar to the cervical and dorsal vertebrae. By the transverse processes we can most easily distinguish the vertebrae of one region from those of another.

77. Separate Vertebrae.

I. Atlas, first cervical, lies like a ring at the circumference of the foramen Magnum, close to the skull, which it supports; consists of an anterior and a posterior segment. Arcus anterior, in the place of the vertebral body, is flat, convex anteriorly with a tubercle, tuberculum anterius, and on the concave posterior surface provided with a flat, egg-shaped, articular fossa for the odontoid process of the second cerv. vertebra. The lateral portions, massæ laterales, are strong, present above the concave fossæ condyloideae, corresponding to the superior oblique processes, for the proc. condylolîd. occipitis; below the round, flat, proc. obliqui inferiores, for the Epistropheus; upon the internal surfaces of either side a tubercle, tuberculum laterale, for the ligam. transversum. Arcus posterior, the largest part of the Atlas, consists of two narrow plates, which meet together at an angle and terminate with the tuberculum
postic, instead of the proc. spinosus.—Proc. transversi arise from the lateral portions, are strong and provided with an eminence, for the oblique muscles of the head.—Incisurae vertebrales lie behind the proc. obliqui, are deep, and form, almost alone, foram. intervertebralis; the superior, for art., ven., vertebræ, and n. cervical, 1., forms with the foram. vertebræ a canal, often closed, which is at the commencement vertical, then perpendicular.—Foramen spinale wider than that of the other vertebrae.

II. Epistrophæus, axis, dentatus, the second cervical vertebra, is particularly distinguished by its odontoid process, which projects six lines from the anterior superior part of the body; it has a broad basis, a contracted (brittle) portion, collum, and the extremity terminates in a tubercle, apex, for the lig. odontoid. Its spinous process is very long and strong, its foram. spinale cordiform and wide, its transverse process neither grooved nor bifid, the vertebral foramen passing obliquely outwards, and the superior articulating surfaces are nearly horizontal.

III. Vertebra prominens, seventh cervical.—The spinous process projects strongly backwards, and has only one tubercle at the apex.—Foram. vertebræ, sometimes wanting, is frequently very narrow. On the body there is often a semiarticular fossa, for the first rib.

IV. First dorsal vertebra.—On the body the projecting lateral borders as on the cervical vertebrae; besides, one whole articular surface for the first rib and half a one for the second rib.

V. Eleventh dorsal vertebra. A complete articular fossa for the eleventh rib; instead of the transverse process, a tubercle.—The twelfth dorsal vertebra is distinguished from the eleventh by the curved surface of the inferior articular processes, and their great projection in a vertical direction, downwards.

VI. Fifth lumbar vertebra. The transverse processes are much larger than those of the rest of the lumbar; the inferior articular processes are more widely separated, look directly forwards, are flat, not convex.

At the limits of any two regions, the characters of the vertebrae more nearly assimilate.

78. False Vertebrae, Vert. spuriae.

There are nine pieces, which in the adult are united together into two bones.

79. 1. Os Sacrum,

originally consisting of five vertebrae, lies at the posterior, central part of the Pelvis, behind its point of junction with the thigh bones; above, it unites with the last lumbar vertebra, below with the coccyx, right and left with the hip bones.

Direction: oblique from before to behind, and from above to below, forming with the lumbar vertebrae an obtuse angle, Promontorium s. angul. sacro-vertebralis.

Figure: a quadrangular pyramid with a blunt apex, the base above.

Muscles: glutæus. max.; ilio-costalis, s. Sacro-lumbalis; latissim. dorsi; pyriformis; multifidus spinae.
Base presents: a superior, oval articular surface, turned towards the inferior surface of the body of the last Lumbar vertebra; behind this, a triangular opening, formed of two planes, behind, a spinous process; two triangular lateral surfaces, which help to form the great pelvis; notches to form the last intervertebral foramina; two superior oblique processes.

Apex: blunt, with a transversely lying articular surface for the coccyx, behind the termination of the sulcus of the sacrum, two sacral cornua, which are the most inferior articular processes.

Surfaces—

a. Anterior, concave, with four elevated transverse lines, marking the points of junction of the \textit{vertebrae spur.}; on either side four anterior sacral foramina, for nerves and vessels. In this curvature lies the \textit{Rectum}; \textit{m. pyriformis} arises external to and between these foramina.

b. Posterior, close beneath the skin in the centre, convex; in the middle line the \textit{Crista Sacralis}, a continuation of the \textit{Spinous processes}, which, partially divided, has close to it, laterally, two flat furrows and four \textit{foram. sacral. post.}, for the \textit{nervi sacr. posterior}. Besides, the united \textit{oblique processes} projecting more strongly outwards, and the \textit{transverse processes}, also sacral, in one piece.

c. Lateral surfaces: triangular, above broad, below narrow, oblique from before to behind, and from without inwards. Anteriorly a semilunar articular surface, \textit{facies auricularis}, for the \textit{Hip bone}; behind it rough elevations for the post. sacro-iliac ligaments. Below on the indented borders the \textit{Sacro-Ischiatic ligaments}.

\textit{Canalis sacralis} is the termination of the \textit{can. spinalis} triangular, above broad, below narrow, and terminating in a groove. Into it the anterior and posterior sacral foramina open; out of it the \textit{Sacral nerves} come forth.

80.

2. \textit{Os coccygis}, fundament, tail bone,

consists of four united flat tubercles, the size of which diminishes downwards; is flat, triangular, above, broad at the extremity of the Sacrum, below, pointed and free.

Direction: usually that of the sacrum, forming, sometimes with this bone a \textit{right}, indeed, even an \textit{acute} angle. Important in obstetricry.

Muscles: \textit{gluteus maxim., coccygeus, levator et sphincter ani}.

Basis, the most superior piece, often united to the \textit{os sacrum}. Behind two cornua stand upwards from it; externally two notches, for the fifth pair of Sacral nerves.

Apex sometimes forked, or aside from the middle line. For the \textit{levator Ani}.

Surfaces: Anterior. Before it lies the \textit{rectum}.

Posterior, close beneath the skin, serves for the attachment of the \textit{m. gluteus Max}.

Sides, narrow, indented, rough, for \textit{Sacro-Ischiatic ligaments}.

\textit{Canalis Spinalis}, Canal for the Spinal cord, is formed by the \textit{foramina spinalia} lying over one another; it follows all the curvatures of the vertebral column, the diameters of which, however, differ from those of the canal.

Commencement: at the \textit{great Occipital foramen}.

Termination: in the \textit{Sacrum}.
The largeness of the canal accommodates itself to the mobility of the particular regions of the vertebral column, and to those portions of the spinal cord whence the greatest number of nerve filaments passes off. In the cervical and lumbar regions the column is most moveable, the nerves forming the Brachial and Lumbar plexuses very numerous, the canal the widest; in the dorsal and pelvic portions the reverse.

The anterior wall of the canal is formed by the vertebral bodies lying close over one another, merely separated by the intervertebral ligaments, the posterior by the vertebral arches, the interspaces between which are closed by short extensible ligamentous masses, ligament. flava.

On both sides the foram. intervertebralia open into it.

Canalis vertebralis, vertebral canal, on either side of the neck is formed by the over-lying forum. vertebrales of the transverse processes; it contains arteria et vena vertebralis.

81. **The Tissue of Vertebral Bodies,**

consists almost entirely of spongy substance with large meshes, covered externally with a thin layer of compact tissue. A great portion of the processes, and the whole of the arches, consist of the last mentioned.

The vertebrae are very richly supplied with blood-vessels. For this purpose we find on the dorsal surface of each vertebral body a horizontal canal, which divides into several and always smaller branches in the spongy substance, all of which are lined with a thin layer of compact bone and perforated by innumerable smaller foramina.

82. **Development of the Vertebral Column.**

In the first months of fetal life the vertebral column forms the entire length of the trunk, at birth three-fifths, and in the adult only two-fifths of the length of the body.

In the first period of development the curvatures of the Vertebral column are wanting, later it becomes curved in the form of a wavy line, the convex surface in the neck is directed forwards, in the dorsal region backwards, in the lumbar region, again, forwards, and in the pelvic strongly backwards. The smallest deviation from the curvature in one of the above named parts produces corresponding deviations in the other parts.

Besides these there exists in the region of the 4th and 5th dorsal vertebrae, in the region of the Aortic arch, a lateral inclination; the concavity to the left, convexity to the right.

Abnormal curvatures, forwards, backwards, and laterally by wasting or destruction of the vertebrae, or by inactivity of the muscles of one side and preponderating activity of those of the other, occur.

In old age the vertebral column curved forwards frequently exhibits a union of several dorsal or lumbar vertebrae.

The height of the column differs according to age, increasing to about the twenty-fifth year, and decreasing upon the advance of old age. Its average vertical diameter measures 2 feet 2 inches.

The separate vertebrae are developed from three centres of ossification, at first on the lateral boundaries of the spinal canal, as a defence for the spinal cord, and vertebral body. Five other points of ossification are presented, only later, for the processes.
Ossification commences with the fortieth day of fetal life; a year after birth the two lateral portions first unite together, in the arch, and only in the third to the fourth year with the body; the ossifying points of the transverse and spinous processes are first united in the twentieth to the twenty-fifth year.

In the Sacrum and Coccyx ossification commences, first in the body, in the second to the third month; the junction of the many ossifying points takes place very late, sometimes not at all. From the fortieth to the sixtieth year the coccyx usually unites with the Sacrum, but it is generally more slow in females than in males.

83. Thoracic cavity, chest, thorax s. pectus.

Situation: between the seventh cervical and first lumbar vertebrae, below the clavicle.

Figure: conical, the base below, the obtuse apex turned towards the neck, flat from before to behind.


84. I. Sternum s. os pectoris, Breast bone.

Position: anterior, central part of the chest.

Shape: flat, sword-shaped, above broad, one and a half to two inches, below, narrow, rounded; before, somewhat convex; behind, rather concave. Length, from five and a half to seven and a half inches; thickness, above, six lines; below, three lines.

1. Manubrium Sterni, handle, the most superior piece, for m. sterno-hyoidei, —thyreoidei,—mastoidei.
   a. The superior border, concave, called incisura semilunar is, s. Furcula (Vogel); on either side Incisura clavicularis, an oblong articular surface for the clavicle.
   b. Lateral borders, longer; with Foveae articulares for the first and second ribs.
   c. Inferior limit, a transverse line, the commencement of the body, where the second rib attaches.

2. Corpus, s. Mucro, middle piece, for m. triangularis and pectoral. major, the longest portion. Foveae articulares, for 3 to 7 ribs. Transverse line.

3. Processus ensiformis, s. xyphoides, ensiform process, termination of the breast bone, for m. rectus abdom., Diaphragm, flat, blunt pointed or forked at the end, generally cartilaginous, with one, sometimes two holes, for art. mamm. intern.

Structure: within, spongy; without, compact substance, covered with membr. propria sterni.

Development: Ossification commences late in the manubrium, about the fifth to the sixth fetal month, in the spaces between the extremities of the ribs. In the fifteenth to the sixteenth year there are five to six, later only three pieces to be seen. Ossicula episternalia, according to Breschet, rudimentary ribs, are some-
times present at the superior border of the sternum, one upon either side; they are generally rather larger than the Pisiform bone.

85. II. Costæ, Ribs, twenty-four.

Position: between the vertebral column and sternum; twelve upon either side.

Figure: flat, narrow, long, thin, elliptically curved, and directed from behind forwards, from above downwards.

Breadth: From three to six lines; thickness: one line.

Division: Costæ verae, 7; Costæ spuriae, false ribs, 5 upon either side.

Portions of each rib: Body, posterior and anterior termination.

Connection: with the twelve dorsal vertebrae, with the cartilages of the ribs and the sternum, with the last bone by means of the cartilages of the seven superior, or true ribs.

1. Posterior extremity, Head, presents: Capitulum with two semi-articular surfaces, uniting with bodies of the dorsal vertebrae, from the second to the tenth rib between the two vertebrae, on the eleventh and twelfth rib in the centre of the body [on the eleventh above the centre]. Neck, the thinnest part; rough, in relation with the transverse proc. of the vertebra above it; Tuberculum, tubercle, the internal portion, for the transverse process of the vertebra below; the external for ligaments; the termination of the neck of the rib.

2. Body, central portion, with the Angulus costae not far from the Tubercle; has an external convex, rough, and an internal, concave, smooth surface, a thick superior, a sharp inferior border. On the last, within: Sulcus costalis, for the art., ven., and nerv. intercostalis.

3. Anterior extremity, with oval articular surfaces [fosse] for the cartilages; at the last an obtuse angle.

The true ribs unite by their cartilages, immediately, with the sternum at an acute angle; increasing in length from above to below.

The false ribs, c. spuriae, five, decrease from above to below in length; as well as their cartilages.

Particular ribs. 1. First rib, the smallest and broadest, with short and thick cartilage almost immoveable. The external surface; for ven. subclavia, before, for art. subclavia, behind—m. scalenus anteri and subclavius, looks upwards, the superior border inwards. On the Capitulum one articular surface; Colium, long, cylindrical; Tuberculum, projecting, angular; anterior extremity broad.

2. Second rib, as long again as the first, may lie horizontal, the angle very indistinct. External surface, above, for m. serratus post. sup., scalenus med. et post. Internal surface obliquely downwards, with a very superficial groove.

3. Third rib, much larger, more arched below and before: angle more marked.
4. The eleventh and twelfth ribs, Costae fluctuantes—very moveable; marked curve. Collum, Tuberculum, et Sulcus, wanting. On the Capitulum only one flat articular surface. Anterior extremity very thin and pointed. The eleventh is longer.

The costal cartilages are flat like the ribs, chiefly formed as these, and ossifying easily upon the surface. They are twenty-four, sometimes twenty-six, or only twenty-two.

The external extremity lies in the fossa at the anterior termination of the rib, the internal is either immediately united with the Sternum, in the true ribs, or with the inferior border of the rib above, as the eighth to the tenth costal cartilages, or extends freely into the abdominal walls, eleventh to the twelfth. The borders of the fifth to the seventh ribs are united together. The three superior are straight; the rest curve outwards. Length: the first rib is very short and thick, often ossified; the following to the seventh always longer; from the eighth to the twelfth always shorter; the twelfth only a few lines long. In general, the length of the cartilage measures one-fifth of that of the entire rib.

Structure of the ribs: it is similar to that of the flat bones generally.

Development: Ossification commences with the second month of fœtal life, from the body outwards. The osseous nuclei in the capitulum and tuberculum appear only in the sixteenth year, and completely united in the twenty-fifth year.

86. **External surfaces of the Chest.**

1. Anterior region, much broader below than above, inclining from behind forwards, from above downwards. In the centre—sternum, laterally the costal cartilages with the intercostal spaces; externally on either side the linea chondro-sterinalis, behind this the limit, namely the line of the anterior angles.

2. Lateral regions, more convex behind than before, presents the central piece and the interspaces of the ribs. **Intercostal spaces:** these decrease in breadth from above downwards; however, the two last are broader than those in the centre; and the space between the anterior is broader than between the posterior extremities of the ribs.

3. Posterior region, between the posterior angles. In the centre: 12 Proc. spinosi dorsal; close to these the sulci vertebralis; 12 Proc. transversi; the articular connections with the tubercles.

87. **Cavity of the Chest, Cavitas thoracis.**

Anterior wall; concave, breast bone: costal cartilages. Posterior wall; in the centre: the projecting column of the vertebral bodies; at the excavated sides, fossae pulmonales, for the convex posterior surfaces of the lungs; posterior terminations of the ribs.

Lateral varieties, formed by the ribs.

Inferior wall, formed by the diaphragm.

Superior wall wanting; in place of it, an oblique opening inclining from above and behind downwards, for Trachea, Esophagus, ductus thoracicus, the great cervical and brachial vessels, nerv. vagus and phrenicus, the apex of the lungs, several muscles.
The a-ex of the cavity is almost immoveable; the rest of the part, and particularly of the basis, by means of the ribs, very moveable. It is expanded in inspiration, contracted during expiration.

In the fœtus are: 1. The diameters from before to behind greater than the transverse diameter, the Sternum projects, on account of the size of the heart and the thymus gland.

2. The vertical diameter shorter, since the diaphragm projects high upwards.

3. The ribs slightly curved, the fossæ pulmonales not yet developed, as the lungs have not yet resired.

4. The inferior opening larger in all directions, on account of the large size of the Liver.

88. The Pelvis,
formed of—1. The Sacrum and Coccyx;
2. The hip, or unnamed bones, ossa coxarum, s. innominata, two.

It lies below the fifth lumbar vertebra, at the side and before the inferior parts of the vertebral column; contains a portion of the intestinal canal, and especially the organs of procreation [with those of micturition].

89. Os coxae, Hip bones,
occupy the anterior sides of the Pelvis, are flat, and consist, before the age of puberty, of three separate bones,—the Ilium, Ischium, and Pubes, which are united together by their thickest parts in the Acetabulum.

Connection: behind with the os sacrum, before and below with each other, laterally with the thigh bones.

90. 1. Os Ilium,
is the largest and broadest piece; the most superior, and forms the lateral wall of the Pelvis; extends from the Sacrum to the superior third of the Acetabulum:

a. External surface; undulating, with 1 to 2 lineæ arcuatae externæ, for glutæus medius and minimus; and a few foramina for vessels.

b. Internal surface; with linea arcuata interna, the limit between the superior part, for m. Iliacus internus, which is the lateral wall of the great pelvis, and the inferior portion, that of the lesser pelvis. Behind: tuber Ilium and facies auricularis, the articular surface for the Sacrum.

c. Crest of the hip, Crista Ilii, is the superior S-shaped border, for m. latissimus dorsi, and quadratus lumborum; with, 1. labium externum, for obliq. externus; 2. lab. internum, for m. transvers. abdom.; 3. linea intermedia, for m. obliq. internus.

d. Anterior border, descending at an obtuse angle with the Spina Ilii ant.
SPECIAL ANATOMY.

sup., for m. sartorius, tensor fasciae latae and—inferior, for m. rectus femoris; between the two spines and below the spina inferior, a notch, for m. Iliacus, terminates in the anterior horizontal ramus of the pubes, where is the eminencia ileo-pectinea.

e. Posterior border, with Spina ili post. sup.; inferior; Incisura semilunaris.

f. Inferior border, from the Spina poster. infer. presents. Incisura ischiadica major, for m. pyriformis, art. and nerv. glutaeus, ischiadicus, and pudend. communis.

91. 2. Os ischiin, seat bone, for m. levator ani.

The most inferior portion; below and behind the Ilium.

a. Corpus, the inferior portion of the acetabulum. Internal surface smooth, forms the inferior portion of the small pelvis. Posterior border with Spina ischi, the limit between Incisura ischiadica major and minor, for m. gemellus super., coccygeus and Ligam. spinoso-sacrum. Anterior border, commence- ment of the obturator foramen.

b. Ramus descendens, short and thick. Posterior border forms the Incisura ischiadica minor, for m. obturator internus, art., ven. pudendus communis, from Spina ischi to Tuber ischi, for m. gemellus infer., quadratus femoris, semitendinosus, semimembranosus, biceps, transversus perinæi, Ligam. tuberoso-sacrum. Anterior border, sharp, assists in forming obturator foramen.

c. Ramus ascenden⊥—ascends from Tuber ischi forwards and inwards, for m. ischio-cavernosus. Internal border forms the internal part of the obturator foramen. External border a part of the Pubic arch.

92. 3. Os pubis s. pectinis,

in the anterior region of the pelvis.

a. Corpus—the inner third portion of the acetabulum—with Eminentia ileopectinea, for crural artery above the Acetabulum.

b. Ramus horizontalis, for m. rect. abdom., pyramidalis—above. Superior border, sharp, Pecten s. Crista pubis, for Pectineus m., a continuation of linea arcuata, terminates in Spina pubis, for ligam. Pouparti. Inferior border, the superior part of the obturator foramen.

c. Ramus descendens for m. adduct., gracilis, descends from the Spina pubis, to meet the ram. ascend. of the Ischium. External border forms the internal of the obturator foramen; internal border, with that of the other side, the pubic symphysis, over this angulus pubis, superior; beneath it the superior portion of the pubic arch.

Acetabulum, the hemispherical, hollow surface, in which the body of the three bony pieces meet together, lies on the external side of the pelvis obliquely outwards and downwards, and is destined for the reception of the thigh bones. Its crescentic, sharp edge, supercilium, has below and internally a deep Incisura acetabuli, for the vessels of the joint to enter, and is still more deepened by a tendinous ring, labrum cartilaginem. Above is a horizontal groove, for tendo recti femor., beneath a deeper, for tendo obturator externi. The whole external surface is covered with cartilage, that is the facies lunata, to the small Fovea for the attachment of the ligam. teres. The internal surface turned towards the small pelvis is rather curved downwards and backwards,
passing to the spina ischii. Important at the time of labour on account of the turning of the fetal head.

The Obturator foramina, 2, foramen obturatorium, s. ovale, formed by the ischiium and pubis, lies at the anterior region of the pelvis. At the superior external wall a groove, for art., ven., nerv. obturatorius; otherwise entirely closed by the memb. obturaria. External boundary for the m. obtur. extern.; internal for m. obtur. intern.

Symphysis ossium pubis, in the central line of the body at the anterior region of the Pelvis, formed by the internal vertical borders of the two osa pubis, 15 to 20 lines in height, higher in the male than the female. The articular surfaces are oval, flat, but directed obliquely from behind and internally to before and externally. There is a triangular space, with the apex behind, between them, which is filled with an elastic, strong, Ligamentum intersusseum pubis. Besides this, three ligamenta pubica serve to unite the pubes, the most important of which, triangulare, assists in forming the pubic arch.

The Pubic arch, Arcus pubis, angular in the male, round in the female, is formed by the ascending rami of the Ischia on either side, by the inferior border of the Ram. descend. os pubis, and the ligam. triangulare s. arcuatum. Superior transverse diameter one inch, inferior three inches.

The Sacro-Iliac symphysis unites the osa innomina inad behind with the sacrum, superficies auriculares, making a double angle, first vertical, then from behind to before. This articulation is also moveable, although not to the same extent as the Symph. pubis.

93. Cavity of the Pelvis, cavitas pelvis, contains, a portion of the small intestines, the rectum, the urinary bladder, the internal organs of generation, vascular and nervous trunks.

1. Pelvis major, the great Pelvis; open before and behind, (closed behind, if we consider with the Obstetricians, that the fifth Lumbar vertebra forms a part of the pelvis,) formed by the axe of the Ilia, fossae iliacae, for m. Iliacus intern., and the small intestine; is below narrower where the linea arcuata divides it from the small pelvis. Anterior transverse diameter between the Spinae anter. sup. Eight to nine inches.

Linea arcuata, a crescentic raised line, passing from the centre of the superior border of the Sacrum; over this, the Ilium and the os pubis to the anterior spine of the pubis.

Promontorium—angle of the fifth lumbar vertebra with the sacrum.

2. Pelvis minor, the small pelvis at the superior and inferior outlet narrower than in the centre.

a. Apertura superior, elliptical or oval, with three diameters:

1. Straight diam., conjugata [antero-posterior] = 4 inches, from Promontory to superior border of symphysis pubis.

2. Transverse diam. = 5 inches from the centre of the linea arcuata of the one to that of the opposite side.

3. Oblique diam., Diam. Deventeri, two, = 4½ inches from sacro-iliac sym-
physic of the one side to the ileo-pectineal eminence at the superior border of the Acetabulum of the other.

b. Cavum pelvis minoris, formed, behind, by the Sacrum and Coccyx, the cavity of which is 4 inches 6 lines, and depth 10 to 12 lines; anteriorly by the symphysis and ossa pubis with foram. obturator; laterally by oss. Ischii. Diameter.

1. Straight diameter [ant. posterior] = 4½ inches from the centre between the second and third pieces of the Sacrum to the Symphysis pubis.

2. Transverse diam. = 4 inches between the Spina ischii, before and above them.

c. Apertura inferior, pelvic outlet, formed by the apex of the coccyx, the Tuber Ischii, and Arcus pubis; has three notches; arcus pubis and Incisurae ischiadice.

1. Straight diam. [ant. post.] = 3½ to 4 inches from the apex of the coccyx to the crown of the pubic arch.

2. Transverse diam. = 4 inches from internal border of one Tuber Ischii to the other.

3. Oblique diam., two, = 4 inches from the centre of the ligam. sacro-ischiadic of one to the Tuber Ischii of the other side.

The axis of the small pelvis, that is, a perpendicular drawn through the centre of the straight diameter, passes above obliquely backwards, below obliquely forwards. Inclination. The Promontory lies 3½ to 4 inches higher than the superior border of the Symphysis pubis, and the Conjugata therefore makes with a horizontal line an angle of 60°. The apex of coccyx lies ¾ to 1 inch higher than the inferior border of the Symphysis pubis.

Development of the Bones of the Pelvis.

Ossification commences in the acetabulum, first, that is, in the body of the Ilium, in the fourth month of the foetus. At the age of puberty the inferior border of the Ischium and the crista Ili first ossify, and the last only unites with the rest of the bone at the twentieth to the twenty-fifth year.

In young children, and even more in the unborn, the pelvis is relatively much more narrow, and strongly inclined, so that the urinary bladder lies with its whole anterior surface on the abdominal parietes, instead of in the lesser pelvis. Characters of the female pelvis, vide 109.

Bones of the Extremities, Ossa extremitatum.

A. Thoracic extremities, arms, extremitates superiores, s. thoracice, Brachia.

94. I. Shoulder, Humerus, consists of the shoulder-blade and collar-bone.

1. Scapula, Omopleta, Shoulder-blade.

Position: behind on the Thorax, behind the second to the seventh ribs on either side of the vertebral column, very moveable.
Shape: triangular, shield-like, flat.
Portions: 2 surfaces, 3 borders and angles.
Connection: with the Clavicle and Humerus.

a. Anterior surface, turned towards the ribs, concave; this is \textit{Fossa subscapularis}, for \textit{m. subscapularis}, lying close to the surface of the back; \textit{Scapulae alatae} stand off from it.
b. Posterior surface, divided into the smaller superior \textit{fossa supraspinata}, for \textit{m. supraspinatus}, and a larger inferior \textit{fossa infraspinata}, for \textit{m. infraspinatus}, by the ridge, \textit{Spina scapulae}, for \textit{trapezius, deltoide}: this is triangular, presents a superior and inferior surface, an external short, and a posterior thick border, close beneath the skin, with a triangular surface, for the \textit{m. Trapezius}; passes forwards, upwards and outwards, to the top of the shoulder, \textit{Acromion}, which, triangular and flat, projects over the shoulder, protects the articulation above and behind, and possesses at the superior border a small \textit{articular} surface for the \textit{Clavicle}.
c. Borders: 1. Internal, Vertebral border, \textit{Basis scapulae}, the longest, with an external lip, for \textit{m. rhomboideus}, and an internal, for \textit{m. serratus anticus major}.
2. External border, the thickest, inclined downwards and forwards towards the arm [the axillary border], for \textit{m. teretes et anconaeus longus} [long head of the Triceps], above.
3. Superior border, sharp, small, for \textit{m. omohyoideus} with \textit{Incisurae scapulae s. lunata}, formed into a foramen by \textit{ligam. transversum}, for \textit{ner. suprascapular}; it passes into the coracoid process.
d. Angles: 1. Internal, almost a right angle, for \textit{m. lev. anguli scapulae}.
2. Inferior, very pointed, \textit{m. Serratus magnus}, attached to it, separated from the skin by \textit{m. latissimus dorsi}.
3. External, is the oval, vertical \textit{Condylus scap.} with the surface \textit{Cavitas glenoidalis}, the articular fossa for the head of the \textit{humerus}, supported by a \textit{Collum scapulae} under which the \textit{Incisum collis}, the junction of the \textit{fosse supra et infra spinata}, over which the \textit{Process. coracoideus} projects, for the short head of the \textit{biceps}, at the apex \textit{m. coraco-brachialis, pectoral minor}, farther above, \textit{ligam. coraco-clavicularia, acromiale}. \textit{Proc. coracoid} bends under the clavicle, forwards and outwards over the shoulder joint, and protects it from before.

Development: ossification commences in the centre, at the end of the second month of the foetus. In advanced childhood the coracoid and acromion are still cartilaginous; they contain, like the posterior border and inferior angle, but not the \textit{spina}, special osseous nuclei. The \textit{acromion} has two, but later. The \textit{P. coracoid} unites with the body of the bone in the fifteenth to the sixteenth year, the remaining points, especially the inferior border, only after full growth.

95. 2. Clavicula, furcula, Collar-bones, 2.
Position: before and above the first rib, between shoulder-blade and breast-bone, horizontal.
Direction: both converge forwards and rather downwards, to the Sternum.
Figure: cylindrical, sigmoidal, at the internal extremity thick and round, external flat.

Curvatures: convex, anteriorly, in the sternal, posteriorly, in the acromial half.

Connection: with the breast bone, the shoulder-blade, and often, with the first rib.

a. Body, middle piece, almost immediately under the skin, is frequently fractured, with Tuberculum for m. Cleido-mastoid. Inferior surface, externally broad, with a rough line, for m. Subclavius; with an articular surface internally, for the first rib; in the middle third corresponding to the first intercostal space, for Plex. brachialis et Vasa axillaria; the outer third, united with Proc. coracoid. by the ligam. Conoid. et Trapezoïd. Posterior border, two-thirds concave, one-third convex, externally. Lies on Subclavian vein; behind that Art. et Plexus brachialis.

b. External termination, extremitas acromialis, for m. trapezius et deltoides, flat, weak, and easily broken; with an articular surface for Acromion.

c. Internal termination, extremitas sternalis, enlarged, angular, covered with cartilage, projects over the articular surface of the Manubrium sterni into the incisura clavicularis of which, it is received; for m. sterno-clido-mastoïd., and pectoralis major.

Varieties. In the female the Clavicle is more slender, less curved, and more horizontal. Structure: The medullary canal in the interior of the Clavicle is very small; the extremities consist of more Spongy tissue.

Development, at a very early period, at the thirtieth to the thirty-fifth day from one osseous nucleus in the centre. In the fifteenth to the eighteenth year an osseous nucleus appears as a thin disc at the sternal end. In mature childhood the humerus is only about \( \frac{2}{3} \), in adults \( \frac{4}{3} \) larger than the clavicle.

The shoulder is placed before and behind close to the Thorax, but stands out from it, and the space thereby formed forms the superior part of the cavity of the axilla.

96. II. Os humeri s. brachii, Bone of the upper arm.

Position: between shoulder and fore-arm, on the sides of the chest.

Length: reaching downwards to the second Lumbar vertebra, farther in Negroes.

Direction: parallel with the axis of the trunk, yet rather oblique from above downwards, and without inwards.

Figure: tubular, cylindrical.

Connection: with the shoulder-blade and the fore-arm.

a. Superior extremity with: 1. Caput humeri, a segment of a sphere, about \( \frac{2}{3} \); lies in the Cavit. glenoïd. scapulae, is surrounded by a circular flat groove, the Collum humeri of Anatomists, and forms an obtuse angle with
the axis of the shaft of the bone. 2. Tuberculum majus, on the outer side, with three surfaces, for m. supra-., infraspinatus, et Teres minor. 3. Tuberculum minus, anterior, for m. subscapularis. 4. Suleus longitudinalis, between the two tubercles, for the tendon of the Caput long. biceps. 5. Spina tuberc. major, for m. pect. maj. et deltoid. 6. Spina tuberc. min., for m. teres maj., latis. dorsi, et coraco-brachial. 7. Collum humer. chirurgorum at the superior sixth of the humerus and the point of transition into

b. The middle piece, the body. Superior half cylindical, inferior, triangular, prismatic.

1. Surfaces: external, below the superior third a V shaped depression, for m. Deltoideus. Internal anterior surface, for m. brachialis internus, oblique from above, downwards, and from before, inwards, the course of the Art. brachialis, presents: Foram. nutritium. Posterior surface below very broad, for m. triceps.


c. Inferior extremity flat, broad; presents, from without inwards: 1. Condylus externus, for the extensor and supinator muscles. 2. Eminencia capitata s. rotula, the small articular head, unites with the Radius of the fore-arm. 3. Trochlea, it receives the Ulna. Above it we find Fossa ant. maj. for Proc. coronoides ulnae, minor, for the radius;—posterior, for Olecranon. 4. Condylius internus, for the flexor muscles, pronator teres, and palmar. long., behind with a flat groove, for nerv. ulnaris.

Structure. At the extremities spongy tissue, in the body compact substance and medullary cavity.

Development commences early, second month, in the centre; both extremities still remain cartilaginous in the second year; then at the superior extremity, for caput and tuberc. majus et minus, three osseous nuclei appear; lastly, at the inferior extremity four osseous centres. In the eighteenth to the twentieth year the extremities first unite with the centre piece, the inferior soonest.

97. III. Ossa antibrachii, Bones of the fore-arm.

1. Ulna s. cubitus, Elbow.

Position: on the inside of the radius, between upper arm and hand, on the same side as the little finger.

Shape: prismatic, triangular, rather twisted; above thicker than below; longer than the radius.

Direction: rather oblique from above, downwards and outwards.

Connection: with the upper arm, the radius and cuneiform bone by the ligam. capsulare sacciforme.

a. Superior extremity, behind, has the hook-like process, Proc. anconeus s. Olecranon, for the Anconeus muscle, the extremity of which moves in the fossa olearani post.; anteriorly, Proc. coronoides, for m. Brachialis internus, the point
of which moves in the Fovea anterior; the Basis in which the Olecranon and Coronoid processes meet together, is thin and brittle; between the two: Fossa sigmoidea maj., for the Trochea of the upper arm; minor on the outer border of the Coronoid process for capitulum radii; under that a rough, deep, triangular surface, for m. supinator brevis.

b. Centre piece, shaft, 1. Surfaces; Anterior, Volar; above broad, with foram. nutritum. Muscles: flex. digit. et pollic. long., carpi ulnaris. Posterior surface: somewhat convex, divided by a longitudinal line. Internal surface: above very broad; below narrow, and close beneath the skin, smooth.

2. Borders. External, crista, the sharpest, particularly in the centre, diminishes below for abduct. long. et extens. brevis. pollic., ligam. interrosseum. Anterior or internal, obtuse, for flex. digitor. comm., pronator quad. Posterior: commences below the Olecranon, and is lost on the inferior fourth; perceptible through the skin.

c. Inferior extremity, for M. pronator quadratus. Capitulum s. condylus ulne unites with the inferior extremity of the Radius and the cuneiform bone. Internal to the small head, Proc. styloideus, for ligam. laterale intern. of the hand and fore-arm; between the two a hollow, for ligam. triangulare.

Structure. Compact in the centre, spongy at both extremities, particularly at the elbow. Olecranon sometimes forms a special bone.

Development: three osseous nuclei. The first appears in the body at the thirty-fifth to the fortyeth day of the fetus. The extremities only ossify with the sixth year, and the inferior first. In the fifteenth to the sixteenth year the middle unites with the superior, in the eighteenth to the twentieth year with the inferior extremity.

98. 2. Radius.

Position: on the outer side of the Ulna, on the same border as the thumb,—radial border.

Shape: prismatic and triangular, above thin, below thick; in the centre slightly curved.

Connection: with the upper arm, rotula proc. cubital., Ulna, the wrist, os lunare, naviculare.

a. Superior extremity. 1. Capitulum radii, with a lateral, annular, articular surface, circumferent. articular., for the fossa sigmoid. minor, and a superior, for the rotula.

2. Collum, five to six lines long, inferior limit of which:

3. Tuberositas radii, for m. biceps, the tendon; behind, rough; before, smooth.

b. Central piece, shaft, slightly curved, internally concave. 1. Borders: anterior, blunt, commences from the tuberosity, passes obliquely outwards, and terminates below, before the Proc. styloideus; posterior, above and below slightly marked; external, for ligam. interrosseum, Crista, from the tuberosity to a small articular surface below and internal.

2. Surfaces: Anterior; above, narrow; below, broad; with foram. Nutritium, for m. supinator brevis, flex. pollicis long., digitor. commun. sublimis. External surface, convex, for m. Pronator teres. Posterior surface, rather hollow, for m. abduct. pollicis longus.

b. Inferior extremity, thick, quadrangular, for m. pronator quadratus, with
an inferior, concave, divided, articular surface. 1. Cavitas glenoïdalís, for os navicu-
laré, on the outside, os lunatum on the inside. 2. Externally: proc. styloïdeus, for supinat. longus, between the anterior and external border, a groove, for m. abduct. long. and extens. brevis pollicis. On the circumference upon the dorsal aspect. 3. Two grooves, for the tendons of the extens. carpi radial. long. and brevis; anteriorly, for those of the extens. digit. comm., and behind, pollic. long. Incisura semilunaris, in which the Capitulum Ulnæ moves.

Development proceeds from three osseous points, first in the central piece; in the inferior extremity, towards the third year, in the superior towards the ninth; the last unites with the shaft in the twelfth year; the first in the eighteenth to the twentieth.

99. IV. Ossa manus, Bones of the hand.

1. Carpus, root of the hand, wrist, about an inch long, $2\frac{1}{2}$ broad, consists of eight short bones, lying close together in two rows, one above the other, and four bones in each. The wrist is united above, with the fore-arm; below, with the metacarpal bones; concave upon its anterior or palmar surface, hollow of the hand, it forms with the ligam. carp. volare prop., a ring for the tendons of the flexor muscles; convex on the posterior, dor-
sal surface. It presents an Ulnar and Radial border,—Vola, pal-
mar—Dorum manus, dorsal surface, back of the hand.

Eminentiae carpi are two projections on either border of the palmar surface.

At the ulnar border: 1. the superior, os pisiforme; 2. the inferior, the hooked process of the unciform bone.

At the radial: 1. the superior, os naviculare; 2. the inferior, os trapezium.

a. Bones of the superior row passing from the Radial to the Ulnar border.

1. Os naviculare s. Scaphoïdeum lies below the radius, above three bones of the second row, with a deep, articular fossa, for os Magnum, with a convex, articular surface, for oss. trapezium et trapezoid, the largest bone of the first row.

2. Os lunatum, semilunare, lunar bone, lies below the radius above the os magnum, between 1. and 3.

3. Os [cuneiforme] triquetrum, pyramidal bone, below the Ulna, above the unciform bone.

These three bones, when united, are convex above, concave below. They are connected with the fore-arm.

4. Os pisiforme, pea-like bone, for flex. carpi ulnaris, abduct. digitii 5, lies free in the hollow of the hand, only united with the pyramidal bone [cunei-
form] at the ulnar border.

b. Bones of the inferior row from the radial to the ulnar border.
1. Os [Trapezium] multangulum majus, for opponens, abductor brevis pollicis, below the navicular, above the first metacarpal bone; with a groove in its palmar surface, for the tendon of the flexor. carp. rad.

2. Os [Trapezoides], multangulum minus, s. pyramidale, for flex. pollicis brevis, below the navicular, above the second Os Metacarpi. Ossa multangula form a concave, articular surface, for os naviculare.

3. Os [magnum], capitatum, for adductor. and flex. brevis pollicis, below the scaphoid and semilunar, bones, above the third metacarpal bones; with Capitulum.—The largest bone of the second row.

4. Os [unciforme], hamatum, hooked bone, below the cuneiform, above the oss. metacarp. iv. and v. Its hook, proc. uncinatus, for m. flex. brevis et opponens digitii 5, lies close to the pisiform bone.

Os capitatum et hamatum form an articular head, for the articular fossa of the first row.—The Middle bones have four, the external only three articular surfaces.

Structure. The carpal bones consist of a spongy, bony mass, covered externally with compact tissue. Ossification commences after birth; at the end of the first year in the magnum and the unciforme bone; between the third and fourth years in the cuneiform; between the fourth and fifth in the trapezium and semilunar; between the eighth and ninth in os naviculare and trapezoid; between the twelfth and fifteenth in os pisiforme, which is generally the latest perfected of all the bones.

100. 2. Metacarpus, Middle hand,
consists of five parallel, columnar bones, which, united together like a grating, are connected with the carpal bones and phalanges of the fingers.

a. Superior carpal end, Basis; enlarged, rather hollowed out, for the reception of the carpal bones; tri- or quadrangular, with two small lateral surfaces to receive the lateral metacarpal bones.

Basis. oss. Metacarp.
I. For abduct. poll. long., unites with os trapezium.
II. For flex. et extens. carp. rad. longior., with os [Trapezium], Trapezoid, and [Magnum].
III. For extens. carp. rad. brev., with os magnum.
IV. With os [magnum] and unciforme.
V. For extens. carpi ulnaris., with os unciforme.

b. Central part, for m. interossei, roundish, triangular, rather concave on the palmar aspect.
c. Inferior, digital end, capitulum, with two tubercula and one sinus on either side.

Capitul. oss. metacarpi: I. for m. opponens, abduct. brev. pollic.
V. for m. opp. minimi digit.

I. The metacarpal bone of the thumb, is shorter and thicker than the rest; has no lateral articular surfaces, and is moveable in a free joint, Arthrodia.
II. is the longest, has on its base only one lateral articular surface. A little shorter, but thicker, is
III., with two lateral articular surfaces.
IV. is shorter, and V. shorter still. The last has only one articular surface, but a tubercle on the base, for m. extens. carp. ulnaris.
THE BONES.

Structure, as in the long bones, spongy substance at the ends, compact in the centre, medullary canal, but narrow; in the interior.

Development; from two osseous points, one for the centre and superior, one for the inferior extremity. The I. metacarpal at the superior end like the phalanges, which it also resembles. At birth the central piece is almost entirely ossified; at the extremities ossification commences between the second and third year, and is only completed with the eighteenth to the twentieth year.

101. 3. Digiti, fingers.

On either hand there are five articulated pyramids, each of which unites with one of the five metacarpal bones.

I. Finger, thumb, has two, the rest three members, phalanges. The first of the three, or two members, is united with the end of the metacarpal bone, the third (second) is free, as the ungual. Each phalanx has a superior, hollowed extremity, for the reception of the bone lying above it, an anterior concave body, and an inferior roller-like end, for its junction with the phalanx below; only the ungual member, phalanx unguicularis, terminates in a semilunar end.

I. Thumb, pollex; in it the centre Phalanx is wanting; on the base of the first, at the metacarpal end, in the hollow of the hand, lies an os sesamoideum externum, for m. flexor pollicis brevis, and internum, for m. abductor pollicis.

1. Phalanx—sup. Extremity, for extens. et abd. brevis.
2. " " for flex. et extens. long.

II. Index finger.

1. Phalanx, Radial side, for m. lumbricalis I., Interosseus.
2. " for m. flex. comm. subl., extens. comm.
3. " for m. flex. comm. prof., extens. prop.

III. Middle finger, digitus med., muscles as in II.; the last excepted.

IV. Ring finger, dig. annularis, as in III.

V. Ear finger, dig. auricularis s. minimus.

1. Phalanx, for abduct. et flex. brevis.
2. " for flex. comm. subl., opponens.

Development. Each of the phalanges is ossified from two points, the body and the inferior extremity, in the third foetal month. The extremity first unites with the body between the eighteenth and twentieth year after birth.

Abdominal Extremities.

B. Extremitates inferiores s. abdominales.

102. I. Os femoris, Thigh-bone.

Position: close to and beneath the Pelvis, above the leg.
Shape: long, cylindrical, with thick extremities: the longest bone in the body.
Direction: from above to below, and from without to within, particularly in the female.

Connection: with the acetabulum of the pelvis and the shin-bone.

a. Superior extremity—taking a course from the shaft or centre piece from without, inwards and upwards. On it,

1. Caput femoris, head of the thigh bone, almost two-thirds of a sphere with foræa, for ligam. teres.
2. Collum, neck of the thigh bone; forms with the central piece an obtuse angle; flat. Anterior surface short, posterior longer and rather concave. Behind it

3. Trochanter Major, above and externally in a plane with the corpus femoris, for m. glutæus med. and minimus, pyriformis, quadratus femoris, with: Fossa trochanterica, for m. gemelli et obturatoria.
4. Trochanter Minor, below and internally from the base of the neck, for the tendon of the m. Psoas et iliacus.
5. Linea intertrochanterica anterior, for m. cruralis, posterior, [part] for m. quadratus femoris.

b. Centre piece, body. Anterior surface rather convex, inferior broader than above, for m. cruralis. Internal surface, flat, below broader and directed backwards, indicating course of art. femoralis. External surface, narrow, in the longitudinal direction rather concave; the external and internal borders are roundish. Posterior border, sharp and rough, the Linea aspera; above and below divided. Above, the external angle terminates in the Trochant. major, the internal; the more feeble, in Troch. minor.
Internal angle, for m. pectineus adductor brevis, vastus intern.
External angle, for m. Glutæus max., adductor magnus, vastus externus, Caput breve bicipitis.

Centre, the linea aspera, for m. adductor longus et magnus, with: Foramen nutritium. Below, the Linea aspera terminates in the two condyles, for the m. gastrocnemius, between which is a triangular space, the superior part of the fossa poplitea, for art. ven., et nerv. popliteus.

c. Inferior extremity broad, flat from before to behind; with

1. Condylus externus, for m. Popliteus, plantaris, Cap. extern. m. gastroc. upon a plane with the corp. femoris.
2. Condylus intern. projects very much inwards from the axis, for Cap. intern. m. gastroc.

On the articular head:

1. Inferior articular surface, for the tibia and patella.
2. Tuberositas interna projects greatly; over it a surface, for m. adduct. magnus; externa, less marked, with a tubercle. Both for ligamenta cruciata.

Between them:

3. Posterior Fossa intercondyloidea, forms the fossa of the knee.
4. Anterior Trochlea femoris, corresponds to the Patella.

Structure: type of the long bones.

Development: five osseous centres: one, for the body, one for each extremity, one for each Trochanter. The first appears in the body, between the fortieth and fiftieth days; the second in the inferior extremity, regularly, in short, before the maturity of the foetus; the third in the middle of the head at the end of the first
year. The neck ossifies by extension from the body. The Trochanter major ossifies in the fourth year,—minor in the thirteenth or fourteenth. Both are first united to the head towards the twenty-eighth year, the other parts soon after puberty.

103. II. Ossa cruris, Bones of the leg.

1. Tibia, shin-bone.

Position: below the thigh-bone, above the foot, on the inside of the Fibula, on the same border as great toe, Tibial.

Direction: vertical.

Shape: three-sided, prismatic; above and below enlarged. The strongest and longest bone next to the femur.

Connection: with os femoris, Fibula (immoveable); Astragalus; the Patella by ligam. Patellae.

   a. Superior extremity, caput tibiae, broad, much stronger than the inferior extremity.
   1. Cavitas glenoidalis interna, longer and deeper than externa. Both oval, concave, for Condylus femoris; divided by
   2. Eminentia intermedia, pyramidal, rather posterior, for ligam. cruciata; supported by
   3. Condylus internus, behind with a horizontal groove, for the Tendon of Semimembranosus, and by Condylus externus, a slight enlargement with the small external superficies peronea, for the head of the fibula. Posteriorly between the condyles—a deeper notch, incisura poplitea; before a triangular surface with several foramina, and under that,
   4. Spina tibiae, rough, for tendo communis recti, crural., vasti, externally and above a tubercle, for m. tibial. anticus.

   b. Central piece; three-sided, thick, weakest in the inferior third.

   Internal surface, above, covered by an Aponeurosis, pes anserinus, below only by the external skin, above broad and oblique from before inwards, inferior fourth narrow and directed directly inwards.

   External surface, for m. tibial. ant. et extens. digit. comm., above concave, below directed forwards.

   Posterior surface, for m. tibialis posticus and flex. digit. comm., above broad; with Linea obliqua, for m. Soleus, and a triangular surface, for m. popliteus; Foramen nutritium.

   Anterior border, Crista tibiae, close under the skin, sharp, rounded in the inferior fourth: continuation of Spina.

   External border, for ligam. inteross., divided below.

   Internal border, obtuse, for m. sartor., gracilis et semitendinosus.

   c. Inferior extremity, basis, almost four-sided, broad; before convex, for the Extensor tendons; behind, even with a slight fosse, for tendo m. flex. hallucis long.; externally, a triangular fossa, Incisura fibularis, for the Fibula; internally, the thick four-sided Malleolus internus, springing strongly forwards. The posterior border of the internal malleolus presents an oblique fossa descending from without inwards, for the tendons of tibial. post. et flex. digit. long. The external surface assists in forming the inferior articular surface. This last, fossa glenoidalis, is four-sided, broader externally, divided by an elevation into two lateral halves, and it unites with the Astragalus.
Structure. The spongy mass of the Extremities is perforated by numerous vascular foramina.

Development. Three osseous points. In the body the first appears between the thirty-fifth and fortieth days; in the superior extremity with the conclusion of the first year; in the inferior extremity in the course of the second. The union of the three portions commences at the inferior extremity, and is only perfect when the growth is complete, between the eighteenth and the twenty-fifth year.

104. 2. Fibula s. Perone.

Position: upon the outer, as well as above, upon the posterior side of the shin bone, on the same side as the little toe of the foot, —Fibula border.

Direction: vertical, below a little external.

Figure: thin, long, like the tibia, twisted.

Connection: with the tibia, the astragalus; and with the os femoris by the ligam. lateralia.

a. Superior extremity, capitulum; with: superficies tibialis superior, the concave articular surface of the Tibia; externally, flat fossae for ligam. lateralia extern. et m. biceps; behind; and above the point, apex seu proc. styloideus, for m. biceps.

b. Central piece, three-sided, prismatic. External surface, grooved, for m. peroneus long. et brevis, inferiorly one-fifth directed backwards.

Internal surface, divided by a Crista, for lig. interosseum into two halves, for Tibial postic., peroneus tertius, and extens. hallucis longus; below turned forwards.

Posterior surface, above narrow, below broad and directed inwards, with Foram. nutritium. Muscles: soleus, flex. hallucis longus. The borders are sharp; the internal, for ligam. interosseum inclines forwards, the anterior outwards, the external backwards.

c. Inferior extremity, projects beyond the articular surface of the Tibia, is longer and thicker than the inferior extremity of the last. Malleolus externus: external surface convex, lies close beneath the skin; internal surface forms the articular fossa for the astragalus and unites with the Tibia; with Tuberculum anticum et posticum, for the ligam. tibio-fibularia; posterior surface, grooved for the tendons of the two peronei, with fossa malleoli externa, for ligam. fibulare tali post.

Structure. The medullary canal in the centre is very narrow; the extremities are spongy.

Development. Three osseous nuclei; the first, in the centre piece, appears between the fortieth and fiftieth days, fetal; the second, in the inferior extremity only, in the second year; the third, at the superior extremity, in the fifth year. The inferior extremity first unites with the body, between the twentieth and the twenty-fifth year.

Position: between *femur* and *tibia*, before the knee. The largest *os sesamoideum*.

Figure: flat, roundish, triangular, however very variable; above broad, below pointed.

Connection: with the *femur* and *tibia*.

a. Anterior surface, convex, covered by a thick fibrous tissue, beneath the skin.

b. Posterior surface, fits close upon the *Trochlea* of the inferior extremity of the *femur*; is covered with cartilage, and presents:
1. *Crista*, from above, downwards and inwards.
2. *Fossa articular. externa*, broad, and *interna*, narrow.

c. Circumference. Superior border, *basis*, thick, for the *tendons* of the *extensors* of the leg. Lateral borders, for *lig. capsulare*. Point, *apex*, lies towards the *Spina tibiae* [for *ligam. Patellae*].

In flexion of the leg upon the thigh the *Patella* remains fixed and projects, in extension it is moveable and serves as a roller for the *Extensor muscles*.

Structure. Entirely spongy, only covered upon the anterior surface with a thin layer of compact tissue which, as an exception in these short bones, consists of longitudinal fibres.

Development. From one osseous centre in the third year.

III. *Ossa pedis*, Bones of the feet.

106. 1. *Tarsus*, root of the foot, instep,

consists of seven bones, placed unequally in two rows; arched above, hollow below.

a. Posterior row, consists of the two largest bones of the *Tarsus*.

1. *Astragalus* s. *Talus*, knuckle bone. Situation and connection: below the *Tibia*, above the *Calcis*, internal to *Malleolus externus*, *fibula*, behind the *navicular* bone. Figure irregularly cubical. Six surfaces. Body and head.

a. Body. Superior surface, a half *trochlea* for the *tibia*; Lateral surfaces flat, enclosed by the *malleoli*. Inferior surface, for *calcaneus*, concave. Posterior surface with a groove, for *flex. halluc. long.*

b. Head, for *os naviculare*, united to the body by the *Collum astrag.*, has above, a broad notch, *before*, an articular surface, for *os naviculare*, below, a fossa which forms with another on the *Proc. anterior Calcanei*, the *Sinus tarsi*; lies on the anterior surface of the astragalus.

2. *Calcaneus*, heel bone, the largest of the tarsal bones. Position: below the *Astragalus*, behind the *Cuboid*. Figure: longitudinal; a body and processes.

a. Body. Posterior termination, *proc. poster. s. calx*, heel, for the *tendo Achillis*; inferior, narrow surface, with two tubercles; superior surface, with two convex articular surfaces, for the Astragalus; external surface, only covered
by skin, with two grooves, for the tendons of peronei, and a tubercle before and above, important in a Surgical point of view, as a guide in exarticulatio ped. Chopart. Internal surface, deeply concave, forms with

b. Process. intern. s. minor, a blunt hook, projecting forwards and upwards, and having an articular surface, for proc. anter. astrag., the Sinus tarsi, for the tendons, vessels, and nerves of the sole of the foot. Below it a sulcus, for the tendon flex. halluc. long.

c. Process. ant. s. magnus, represents the anterior surface of the Corp. Calcanei; has anteroily an articular surface, for os cuboid; is externally rough, for abduct. digit. 5, and extens. brevis; internally a small process projects, sustentaculum tali.

b. Anterior row, consists of five bones, namely:—

3. Os naviculare s. scaphoideum. Position: on the same side as the great toe, before the talus, behind the three cuneiform bones, internal to the Cuboid. Figure: longitudinal, flat. Posterior surface, concave, for Talus; anterior, convex for the three cuneiform bones; superior, convex, free upon the back of the foot; at the internal extremity, tuber. oss. navicularis, for attachment of m. Tibialis posticus, perceptible through the skin; at the external termination a small articular surface, for the os cuboideum.

4, 5, 6. Osso cuneiformia, three small, four-sided bones. Position: between Navicular and the three internal metatarsal bones.

I. Os cuneiforme, at the side of the foot, the largest; internal surface, beneath the skin; external, angular, for the second cuneiform and two metatarsal bones; posterior concave, for the navicular; anterior rather convex, for the first metatarsal; inferior, with tuberculum, for m. tibialis anticus.

II. Os cuneiforme lies between I. and II.; is the smallest, for the second os metatarsi.

III. Os cuneiforme, between II. and the cuboid bone, for the third os metatarsi, m. adductor. halluc.

7. Os cuboideum, Cube bone. Position: before the calcis, behind the fourth and fifth metatarsal bones, outside the navicular and os cuneiforme III.; on the outer, little toe, border. Superior surface, with sulcus oss. cub., for the tendon of m. peroneus long. on the outer border. Inferior surface, with the eminentia obliqua, for ligam. calcæn-cuboideum.

Development. Calcis and Astragalus ossify even in the sixth month of fetal existence; the rest only in the first year after birth; but Tuber calcanei only in the tenth year.

107.

2. Metatarsus, middle foot, consists of five columnar, parallel bones united like a grating with four interstitia interossea. Position: horizontal between tarsus and toes. Connection: behind with the three cuneiform and the cuboid bones; before with the first phalanges of the toes; with one another. Structure: the same as the long bones.

a. Posterior extremity. Basis, from the first to third metatarsal bone, corresponds with the three cuneiform bones; that of the fourth and fifth with the cuboid; with one posterior, for the tarsus, and two or one lateral articular surfaces for the metatarsus.
I. Os metatarsi, for m. tibial. antic., flex. brevis, abduct. hallucis, on the great toe border; very strong; the posterior, articular surface, for the first cuneiform bone, longitudinally concave, both lateral surfaces wanting; on the Plantar border, tuberculum plantare, for tendon of Peroneus long.

II. Os metatarsi, with three articular surfaces for the three cuneiform bones [two lateral, one posterior], and one for the third os metatarsi.

III. Os metatarsi; three articular surfaces, namely, one behind for third cuneiform, two lateral for second and third os metatarsi. III. and IV. for m. adduct. hallucis.

V. Os metatarsi, for peroneus 3, flex. brevis digiti 5, with only one lateral articular surface for the IV. os metatarsi; and tuberositas on the free outer border, for m. peroneus brevis s. Proc. triangularis and abductor digiti 5, projects backwards and outwards, important in exarticulatio metatarsi.

b. Middle portion, diaphysis, for m. interosse; three-sided. Superior surface rather convex; internal and external meet below in the concave, plantar surface, at an acute angle. I. II., os metatars., are the longest and strongest. V., flat and thick.

c. Anterior extremity, capitulum, with anterior, convex, articular surface, which is largest in the sole; and two lateral fossae, sinus, and two tubercula, for ligam. lateralia.

The first os metatarsi, projects into the sole of the foot, ball; and has two grooves, for osa sesamoidea. IV. and V., for caput breve m. transversal. pedis.

Development of the metatarsus begins in the third fetal month with one osseous nucleus in the centre piece, and with another at the anterior (in the first os. metatarsi. at the posterior) extremity in the second year, but only in the eighteenth year are the pieces completely united together.

108. 

Digiti Pedis, Toes,

five on each foot, each consisting of three, the great toe of two members, phalanges.

Phalanx I. the largest. Ph. II. small and short. Ph. III. Ungual, the smallest, flat. The posterior extremity, basis, of each phalanx is even, concave, for capit. metatarsi. with tubercula on either side. The anterior extremity roller shaped, convex, with a sinus on either side; that of the third Ph. free, semilunar.

1. Hallux, great toe; two members; thick and large, less moveable than the fingers, on account of its strong ligament. To the plantar surface, flexor brevis, to the basis the first Phalanx.

2. Osse sesamoidea, for abductor and adductor hallucis; Dorsal surface of first Phalanx, for m. extensor hall. brevis. To the basis the second Phalanx—one os sesamoideum:—Plantar surface, for flex. hall. long. Dorsal surface, for extens. hall. longus.

Second to fifth toes are always smaller.—First Ph., for m. lumbricales. Second Ph., for flex. comm. brevis. Third Ph., basis, for flex. comm. long. Dorsal surface of all three, for extens. comm. long. and brevis.

Fifth small toe, Digitus minimus. First Ph., basis, for flex. brev. and abduct. digiti 5.
Development. Two osseous nuclei, a. in the centre piece, at the end of the third foetal month; b. in the posterior end, ext. halluc. The second phalanx ossifies last. At birth the apex of the ungual phalanx is ossified.

109. **Characteristics**

of the *Male* and

*Bones*: stronger, larger, heavier, and more rough.

*Head* and *extremities* preponderating over the trunk.

*Thorax*: more elevated: anterior flattened; dorsal vertebrae higher; the ribs passing more obliquely downwards.

*Sternal*: longer and flatter.

*Clavicles*: more strongly curved, longer, inclined outwards; the angle with the sternum obtuse.

*Abdominal vertebrae*: shorter; and therefore the space, ventral cavity, between them and the chest is likewise shorter.

*Pelvis*: narrower, higher. *Promontorium* more pointed. *Crista Iliaca* more sigmoidal and curved. *Arcus pubis*, angular. The *acetabula* closer to the axis of the body, therefore the gait less rolling.

*Sacrum*: narrower; *Coccyx* broader.

*Extremities*: longer, the inferior less converging.

Cranial and facial cavities, with exception of orbits, larger.

*Canalis spinalis*, narrower.

of the *Female Skeleton.*

Shorter, thinner, lighter, and more smooth.

Trunk relatively larger than head and extremities.

Chest smaller, more barrel-like, farther removed from the pelvis; before roundish; dorsal vertebrae and ribs shorter; the last more horizontal.

*Sternal* shorter.

Clavicles straighter, more inclining outwards; the angle with the sternum almost a right angle.

Higher. Abdominal cavity more spacious.


Broader; *Coccyx* narrower, more moveable, less projecting.

Shorter, the inferior converging to the knees; the Trochanters broad and more separated.

Mouth and nose, together with orbits, smaller; teeth smaller.

*Canalis spinalis* more spacious.
ARTHROLOGIA.

OF THE ARTICULAR EXTREMITIES OF THE BONES, AND THEIR CONNECTION BY MEANS OF LIGAMENTS, FORMING JOINTS.

SYNDESMOLOGIA.

"In proportion indeed as we comprehend the principles of mechanics, or of hydraulics, as applicable to the animal machinery, we shall be satisfied of the perfection of the design."—The Hand. Sir C. Bell.
ARTHROLOGIA.

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110. OF THE LIGAMENTS.

In the union of the articular surfaces of bones three kinds of accessory organs are present which, in Syndesmology, are treated of in common, namely ligaments, synovial capsules, articular cartilage.

For a description of the manner in which the bones form joints, and the modes of their association, refer to page 30.

a. Ligaments of bones, ligamenta, συνδέσμων, formed of firm and flexible fibrous tissue, consist of white and yellow fasciculi or cords which are not extensible and little sensitive, of a flat, longitudinal, oval, also annular or angular figure; they lie either between the bones, or on their external circumference, almost inseparably attached to the extremities which they unite together. We distinguish the following forms:

1. Proper ligaments, ligamenta fibrosa accessoria, flat cords.
2. Fibrous capsules, ligg. capsularia, which are tendinous cylinders, attached by their openings to the bones, enclosing the Synovial capsules together with the Cartilages.

Yellow ligaments, ligg. flava, assigned to a particular purpose, do not belong to these tissues.

b. Synovial capsules, capsulae s. membranae synoviales, articularis, thin, translucent, closed sacs of serous uniting tissue between the articular extremities of the bones, connected externally with the surrounding ligaments, secreting inside a thin, serous fluid, or a thick, albuminous Synovia, drawing out into threads, which prevents the attrition of the bones upon one another. Folds which have lying between them small masses of fat, form internally the falsely so-called Glandulae Haversianae. The synovia is not secreted by them, but from innumerable blood-vessels, especially upon the lateral parts.

c. Articular cartilage, cartilagines articularis, are elastic discs of cartilage tissue which are present in all cases where joints exist, for the purpose of obviating or equalising the pressure of the bones upon one another. They are so much the thicker, the more moveable the articulation, particularly at the circumference of the articular cavity, but, in the centre upon convex surfaces. We distinguish:

1. Cartilage connected with the bones, which it is extremely difficult to separate from them, and the free surface of which looks into the articular cavity, and
2. Free articular cartilage, cartilag. interarticularis, which on one of the two surfaces is connected with the articular end of the bones, is covered by the synovial sac, and connected on the borders with the fibrous capsule. They are from ½ to ¾ of a line thick, and are only present in very moveable artici-
lations. They are named *Menisci*, from their Biconcavity. The cartilage may waste away by attrition.

3. Fibrous cartilages of the osseous joints, are generally disc-shaped, united closely with the Periosteum; for example, *symphysis pubis*, or annular *labra glenoidea* attached to the borders of the articular fossae.

III. Connections of the *Vertebrae* with each other, *Articulatio vertebrarum*.

a. The vertebral bodies are united with each other by a close articulation, *amphiarthrosis*. The articular surfaces which are the superior and inferior surfaces of each vertebral body, are rather concave, do not immediately touch, but lie upon one another by means of:

1. The *ligg. (cartilagines) intervertebralia*, twenty-three strong lenticular discs, consisting of concentric fibrous rings which, closer in the periphery, are separated towards the centre, the interspaces being filled by a yellow jelly, which, in the central point, becomes hardened into an elastic osseous nucleus. Their vertical diameter varies; it may, for example, diminish after standing long in the erect posture. In youth the gelatinous masses are softer and whiter than in old age, and on this account the vertebral column is less moveable in the latter than in the former. The vertebral bodies are further surrounded with a fibrous sheath, the

2. *Lig. longitudinale anterius*, on the anterior surface, from the *Tuberculum atlantis anticum* to the upper part of the *os Sacrum*; above narrow, below broad; white, membranous, thicker on the dorsal than upon the cervical and *lumbar vertebræ*; consists of two lateral portions, which are separated in the centre by a series of openings, for vessels. Below it mingles with the fibres of the crura of the Diaphragm and the Aponeurosis of the *m. psoas*; above with the tendons of the *m. long. colli* and *rectus*.

3. *Lig. longitud. posterius*, on the posterior surface, on the anterior of the *Canal. spinalis*, thicker and narrower than 2, commences upon the internal surface of the *pars basil. occip.*; the superior portion, from the third cervical vertebra, is particularly distinguished as *apparatus ligamentosus*, terminates in the *Canal. Sacralis*. The posterior surface is connected by processes with *Dura Mater*, the anterior with the *ligam. intervertebralia*. On the borders, passes *sinus venosi*, in the centre, between the ligament and the vertebral body, the *vena vertebræ*. It extends, like the anterior, upon the intervertebral cartilages, and attaches itself firmly to them.

b. Connection of the *Processus obliqui*.—*Arthrodia*. The articular surfaces are covered with cartilage, provided with a synovial sac, and united together by *ligg. capsularia*.

c. Ligaments of the Vertebral arches:

*Ligg. flavæ s. intercruralia*, filling up the intervals between the arches, are, really, higher than these, thicker in the *lumbar vertebrae*, thickest in the region of the *Proc. spinosi*. Attachment: to the inferior and superior border of two vertebrae, as the one lies upon the other. Anterior surface smooth, separated from the *Dura Mater* by areolar tissue and *Vv. spinales*. Structure: thick, vertical, elastic but strong fibres. Use: to assist the Dorsal muscles in maintaining the erect posture of the body.
d. Ligaments of the Spinous processes:

1. Ligg. interspinalia, fill the spaces between the Proc. spinosi, are wanting in the neck, muscles existing there, are triangular on the Dorsal, thick and quadrangular on the Lumbar vertebrae.

2. Ligg. apicum, roundish, from the apex of the one to that of the next, Proc. spinosus; wanting in the neck.

3. Lig. nucha, cervical ligament, triangular, continuation of the Ligg. opic. upwards, from the seventh cervical vertebra to the Spina Occipit. extern., receiving vertical elongations from the fissure between the proc spinosi of the superior cervical vertebrae.

e. Ligaments of the transverse processes, ligg. intertransversalia, are thin strips between the apices of the transverse processes, generally only on the Dorsal vert., placed here for the m. levatores costarum et multif. spinæ; very often double.

Movements of the Vertebral column: 1. Forwards [flexion]; 2. Backwards [extension]; 3. Inclination sideways; 4. Rotation. The cervical portion is the most, the dorsal the least moveable.

112. Connection of the Vertebral column with the Cranium, Articulatio capitis.

a. The Atlas with the Occiput:

1. Articular connection—Ginglymus—between Proc. condyloidei occipitis and Proc. obliq. super. atlantis, for the movements of the head, forwards and backwards, is maintained by:

Ligg. capsularia, particularly strong anteriorly and externally, broad, yellowish circles around the articular processes, between which a wide loose synovial capsule.

2. Ligaments:

a. Ligam. obturatorium s. latum anterius, strong and elastic, extends between the superior border of the Atlas and the pars. basilaris occipit.; before it in the centre lies

b. Lig. rectum s. lacertus (Weitbrechti) medius, a thick band, from tubercul. anticus. atlantis. to the Proc. basilaris occipitis, strengthening the before mentioned

c. Lig. obturatorium posterior, thin, broad, and slack, from the posterior arch of the Atlas to the posterior circumference of the foram. magn., laterally perforated by the Art. vertebralis.

d. Lig. laterale, cord-like, from the basis of the Proc. transvers. atlantis. to the proc. jugular. occipit., forms with a similar from the petrous bone, a ring, for vena jugular. intern., Carotis intern., n. Hypoglossus, vagus, glossohypoglossal, access. Willisi.

b. The proc. dentiformis with the occipital bone, only by ligaments.

1. Ligg. lateralia proc. dentiformis s. alaria Maucharti, very strong and short, from the sides of the apex of the odontoid process outwards to a fossa on the inner side of each Condyle. They prevent too great lateral movement of the head.

2. Lig. suspensorium dentis, from the centre of the apex to the anterior border of the great foramen, it thus forms a figure like an inverted letter J, is quadrangular, and affixed to the Odontoid process.
113. c. The Atlas with the Epistropheus, or vert. dentata.

1. Rotary articulation—trochoides—between the anterior arch of the Atlas and the Odontoid process which last describes on each side within a ring, anteriorly osseous, posteriorly ligamentous (Lig. transvers.), the fourth part of a circle, and prevents every other movement but rotation which is performed by the proc. obliq. inferr. atlant. and super. epistroph., as the atlas and cranium move thereon as one piece.

2. Between proc. obliqui atlant. and epistrophei a free articulation—arthrodia—since the circular surfaces of both planes lie horizontal, and are provided with a wide articular and synovial capsule.

3. Lig. transversum atlantis, very thick and dense, flat, extending horizontally behind the Odontoid process, from one lateral mass of the atlas to the other. The anterior concave surface is in opposition with the posterior surface of the Odontoid process, which is covered with cartilage. [In the centre of this transverse ligament there is a portion of cartilage, and a very delicate synovial capsule is attached around the articular surfaces.] From the superior border an appendix passes upwards to the anterior border of the foram. magnum; a similar from the inferior border to the posterior surface of the Corpus epistrophei; thence arises a ligam. cruciatum.

114. Articulation of the lower jaw, articulatio maxillaris, a free joint, formed

1. By the elongated proc. condyloid. of each half of the lower jaw, covered with cartilage, which is directed rather obliquely from without to within from before to behind; and

2. By the deep and capacious fossa glenoidalis of the temporal bones, the anterior part of which, to the fissura Glaseri, is alone covered with cartilage, and is an articular cavity. The anterior wall forms the convex transverse root of the proc. zygomatic., and upon it the proc. condyloid., likewise convex, rolls backwards and forwards.

Between the articular surface lies a free

1. Meniscus [or interarticular cartilage], firmly attached below, to the Condyle, behind, to the glenoid cavity, dividing the articular cavity into a superior and inferior space.

2. Lig. capsulare extends from the border of the fossa glenoid. to the circumference of the Condyle. Above and below the cartilage lies a synovial capsule; the superior is wider, and proceeds from the boundary of the Cavit. glenoidal. and tuber. articulare, the inferior from colum condyl. 

3. Lig. laterale externum, from the tuber. at the root of the Proc. zygomat. to the outer side of the Collum Condyl. triangular and broad; it covers the outer side of the joint.

4. Lig. laterale internum, from Spina angularis of the Sphenoid bone to the osseous lamellae on the inner side of the foram. maxill. pos., separates the dental vessels and nerves from the musc. pterygoid., is thin and broad, contributing little to the strength of the joint; likewise the so-called Lig. stylo-maxillare, merely fascia.
 Movements of the lower jaw; a. downwards. The condyles, together with the menisci, roll from behind, forwards; Ligam. later. extern. is stretched; Lig. lat. intern. remains unchanged. Drawing down the lower jaw too strongly, as for example in gaping, may produce luxation, that is, a slipping of the condyle out of the foss. glenoidal. into the zygomatic fossa.

b. Upwards, that is, in closing the mouth. The movements of the condyle the reverse of a. Luxation backwards is prevented by the anterior wall of the auditory meatus, to which point the condyles may roll, for example, in edentulous old age.

c. Forwards (and backwards) horizontally: the articular head comes below the transverse root of the proc. zygomat. But it must be preceded by the movement downwards. All the ligaments are stretched. In too great extension the coronoid process is opposed by the upper jaw, and farther luxation rendered impossible.

d. From side to side. The condyle of one side passes sideways from its cavity, stretching its ligaments; that of the other sinks more deeply into its articular cavity, where a luxation inwards is prevented by proc. styloideus and its sheath, as well as by proc spinosus.

The movements c and d are more limited than a and b.

115. Connections of the Thoracic cavity, Chest.

I. Vertebrae with the ribs, Articul. costo-vertebralis.

a. Capitulum costæ has a divided articular surface, which lies in the fovea costales, formed by the bodies of two dorsal vertebrae, unites with the cartil. intervertebr., and forms a free articulation, enarthrosis, not ginglymus. Its synovial capsule is single on the first, eleventh and twelfth ribs, double on the rest; articular capsule incomplete. Instead of it:

1. Lig. capituli anterius s. radiatum, stellate on the anterior surface of the joint.

2. Lig. capituli interarticulare, on the second and to the tenth ribs, from the crista of capituli to the cartil. interartic.; flat, oval, and separating the two synovial capsules.

b. Tuberculum costæ has a convex articular surface which unites with one concave, on the proc. transvers. in a close joint. Moreover, ligaments pass from collum costæ to the proc. transversi.

1. Synovial capsule.

2. Lig. tuberculi s. transversorium posteriorius, quadrangular, behind the joint; from the apex of the proc. transvers. to the posterior surface of the Tubercul. costæ of the first to the tenth ribs inclusive.

3. Lig. transversorium-intermedium, from the anterior surface of the proc. transv. to the posterior of the collum costæ; very strong.
4. Lig. transversarium internum, rhombic, from the inferior border of the proc. trans. of the vertebra next above to the superior border of the Collum, wanting on the twelfth rib; divides the posterior and anterior branches of the Intercostal nerves.

5. Lig. transversarium intern., triangular, weak, descends from the root of the proc. transvers. of the vertebra next above to the posterior surface of the collum costa, close to the capitulum; it is wanting on the first, eleventh, and twelfth ribs.

116. II. The ribs with the sternum, articulatio sterno-costalis, Amphiarthrosis. The cartilages of the ribs which are firmly connected with the bone, and possess no farther external means of union than the common Periosteum, Perichondrium, are intimately attached in the incisura. costal. sterni by Synovial capsules and stellate ligaments, from the second to the seventh rib. The fifth to the ninth ribs have, at their place of contact, delicate synovial capsules. The first rib cartilage is, generally, closely united with the sternum.

Ligaments: 1. Lig. interarticolare, of the second to the fifth ribs, divides the double synovial capsules.

2. Lig. radiatum externum, proceeds from a true rib cartilage of one side to the one next above of the other, crosses also upon the centre of the Sternum, and loses itself in the Periosteum and the tendinous expansion of the great pectoral muscles. In a like manner is arranged the less strong Lig. rad. internum upon the posterior surface of the Sternum.

3. Ligg. coruscantia, brilliant bundles of fibres between the third to the tenth rib cartilages, to fill up the spaces between the cartilages of the ribs. Vide m. intercostales.

4. Ligg. processus ensiformis, proceed from the inferior border of the sixth and seventh rib cartilages over the centre of the ensiform process and attach it to them.

5. Membrana sterni propria, covers the external and internal surface of the Sternum, and consists of the fibres of Periosteum crossing each other.

Movements of the chest.

1. Expansion, upon inspiration, by elevation of the ribs, whereby the anterior extremities of the ribs move forwards, the lateral outwards, and the diameter of the thorax is increased from before to behind and transversely. In forcible inspiration the Sternum also is elevated. The first rib remains immoveable.

2. Contraction, upon expiration, depends upon the falling back of the ribs and these parts, from their weight, and the elasticity of the cartilage, as well as in consequence of the direct action of the expiratory muscles.

117. Connections of the Pelvis.

a. The Ossa coxarum with each other. Symphysis ossium pubis. Pubic symphysis with:

1. Lig. (s. cartilago) interosseum pubis, a prismatic, fibro-cartilage, as on the bodies of the vertebrae, half an inch broad in front, covered by crossed fibres and by Lig. pubis, s. arcuatum, superius, transversely from one tuberculum pubis to the other.
2. *Lig. annulare*, consisting of transverse fibres, the rings passing round the borders of the articular surfaces.

3. *Lig. arcuatum inferius s. triangulare* or sub-pubic, beneath the symphysis, triangular, continuation of the *Lig. inteross.*, forms the superior border of the pubic arch; proceeds from one ramus descend. pub. to the other.

b. The *ram. coxarum* with the vertebral column, *symphysis sacro-iliaca*.

The articular surfaces of the Sacrum and Ilium, *superficies auriculares*, covered with cartilage and with a thin Synovial capsule, which in children and pregnant women is more distinct, are united by a slight layer of fibro-cartilage with gelatinous substance, and form an amphiarthrosis. Contributing to strengthen the articulation there are:

1. *Ligg. sacro-iliaca vagina anterior*, short, transverse and oblique from the superior surface of the Sacrum to the internal of the Ilium, they blend with the memb. oss. sacri propria.

2. *Ligg. sacro-iliaca vagina posterior*, short, crossed, filling up the fossa between the posterior surface of the Sacrum and *tuber oss. ilium*.

3. *Ligg. pelvis, s. ileo-sacra postica*, two; thick, on the posterior side of the pelvis;—*longum arising from spina ilei poster. super.*;—*brevus* arising from *spina ilei post. infer.* Both are attached to the *proc. transversus* of the third and fourth sacral vertebrae. Sometimes three lateral bundles pass from the hip-bone to the *proc. transvers*, of the first and second sacral piece.

4. *Lig. ileo-lumbalia s. pelvis anterior*; lies over the *sacro-iliac symphysis*; springs from *proc. transv.* of the fifth or fourth lumbar vertebra. *Lig. superior* is fixed to the posterior part of the *crista Ilei*. *Lig. inferius* is attached broad upon the superior surface of the Sacrum and the internal of the Ilium, close to the *spina ilei poster. super.*

c. Of the sacrum and coccyx—a symphysis, which often ossifies; in very moveable coccyges, a synovial capsule. Between the articular surfaces a delicate layer of fibro-cartilage.—Ligaments.

1. *Ligg. sacro-coccygea postica longa*, from the border of the exit of the *Ca-nalis sacralis*, which they close, diminishing upon the posterior surface of the coccyx, for *m. glutaei maximi*.

2. *Ligg. sacro-coccygea post. brevia*, below the last, passing from the *cornua* of the Sacrum to that of the coccyx; are often ossified.

3. *Ligg. sacro-coccygea antica*, from the apex of the sacrum to that of the coccyx, in front; often wanting.

4. *Membr. ossis sacri propria*, covers the anterior surface of the Sacrum, is above covered by *lig. longitudinale anterius*.

d. Ligaments for the purpose of limiting the pelvic cavity.

1. *Lig. obturatorium*, consists of aponeurotic bundles which cross in all directions, closing an egg-shaped opening; it is perforated at its superior margin by a foramen for *art., ven., nerv. obturator*, and serves to give attachment to the *m. obturatores externus et internus*.

2. *Ligg. sacro-ischiadica majus et minus*.

a. *Majus s. post. s. tuberoso-sacrum* arises from the internal lip of the *tuber
ischii, and with a sickle-shaped extension, falsa ligamentosa, from ramus ascendens oss. ischii, by which arises a groove for art., ven., et nerv. pudend. commun., and thus prevents pressure in the sitting posture; passes obliquely upwards and backwards, and is attached broad to the margin of the sacral, even to the most superior of the coccygeal, pieces; serves for the attachment of the glutaeus maximus.

b. Minus s. ant. s. spinoso-sacrum, lies before a, springs from spina Ischii; passes inwards and backwards and blends with a; serves for the attachment of the muscles levator ani, coccygeus. From the manner in which the Ligg. ischiad. limit the incisura ischiadica below, two foramina arise, of which

1. The superior, incisura major, large, almost triangular, is in great part closed by the mm. pyriformis et coccygeus, together with areola or uniting tissue, and allows the passage through it of the Nervi et vasa ischiadica, glutae et pudenda;

2. The inferior, incisura minor, small, between spina et tuber Ischii, for m. obturator internus. Nerv. et vasa pudenda also pass through it.

118. Connections of the Superior Extremities.

I. The Shoulder-bones.

A. Of the Clavicle with the Sternum, Articul. Sterno-clavicularis.

Arthroclia. The articular surface of the clavicle extends, before and behind, beyond that of the sternum, and the last, incisura clavicularis manubrii, likewise inwards and outwards over the clavicle. This bone is also firmly united with the first rib.

1. Lig. capsulare, round about the circumference of the two articular surfaces; before loose, therefore on this side displacement is more easy than behind; contains an interarticular cartilage with an external loose and an internal synovial capsule, below, connected with the cartilage of the first rib, above and behind, with the clavica.

2. Lig. interclavicularare, unites the internal extremity of one clavicle with that of the other, as it passes transversely over the incisura semilunaris manubrii, and indeed, lies rather behind it.

3. Lig. costo-claviculare s. Rhomboideum, a dense fibrous bundle; proceeds, obliquely backwards and upwards, from the superior margin of the first rib cartilage to the inferior and sternal end of the clavica. An articular surface for the reception of the clavica is, generally, present on the first costal cartilage.

The movements of the shoulder depend upon these articular connections.

a. Movement of the shoulder upwards. In this the sternal surface of the clavica glides downwards, upon the articular surface of the sternum, the Lig. interclav. is relaxed; the cartilage of the first rib prevents the escape of the clavica downwards.

b. Downwards.—The sternal end of the clavica glides upwards; the articular surfaces of the clavicle and first rib are strongly pressed upon one another, whereby the art. subclavia is compressed.
c. Backwards.—The sternal extremity of the clavicle glides forwards; the anterior portion of the Lig. capsulare is stretched, often even to laceration, and then luxation of the clavicle takes place forwards.

d. Forwards.—The sternal end of the clavicle glides backwards; the posterior portion of the Lig. capsulare and of the Lig. interclavicul. stretched.

e. In circumduction the movement is very limited, and it is resigned to the upper arm.

119. B. Of the clavicle with the scapula, Artic. acromio-clavicularis.

Amphiarthrosis.—The articular surfaces are elliptical, even, and lie obliquely to one another; that of the clavicle looks rather downwards and outwards, that of the acromion upwards and inwards; above, between them, but not always, we find a free cartilage, and a synovial capsule.

1. Lig. capsulare (externum) is attached closely with the following.

2. Lig. claviculo-acromiale, proceeds from the surface and the posterior border of the acromion to that of the external extremity of the clavicula; is above very strong.

Ligaments between proc. coracoideus and clavícula artic. coraco-clavicularis.

3. Lig. posterius s. conoideum, triangular, vertical from the root of the coracoid process, expanding as it ascends to the tubercle upon the posterior border of the clavicula.

4. Lig. anterius s. trapezoideum, oblique from the inferior border of the root of the Proc. coracoid, to the inferior surface of the acromial extremity of the clavicle; close before 3.; both of them are loose.

Ligaments of the shoulder-blade.

1. Lig. Coraco-acromiale, is attached broad to the external border of the Proc. coracoid, and by an apex to the anterior blunt point of the Acromion, filling up the space between the two, and forming a roof over the upper arm.

2. Lig. transversum, thin, flat, passes from the root of the Proc. coracoïd, across the incisura scapulae, with which it forms a foramen, for nerv. suprascapularis et ven. trans. scap.

120. II. Connection of Scapula with Humerus, Artic. Scapulo-humeralis s. Artic. humeri, Shoulder-joint, is the most free of the whole body, the type of Enarthrosis.

a. Articular surfaces.

1. Fossa glenoidalis, superficial, concave, oval, directed outwards.
2. *Caput humeri* = \( \frac{1}{3} \) of a sphere, the axis of which forms a very oblique angle with the *Corpus Humeri*. Both are covered with cartilage.

b. *Lig. s. labrum glenoideum*, a ring on the margin of, and for the purpose of deepening, the articular cavity which however does not enclose the entire articular head; consists of fibrous tissue. Vide Interarticular Cartilages.

c. *Lig. capsulare humeri*, from the margin of the articular cavity to the *Collum humeri* and the two *Tubercula*, forming a bridge over the groove between them and the tendon of the biceps; a loose spacious capsule which above has one to two openings, by which a communication is established between the synovial capsule of this joint and the *bursæ* of the mm. *infraspinalis* and *subscapularis*. Is protected, below, by the areolar tissue between the tendons of the mm. *subscapularis* and *teres minor*;—above and externally by the tendons of the *m. supraspinatus*;—before, by the *m. subscapularis*;—behind, by the tendons of the *mm. supra-, infra-spinatus, teres minor*;—above, even strengthened by a *Lig. accessorium* of the *Proc. coracoid*, and by the tendon of the *long head* of the *Biceps* on the anterior aspect;—lastly, by the

d. Arch or vault, which is formed over the joint by the *acromion, Proc. coracoid, Lig. coraco-acromiale*, and *m. deltoideus*.

**Movements:**

1. *Forwards and backwards.*—The head of the *humerus* rolls upon its own axis. The escape of the head anteriorly is prevented by the *coracoid process*. The scapula performs at the same time a movement of rotation.

2. *Outwards,—abduction.*—The head of the humerus glides from above downwards, and presses upon the inferior portion of the capsule, the upper arm may even be conveyed to the skull; the scapula remains inmoveable.

3. *Inwards,—adduction.*—The arms crossed over the chest.

4. Rotation outwards and backwards, inwards and forwards is of little extent.


**Articular surfaces.**

a. Of the Humerus:

1. *Trochlea*.

2. *Rotula*.

3. *Fossa cubital. post.*, for *Olecranon*.

4. *", " ant.*, for *proc. Coronoid*.

b. Of the Fore-arm:

1. *Fossa sigmoid. ulnæ*, for the *trochlea*.

2. *Cavitas glenoid. radii*, for *rotula*. 
Ligaments:

1. *Lig. capsulare cubiti* from the inferior extremity of the Humerus to the Olecranon, the fossa sigmoid. major, proc. coronoid., and lig. annulare radii; loose and wide, behind and on the sides weaker than before; behind, the tendon of the Triceps muscle.

2. *Lig. laterale internum*, three portions from the internal condyle of the humerus to a point below the Coronoid process of the Ulna on the inner side.

3. *Lig. laterale externum*, triangular, from the external condyle to the lig. annulare radii, below the tendon of the Supinator brevis. The Synovial Capsule lies behind the anterior wall of the capsular ligament, reflected from the fossa anterior to the fossa posterior, where it is the widest; it terminates below in a blind prolongation on the inner margin of the lig. annulare radii.

Movements:

1. Flexion, *flexio*. The entire fore-arm moves upon the Trochlea and rotula humeri from behind, forwards, so that the finger-points may touch the mouth. *Proc. coronoid* lies in the fossa anterior, and prevents farther flexion.

2. Extension, *extensio*.—The reverse of the preceding, from before backwards, until the axes of the fore-arm and humerus lie in the same line. *Proc. olecrani* lies in the fossa posterior, and prevents farther extension.

122. Connections of the Ulna with the Radius.

A. *Articulatio radio-cubitalis superior.—Rotatio*.

Articular surfaces:

1. On the *Radius*, circumferentia articularis capituli.

2. On the *Ulna*, fossa sigmoidea minor, elongated from before to behind, forms the osseous portion of the ring in which Capitul. radii rolls.

Ligaments: 1. *Lig. annulare radii*, strong, dense, three-fourths of a ring, surrounds a synovial capsule and capitul. radii; attaches itself to the anterior and posterior extremity of the fossa sigmoid. minor and unites externally with lig. laterale externum; above, with lig. capsulare cubiti; is anteriorly much thinner, and therefore easily lacerates.

2. *Lig. teres s. chorda transversalis cubiti*, Weitbrecht, passes obliquely from below, outwards, from the most external aspect of the Proc. Coronoid, to the inferior portion of the Tuberos. (bicipit.) radii; compensates for the lig. interosseum at the superior part.

122. bis. B. *Articulatio radio-cubitalis inferior.—Rotatio*.

Articular surfaces:

1. On the *radius*: incisura ulnaris.

2. On the *ulna*: capitulum, ⅔ of the external circumference.

Ligaments: 1. *Lig. capsulare sacciforme*, broad and loose, proceeds from the
boundary of the incisura semilunaris to that of the Capitulum Ulnae and the Cartilago triangularis; lies beneath lig. capsulare carpi et antibrachii.

2. Cartilago-triangularis lies with its apex in the angle between Capitul. et Proc. styloideus ulnae, with its base on the inferior border of the incisura semilunaris, and fills up the interval between the two bones; its apex, lig. subcran. entum, unites with the proc. styloid. Ulnae; over it a synovial capsule.

Appendant: 3. Lig. interosseum. A membrane in the space between the central pieces of the radius and the ulna, from the Crista radii to the Crista ulnae; serves for attachment of muscles, extensor brevis, abductor and flexor longus pollicis, extensor indicis proprius, flexor digit. comm. profund.; has above and below spaces through which the interosseal vessels and nerves perforate, and for n. supinator brevis. The fibres of the ligament cross from the radius inwards and downwards.

Movements:

Rotation; the radius alone moves. 1. Forwards,—pronation.

a. At the superior radio-ulnare articulation. The internal portion of the capitul. radii rolls from before backwards; its escape is prevented by the small projection on the foss. sigmoideae minor.; but, however, it sometimes happens, particularly in children while falling, at the same time that the hand is held. b. At the inferior radio-ulnare art. The fossa semilunaris radii rolls backwards and forwards; should the capsular ligament lacerate, the capitulum ulnae passes out backwards.

2. Backwards,—Supination.  a. At the superior articulation: The capit. radii rolls from behind, forwards, and comes in contact with the anterior projection of the Fossa sigmoideae minor. Luxation is very rare. b. At the inferior articulation: Fossa semilunaris radii rolls from before, backwards; the capitulum ulnae may escape forwards, if the capsular ligament is lacerated.

In pronation the once parallel body of the radius is drawn over the ulna, and crosses it, since the superior extremity remains on the outer side, and the inferior passes to the inner. The interosseous ligament is relaxed.

In supination the radius returns back again into its parallel position, with respect to the ulna, and the ligam. interosseum is stretched.

123. V. Connection of the Fore-arm with the Hand, Articulatio carpi.

The wrist-joint, articulatio carpi, forms a free, ball and socket joint.

Articular surfaces: 1. Of the radius and ulna, concave, elongated transversely. 2. Of the carpus—os. navicularis, lunatum, et cuneiforme—forming a head.

That portion of the articular surface, belonging to the Ulna,
contributes only ¼ to the whole, and unites with the os. cuneiforme by the cartilago-triangular (vide ante), but not immediately. On both sides of the articular surface of the fore-arm we find proc. styloidei.

Ligaments: 1. Lig. capsulare antibrachio-carpalis, Günther, before much stronger than behind, covers the lig. capsul. saciforme (vide ante). Attachments: the Dorsal surface of the radius and Cartil. triangul. The Dorsal surfaces of the three carpal bones. This is strengthened by lig. rhomboidenum s. radio-lunato-hamatum dorsale; on the palmar surface completed by ligaments, which pass from the radius to os lunatum, naviculare, and proc. styloid. ulnæ.

2. Lig. laterale externum, from the apex of the Proc. styloid. radii, broad to the outer border of the Os naviculare; strengthens the capsular ligament.

3. Lig. laterale internum, from the apex of the Proc. styloid. ulnæ, roundish, with one portion for the Os pisiforme, the other for the os triquetrum.

The synovial capsule is loose posteriorly. Of the interarticular cartilage or lig. triangulare, vide ante.

Movements: 1. Flexion.—The three carpal bones glide from before, backwards; the posterior capsular ligament and the tendons of the extensor muscles are stretched.

2. Extension.—The three carpal bones glide from behind forwards. The anterior capsular ligament and the Ligg. lateralia are stretched, and prevent too great extension.

3. Abduction.—The radial border of the hand is directed towards that of the fore-arm; Proc. Styloid. et extern. oss. navicul. prevents farther movement.

4. Adduction.—The Ulna border of the hand inclines to that of the fore-arm; Proc. styloid. ulnæ upon os triquetrum. Luxation is difficult and, always, only incomplete.

124. VI. Connection of the Carpal Bones, Amphiarthrosis.

The articular surfaces of the carpal bones of the first row are oblique, those of the second row vertical.

Ligaments: a. Ligg. interossea. 1. Those of the first row are small fibrous bundles between the articular surfaces; of a reddish color. 2. Of the second row, thicker and closer, on the entire surface of the bones.

b. Ligg. volaria, thicker than
c. Ligg. dorsalia.—Both pass transversely or obliquely from the one carpal bone to the other.

Os pisiforme is united by lig. capsulare and two ligg. lateralia with the os cuneiforme by the lig. inferius externum with Proc. uneiform. oss. hamati, by lig. inferius internum with os metacarpi V.

125. VII. Connection of the two rows of the Carpal Bones, Articul. carpo-carpalis.

Os capitatum and Os hamatum of the second row form together an articular head, which sinks into an articular cavity formed by
Os naviculare, lunatum et cuneiforme of the first row, thus forming a Ginglymus joint.

Ligaments: 1. Lig. capsulare commune, passes from the first row, os pisiforme excepted, to the second row; is more dense before than behind.
2. Lig. volare from os Cuneiforme and Naviculare to Os capitatum, or Magnum and Trapezium.
3. Lig. dorsale from the first row, os pisiforme excepted, to the whole of the second row.
4. Lig. laterale externum s. radiale, from os naviculare to os trapezium.
5. Lig. laterale internum s. ulnare, from os cuneiforme to os unciforme.

A single synovial capsule lies between the two rows of carpal bones, with two superior and three inferior small blind extensions in the spaces between the separate bones.

[Liggs. Glenoid. (Crueillier) increase the depth of the articular cavities.]

 Movements. The separate bones move scarcely, or not at all, upon one another; but between the first and second row the following movements exist:—

1. Extension, tolerably limited, as the strong anterior ligaments prevent it.
2. Flexion, and indeed to such an extent, that the os magnum may be dislocated backwards; flexion of the hand takes place in great degree through this articulation, more than by the artic. carpo-radialis.

126. VIII. Connection of the Carpal with the Metacarpal Bones, Articul. carpo-metacarpea.

The inferior surfaces of the second to the fourth carpal bones of the second row, and the superior of the second to the fifth metacarpal bones, are attached angularly to one another, and thus form an immovable articulation, whilst the os I. metacarpi, thumb, is united in a free articulation, moving in all directions, with the os trapezium.—Ligaments: upon the dorsal and palmar surfaces are short and strong.

1. Os metacarpi II. has three ligg. dorsalia; a. externum to os trapezium; b. medium to os trapezoid; c. internum to os magnum.
2. Os metacarp. III. has two ligg. dorsalia: a. rectum to os magnum; b. obliquum to os unciforme.
3. Os metacarp. IV. has one lig. dorsale to os trapezium; longer and looser than 1. and 2.
4. Os metacarp. I., thumb, has lig. capsulare, a loose, large ligament, which passes from os trapezium to

1. Ligg. volaria 2. sublimi et profundum to trapezium.
2. Ligg. vol. 3. externum to os trapezium; medium to os magnum; internum to os unciforme.
3. Lig. vol. 1., to os unciforme.
4. Os metacarpi V. has lig. capsulare, incomplete, much stronger before than behind, where the tendon of
os metacarp. I., a synovial capsule to itself, behind, assisted by m. extens. poll., outside, by m. abduct. long., inside, m. interossei and art. rad.; has close to it anteriorly m. poll. minores.

Note. Günther (d. Handgelenk, &c.) enumerates ninety ligaments in the articulations of the hand.

Movements: of os metacarpi I.: 1. Flexion, obliquely inwards and forwards, approximates the thumb to the fifth os metacarpi (oppositio), and may cause luxation backwards.

2. Extension, goes so far, that upon the outer side almost a right angle is formed between os. metacarp. I. and the radius; luxation is prevented by the dense posterior portion of the capsular ligament.

3. Abduction, the thumb is removed directly outwards from os. metacarp. II.: it may give rise to luxation inwards.

4. Adduction is limited by os metacarp. II.

127. IX. The heads of the Metacarpal Bones, of the second to the fifth are united together by lig. transversum, (volare,) which passes from one to another like a bridge, lying below the tendinous sheaths of the m. flexor digit., and serving for the attachment of the m. lumbricales. The central portions of the ossa metacarp. are maintained in their situation by ligg. interossea.

128. X. Connections of the Fingers.

A. With the metacarpal bones.—Free, ball and socket articulation; that of the thumb, Gingymus. Articular surfaces: on the metacarpus—even, like a head, oval from behind, forwards. On the first phalanx—smooth fossa, oval transversely.

Ligaments: 1. Lig. anterius s. transversum, very strong and dense on the palmar surfaces of the second to the fifth fingers, filling up the articular cavity; connected with the tendinous sheaths of the mm. flexores, above very loose on the Collum capituli oss. metacarpi.

2. Ligg. lateralia, very strong, passing obliquely from behind forwards, and from above downwards, from tubercul. oss. metacarpi to the lig. anterius of either side. On the dorsal surface the tendinous sheath of the m. extensor, takes the place of ligament. [There is, however, a thin delicate capsule.] In the lig. anterius oss. metacarpi. I. are placed two ossa sesamoidea.

Movements: 1. Flexion the most marked, especially in the first, fourth, and fifth joint. The finger can describe a right angle with the centre of the hand. Flexion is limited by the posterior fibres of the lig. lateralia.
2. Extension, to the extent of an obtuse angle, is restrained by
the ring which Lig. anterius and the anterior fibres of Ligg.
lateralia form. In too violent extension the Capitul. os. meta-
carp. passes over the ring or tears it, and dislocation of the finger
backwards arises, which can only be reduced, if the ring is actu-
ally lacerated, but is prevented if it is pushed between the articu-
lar surfaces.

3. Abduction and Adduction.
B. The phalanges with each other—Ginglymus. Articular
surfaces: a. At the inferior extremity of the I. phalanx—a troch-
lea with two small condyles. b. At the superior extremity of
phalanx I. and II.,—two small fossæ.

Ligaments: 1. Ligg. capsularia, on the dorsal surface loose and thin, and
formed even here of the fibres of the tendinous sheaths of mm. extensor., the
rest like the lig. ant., as in A.
2. Ligg. lateralia ext. et. int., as in A.
3. Capsule synoviales, in A and B are, especially on the dorsal surface,
very loose, not connected with the tendons, stretch in flexion, and fold up in
extension.

Movements: Flexion. That of the second phalanx is more
marked than that of the third.
Extension is much more restrained than in the metacarpo-phal-
angeal articulation. Lateral motion is not possible.


I. Of the Thigh with the Pelvis, Articulatio coxae, hip-joint.

Articular surfaces: Head of the femur and acetabulum, united
in a ball and socket joint, not admitting air, less moveable, but
stronger than the shoulder joint.

Ligaments: 1. Labrum cartilagineum acetabuli, a fibrous ring, of four lines
thick, encircling the edge of the acetabulum, which it deepens, passes over
the incisura acetabuli below and before, as lig. transvers. acetabuli, and thus forms
the foram. acetabuli, for the vessels of the joint; is thicker above and behind;
narrower at its free than at its attached border. Consists entirely of fibrous
tissue. See Interarticular Cartilage.
2. Ligam. capsulare femoris, passes from the border of the bony acetabulum
in front, to the linea interrochater. anter.; behind, as far downwards as the
centre of the neck of the femur; is of a dull white hue, composed of crossed
fibres, two lines thick, strong, solid, and looser at the sides; above and exter-
ally, beneath the tendon of the m. rectus femoris, thicker; is strengthened by a
bundle of fibres, the Zona orbicularis seu lig. anterius superioris, which passes
obliquely from Spina ilsi anter. infer. to the inner part of the basis colli femoris,
around this anteriorly and back to the Spina. Anteriorly, the fibres of the m.
Psosas and Iliacus, and their synovial sheaths are attached to it. Internally
are situated the m. obturator ext. e. pectineus; externally gluteus minimus;
behind quadratus femor.; bigemini, pyramidalis oltur. tor internus.
3. **Lig. teres femoris**, one inch long, passes from the fovea pro. lig. terete upon the head of the femur, becoming broader in its course and dividing to be attached to the fovea acetabuli. It lies between the two articular surfaces, is sometimes very thin and even wanting.

The synovial capsule lies inside the lig. capsulare, lines it, the neck of the femur, the articular surfaces, the lig. teres, and is generally in connection on the inner side of the Zona orbic, perforating the capsular ligament, with the **bursa iliaca**, which is the bursal sac of the flexor femoris.

**Movements:** 1. **Flexion**, the thigh brought forwards: the head of the femur rolls from before backwards in the acetabulum. In consequence of the oblique position of the neck of the femur, it is possible for the knee to touch the shoulder.

2. **Extension**: this backward movement is limited by the posterior portion of the neck of the femur striking against the edge of the acetabulum, and the head is supported in its movement forwards by the Zona orbicularis and m. psoas et iliacus.

3. **Abduction**, the limb directed outwards. The head presses against the internal relaxed portion of the Lig. capsul.; and this, the lig. teres, and the meeting of the upper part of the neck of the femur, and the edge of the acetabulum, prevents its escape.

4. **Adduction**: one thigh approaches the other, and may cross it with the assistance of slight flexion. The depth of the acetabulum and the strength of the capsular ligament above and externally prevent the escape of the head upon this side. The Lig. teres stretches; it is torn in the dislocation of the thigh, so frequent in this situation, from a fall upon the knee, &c.

5. **Rotation**: The internal portion of the head of the thigh moves horizontally forwards, the anterior of the shaft outwards; and the reverse. Rotation is impossible in fracture of the neck of the femur.

130. II. Of the Thigh with the Leg Bone, **Articulatio genu**, Knee-joint.

**Ginglymus.** Articular surfaces: 1. On the femur, two roller-like condyles, between which is a deep fossa; 2. On the tibia,—in the centre the eminentia media, on the sides fossae, for the condyles; 3. **Patella,—**in the centre a vertical elevation, which lies anteriorly in the Incissura inter-condyloidea oss. femor. All the articular surfaces are smooth and covered with cartilage. In addition:

**Cartilagines semilunares**, two sickle-shaped cartilages, which lie between the Condyl. oss. femoris et tibiae, and are connected together by a delicate lig. transvers. Their external border is thick, the internal sharp, the anterior and posterior cornua thin; by these the fossae, close to the eminentia tibiae, are deepened. The external, smaller, almost crescentic cartilage, nearly covers the entire fossa. Its cornua are attached between the two tubercles of the
eminentia media. Posteriorly a thick fibrous band passes from it around the lig. cruciat. postic., and is attached behind this to the condyl. extern. femoris. The intern. cartilage is larger, does not much cover the fossa; attaches itself by the cornua before and behind the projections of the eminent. media; the posterior cornu is covered by the lig. cruciat. postic.

Ligaments: 1. Lig. capsulare genu, large and loose, weakest in front and at the sides, behind united with lig. popliteum; passes off from the superior borders of the Condyl. femor. to the circumference of the articular surfaces of the Tibia and the posterior of the Patella, behind lig. Patellae.

2. Lig. popliteum [the posterior ligament of Winslow], oblique from Condyl. extern. femoris to the inner border of the Condyl. internus tibia; strong, flat.

3. Lig. Patellae, a portion of tendo comm. extensorius, thick, almost triangular, broad at the apex of the Patella, narrower at the inferior part, the tuberosit. tibiae.

4. Ligg. lateralia genu. a. externum, round, tendon like, lies before and between the two heads of the m. biceps fem.; from condyl. extern. fem. to the outer portion of the capitul. fibulae; extern. breve lies behind a, and is attached higher up to capitis fib. b. internum, broad and thin, from the posterior portion of condyl. intern. femor. to the condyl. intern. tibiae, is below covered by the tendons of the Pes anserinus (see Myology), and connected with the Cartil. semilun. intern. Both lie rather posteriorly behind the centre of motion of the joint, are slackened in flexion and limit extension.

5. Ligg. cruciata s. intersaeosseae, crossed like the capital letter X between the articular surfaces of oss. femor. et tibiae, in the Incisura intercondylidea.

a. Lig. cruciat. anticum. passes from the posterior internal surface of the Condyl. extern. to the most anterior portion of the eminentia media tibiae; behind it the longer and thicker (b), lig. cruciat. posticum; from the anterior inner surface of Condyl. intern. to the posterior extremity of the eminentia media. It is connected with the Cartil. semilun. externa; it slackens under extension, and stretches in flexion of the joint, whilst the Lig. antic. is slackened in flexion.

A synovial capsule is very distinct; a shut sac lies above between tendo extensor et femur; at the sides of the patella, on the inner side especially, beneath the m. vastus internus, the ligg. alaria which blend behind with a fibrous fold, Lig. mucosum s. adiposum. It invests the whole internal surface of the capsular ligament, the two surfaces of the Cartilag. semilunares, and envelopes the lig. cruciata. Between it and the lig. patella much fat is found, as well as about the ligg. cruciata, and chiefly in the incis. intercondyl.

Movements: 1. Flexion. The heel may touch the thigh. The posterior, lateral, and posterior crucial ligaments are relaxed, the ligament of the patella is stretched, and the bone is fixed, in front of the space between the femur and tibia.

2. Extension. The articular surfaces of the tibia with the cartil. semilunar. roll from behind forwards, until the thigh and leg lie in the same line. Lig. patellae and cruciat. anticum are relaxed, the rest become stretched. The Patella may be displaced.

3. Rotation, inwards and outwards, is very limited, and is only performed by the condylus internus. It is effected, outwards, by the action of the m. biceps fem.; inwards, by the m. popliteus.
131. **Connection of the Tibia and Fibula.**

A. Superior, *Articul. tibio-fibularis superior*—is immovable. The articular surface of the *tibia*, at the posterior part of the *Condyl. extern. tibii*, looks downwards and outwards; that of the *fibula* at the internal part of the superior extremity, upwards and inwards.

Ligaments: 1. *Lig. capsulare capit. fibulae*, passes obliquely outwards and downwards from the border of the articular surface of the *Condyl. extern. tibii* to the *Capitul. fibulae*; it is short and strong.

B. Inferior, *Articul. tibio-fibular. inferior*—likewise immovable. The articular surfaces are only in part grasped by one another, and in other parts a strong interosseous ligament fills the space between them. The synovial capsule belongs partly to the tarsal joint.

Malleolar ligaments: 1. *Lig. tibio-fibul. anticum*, between the anterior tubercle of the *Incis. peronea tibiae* and that of the *Malleolus extern. (fibulae)*.

2. *Lig. tibio-fibul. post.*, between the posterior tubercles of the same parts.

Both divide into a superior and inferior fasciculus, pass obliquely from above to below, and from within to without, and project beyond the articular surfaces.

C. Central, *Membrana interossea cruris*, stretched in the interspace between the *tibia* and *fibula*, it separates the anterior from the posterior muscles of the leg; above it is broader than below; externally and above, it has an opening for the *Vasa tibial. antica*; below, it is perforated by the *Vasa peronealia*. Its fibres are directed obliquely from within, outwards and downwards. Anteriorly are attached to it: *mm. extensores hallucis et digitor commun. longus*; behind, *m. tibialis posticus, flex. digit. commun. longus*.

132. **Connection of the Foot with the Leg, Artic. pedis s. tibio-tarsalis.**

The ankle joint is a ginglymus; that is to say, it consists of a roller which moves forwards and backwards in a depression on the tibia.

Articular surfaces: 1. On the leg (*tibia* and *fibula*), a fossa divided into two halves by a projection, bounded laterally by the malleoli. 2. On the foot (*talus*), a roller, with lateral articular surfaces, for the malleoli.

Ligaments: a. *Ligg. lateralia externa s. fibularia*, three, passing from the *fibula* either to the *Talus* or *Calcaneus*.

1. *Fibulare calcanei s. perpendiculare medium*, roundish, under the sheaths of the *peronei* muscles, passes from the apex of the *Malleolus extern.* to the outer side of the *os calcis*.
2. Fibulare astragali anticum, very short, from the anterior border of the Mall. extern. to the Astragalus, below broader.

3. Fibulare astragali posticum, close upon the capsule, almost horizontal, from the fossa within and behind on the malleolus to the posterior border of the Talus or Astragalus.

b. Lig. laterale internum s. tibiale, stronger than the anterior, consisting of two layers;

1. Superficial s. deltoideum, from the apex and the anterior and posterior border of the malleolus intern. to the calcaneus and lig. calcaneo-naviculare; the most anterior fibres, that is, lig. later. intern. anterius, a thin layer, passes directly forwards to the colhum astragal. and os navicul.

2. Profundum, below this, stronger, outwards and downwards; from the apex and the borders of the malleolus to the internal part of the Talus, below the articular surface.

The Synovial capsule is very loose anteriorly, and covered with fat.

Movements: 1. Flexion. The Talus glides from before, backwards; the Collum tali meets the anterior border of the articular fossa, so that dislocation is scarcely possible. The dorsum of the foot moves upwards and backwards.

2. Extension: Talus glides from behind, forwards. Displacement is rare. The dorsum of the foot moves downwards and forwards. Lateral motion does not take place in this, but in the tarsal joints.

133. Connection of the Tarsus, Artic. tarsi.

I. The first row, that is, Talus and Calcaneus, are united in a limited Arthrodia, by which the lateral movements of the foot are performed.

Articular surfaces: On the inferior surfaces of the Talus an anterior convex and a posterior concave. On the superior surface of the calcaneus, a posterior convex and an anterior concave.

Ligaments: 1. Lig. inteross. (s. Apparat. ligamentosus sinus tars), strong.

2. Lig. capsulare astragalo-calcaneum (synovial capsule), thin; internally strengthened by the fibrous sheaths for the tendons of the M. tibialis pos... flex. digitor. comm., and propr. hallucis; anteriorly and posteriorly, by small bundles of fibres.

134. II. The second row, namely,

Ossa cuneiformia, three in number, naviculare and cuboideum, are united in close articulations, amphiarthroses, with one another.

a. Os naviculare unites anteriorly with the three cuneiform bones by an articular surface divided into three facettes, each of which is triangular. The ligaments are:

1. Lig. dorsalia, two for the Os cuneiforme I., straight from before to behind; one for each of the two others, passing obliquely forwards and outwards.
2. Ligg. plantaria. Those of the second and third cuneiform bones are indistinct; on the contrary, that of the first very strong, from tuberc. oss. navicul. to that of the cuneiforme I.; losing itself in the tendon of the m. tibialis anticus, which is extended to the Os cuneiforme III. and Os metatars. III., and forms lig. tarsi inferius.

b. Ossa cuneiformia are united together by very firm transverse

1. Ligg. dorsalia; connected above with the mm. extensores digitor.; below, with the periosteum.
2. Ligg. interossea, very strong, and firmly attached.

c. Os cuneiforme III. and os cuboideum are united by very strong transverse

1. Lig. dorsale.
2. Lig. interosseum, around the articular surface.
3. Lig. plantare, thin.

d. Os naviculare and os cuboideum united by

1. An oblique Lig. dorsale.
2. Lig. interosseum.
3. Lig. plantare, very thick, transverse from tuber. oss. navicul. to the os cuboideum.

135. III. Connection of the first with the second row.

a. Talus and os naviculare. The fossa of the navicular bone, in which the head of the talus is received, is deepened by

1. Lig. calcaneo-naviculare inferius (plantare); it forms the internal portion, and lies in the triangular space between proc. minor. calcan. and os naviculare; consists sometimes of an internal and external portion, the last round and cartilaginous; is sometimes represented by a thin, osseous plate from the calcis, so that the Calcaneus and os naviculare come into immediate contact.
2. Lig. Calcaneo-naviculare superius (dorsale), from the internal side of the anterior extremity of the Calcaneus to the external of the os naviculare; in the deep hollow on the outside of the Talus, which is filled with fat.

The talus is also firmly united with the os naviculare, by means of the calcaneus only, but it may, by strong concussion, escape from its connection. Its own ligament is weak, namely:

3. Lig. astragalo-naviculare superius, from Collum tali to the circumference of the articular surface of Os naviculare; above, covered by m. extens. digitor. brevis; semicircular.

b. Calcaneus and os cuboideum, the articular surfaces reciprocally coincide. Tubercle on the Calcaneus, important in Amputation.

Ligaments: 1. Lig. calcaneo-cuboideum plantare, the strongest of the tarsal ligaments; passing from the entire inferior surface of the Calcane. to the posterior of the Os cuboid., it may be divided into a superficial and deep.
2. Lig. calc.-cub. internum, short, narrow, strong, in the fossa between talus
SPECIAL ANATOMY.

and calcaneus, describing with the lig. calcan. navicul. superius a figure like the capital letter Y; after their division, the two rows of tarsal bones separate from each other.

3. Lig. calc.-cub. superius, thin, small, from Calcaneus to os cuboideum.

Movements: Adduction and Abduction, whereby the sole of the foot is turned inwards or outwards, arising by talus and calcaneus on one, os naviculare and cuboideum on the other side, assisted by slight lateral movement between talus and calcaneus.

136. Connection of the Metatarsal Bones, Artic. metatarsi.

These bones are united with those of the tarsus and with one another by close articulations.

137. A. With the tarsus. 1. The tarsal extremity angular, with even articular surfaces. That of the third metatarsal bone makes an angle, forwards, with the line of the rest.

a. Os metatarsi I. 1. Lig. plantare, stronger than the Lig. dorsale, with synovial capsule. 2. Aponeurosis of the tendon of m. peroneus long. to the os cuneiforme I. 3. Aponeurosis of the tendon of m. tibialis anticus to the Os metatarsi I.

b. Os metatars. II. 1. Lig. plantaria, two from the second cuneiform, the third from first cuneiform bone, lateral. 2. Lig. dorsalia, three; a. internum from first cuneiform; β. externum from third cuneiform, thin; γ. medium from second cuneiform.

c. Os metatars. III. 1. Lig. dorsale from third cuneiform. 2. Lig. plantare, very thin; instead, the tendon of m. peroneus long. 3. Lig. laterale extern. seu interosseum.

d. and e. Oss. metatars. IV. and V. 1. Lig. interossea, very strong. 2. Lig. dorsale and lig. obliquum, on oss. metatars. V., very loose. Instead of Lig. plantare, the tendon of the muscles peron. long. and tibial. posticus.

138. B. The posterior extremities with each other. Ligg. baseos ossium metatarsi.

1. Ligg. dorsalia. 2. plantaria, stronger. Transverse from the one to the other bone.

3. Ligg. interossea, strong, short, and thick, between the rough, lateral surfaces, are wanting between the first and second os metatars.

139. C. The anterior extremities. No articular surfaces, but synovial capsules; rather moveable on one another.

1. Lig. transversum s. capitulorum oss. metatarsi, on the sole between the heads, below the sheaths of the tendons of the flexor muscles; loose.

Movement: indistinct.—Os Metatars. I., of great toe, is not more moveable than the rest.

a. Of the metatarsal bones with the toes, by ball articulation;  
b. Of the phalanges with each other, by Ginglymus. On the  
first phalanx of the great toe a double pulley with *ossa sesa-
moidea.*

1. *Lig. capsularia,* very thick, cartilaginous in the sole, where is a groove  
for *mm. flexores,* very thin on dorsum, strengthened by tendons of extensor  
muscles, beneath which is a loose synovial capsule.

2. *Ligg. lateralia,* very strong, from the capsular ligaments obliquely to the  
tubercula behind the head of the *oss. metatarsi,* and *ossa sesamoidea,* and the  
Phalanges.

Movement: Flexion limited by the lateral ligaments and extensor tendons. Extension restrained by the inferior portion of the capsular ligament. Both these more marked than abduction and adduction which, moreover, only occur between the metatarsal bones and first phalanges. The great toe is far less moveable than the thumb.
OF THE MUSCLES.

MYOLOGIA.

"The application of muscles in an animal body is either to produce a quantity of motion equal to the quantity of contraction of the muscle; or, by the application of levers, to give a greater motion than could be produced by the single contraction of the muscle. This, in general, is not the case in machines composed by art; for in art the principal reason for the introduction of mechanics is to acquire power in the effect, which obliges us to increase the velocity in the moving cause, as in levers and pulleys."

HUNTER. Croonian Lectures, No. III.
MUSCLES.

Literature.

Minute Structure:—


Bowman. Philos. Trans., 1840–41, and his article in Cyclopædia of Anat. At the end of which is a long list of works.


Gimbernat. On Femoral Hernia. Trans. 1795.

141. MUSCLES, MUSCULI,

form the soft fibrous organs, the substance of which is known by the name of flesh, and which, by the capacity they enjoy of contracting, produce, in an especial manner, the movement which is permitted by the articular connection of the bones and the mobility of the soft parts. They consist, independently of fibrocellular tissue, vessels and nerves which enter into their formation, of a peculiar tissue which is closely related to that of the contractile coat of vessels.

142. a. Tissue of muscles.

Every muscle is composed of a number of bundles of fibres, each of which again consists of filaments which are even once more divisible; so that we may distinguish primary, secondary, and tertiary divisions. All are united together by a general fibrous envelope, perimysium, as well as each being surrounded by its own particular investment, which connects it with the sheath. The tertiary bundles are three-sided, prismatic, about 2" broad, and consist of the flat secondary divisions, lying longitudinally to one another, \( \frac{1}{4} \) to 3" broad, which on their side are formed of the red or pale, flat, fine primary divisions, 0.005" in diameter.

In the primary bundles we observe under the microscope many, 10 to 500, longitudinal striae, which also display many delicate filaments, fibrillae, primitive filaments, lying parallel to one another, appearing of a yellowish red, and perforated by transverse striae, or even only little points, whereby an angular, articulated appearance is produced. Whether a canal exists in the axis of the primary bundle, filled with a gelatinous substance, as in the Embryo, according to Valentin, is still doubtful. The longitudinal striae, even the primitive filaments also, and transverse striae, are not found in all muscles.

Hence we distinguish, transversely striped, striated [compound] (varicose, articulated), and unstriped [simple] organic muscular fibres.

1. To the striated belong all the so-called animal, or muscles of voluntary movement, and of the heart.

2. To the unstriped all the so-called organic, or muscles of involuntary movement, with exception of the heart.

143. b. Characteristics of muscular tissue.

1. Chemical. It is little changed by water and spirits of wine; very easily decomposes, and at last breaks up by means of Gastric juice into globules, but yields on boiling only very little gelatin (from the sheaths). Primitive fibres and sheaths are soluble in concentrated, are rendered transparent and soft by dilute acetic acid; by Potass. carb. firm, in consequence of which the wave-like and cylindrical form of the fibres shows very distinctly.

Chemical constituents: much water (0.77), Albumen, and Hæmatin, Alcoholic and watery extract, with some phosphorus, soda, and lime, and lactic acid; lastly, fibrin, fat, and gelatin.

2. Physical Characters. The red colour of the muscles is not dependent
upon the capillary vessels ramifying throughout, but upon a peculiarity in the colouring matter united with them. The fibres are soft, but firm, and during life with difficulty torn; their elasticity is trifling. After death they become stiff (from seven to ten minutes), as the fibrin coagulates, which is the rigidity of death, _rigor mortis_.

3. Physiological Characters. Muscles are endowed with the faculty of contracting in the direction of their fibres. In consequence, those parts between which they are attached approach more closely together. The contraction, by means of which the fibres shorten, become closer and harder, occurs in consequence of the sudden bending together of the fibres, from the extremities towards the centre, or curling up in a zigzag form, in the transverse striæ (_crispatio_), and is the result of an influence, which the will, the blood, and certain external irritations, exercise upon the numerous interlaced (motor) nerve fibres in the muscles. The irritabiliity (_irritabilitas Halleri_) of the muscles (produced by galvanism, cold, &c.) is only extinct some time after death. Also, the slight shortening maintained during life (_tonus_) terminates immediately with death, or by palsy of the nerves. Whilst at rest the muscles possess their greatest power (Schwann). During every continued movement a small quantity of Plasma is effused which, becoming metamorphosed into the substance of the muscle, accounts for their increase of size. Muscles act (generally) as the power in levers of the third order, that is to a disadvantage, since the power is broken between the fulcrum and the weight.

144. c. Vessels and nerves of muscles.

Arteries. They generally enter on the inner side of the middle part of the muscle, dividing between the larger bundles into large branches, from which smaller pass off between the smaller bundles, until they finally go into a long capillary network which encompasses the primitive fibres, and discharges into the veins which follow the course of the arteries.

Nerves correspond in number and size (not always) to that of the muscles. The nerves of motion principally prevail over those of sensation, in muscles, with which their trifling degree of sensation corresponds. They generally enter the muscle at the posterior part of the superior fourth, take a course like the arteries, but form loops at the ends, from which delicate filaments pass off and encompass the primary bundles of fibres.

145. d. Classification of muscles.

In each muscle we may distinguish the fleshy central portion (belly); the origin, the fixed point, head; the insertion, the moving point, tail. Both the last are provided with tendinous fibres.

1. According to the structure we distinguish animal and organic muscles. (See before.)

   a. The animal muscles are striated, generally dark red, attached especially to bones, and lie on the external boundary of the body; they are connected by tendons, and have antagonist muscles; they are generally thick, cylindrical, sometimes even expanded like a membrane; lastly, they are stimulated to motion by the will. To this class belong the muscles of the trunk [and extremities] and of the commencement of internal canals.

   b. The inorganic muscles are unstripped, generally pale red, lie in the inte-
ior of cavities (chest and abdomen), expanded in a manner resembling and between membranes, without tendons and antagonist muscles. They are not under the influence of the will. To this class belong: the muscular coats of the intestines and excretory ducts; and the fibres of the heart which, however, belong to it, only in relation to their involuntary movement.

2. According to their actions we distinguish—
   a. Antagonising muscles, antagonists; for example, flexor and extensor muscles.
   b. Associated, socii, which act simultaneously to produce a certain effect.
   c. Flexors, flexores, and Extensors, extensores.
   d. Ab- and Adductors, ab- and adductores, which remove parts from, or bring them to, the middle line of the body.
   e. Rotators, rotatores, which roll a part upon its axis, inwards (pronatores) or outwards (supinatores).

3. According to their shape, voluntary muscles are distinguished, as
   a. Long muscles, which arise either with one, two, or several heads or dentations from a fixed point, form one or more thick central portions (belly), and are attached either with a single or divided ends (tail) to the moveable point.
   b. Flat, broad muscles, are thin, tri- or quadrangular, like a membrane, lie on the parietes of cavities, and terminate with Aponeuroses; e. g., the abdominal muscles.
   c. Closmg, circular muscles, sphincteres, with circular, encompassing primitive fibres, lying round about natural openings; e. g., Sphincter Ani.

We likewise find, among the class of involuntary muscles, layers of longitudinal and circular fibres, with others, crossing each other in various ways (hollow muscles).

146. e. Auxiliary organs of muscles.

1. Tendons. Their fibres are not continuations of the muscular, but are only embraced by them, so that the two are separated by boiling; even the capillary vessels of the muscles do not pass into them. Sinews, tendines, are the cord-like tendons which form the prolongations of the muscles, and often extend to considerable length. When the muscular fibres are continued upon both sides, the so-called penniform muscles arise, when only on one side the semi-penniform.

a. Aponeuroses are flat expansions of the tendons, which occur with flat muscles, and which are generally united, as they lie on the same plane, e. g., on the skull.

b. Fasciae (also called aponeuroses), tendinous envelopes for the muscles, surrounding and isolating separate muscles and groups of muscles, maintaining them in their situation, and even serving for their attachment, since they send off, in many places, processes to the bones (ligg. intermuscularia); also the sinews with peculiarly long sheaths (vaginae tendinum fibrosae), or provided with narrow restraining bands (retinacula), to prevent displacement.

Fascia superficialis is such an envelope, which lies close beneath the corium, and surrounds all superficial muscles. It consists of fibrous laminae crossing each other, and interwoven with elastic fibres, between which lie fat, superficial nerves and vessels.
147. 2. Fibro-cartilaginous portions, pulleys, (trochleæ), and grooves, on which the tendons in several places glide, to prevent friction, firmly attached by both extremities to the bones.

148. 3. Serous structures on the tendons, to assist their free movement over bones, cartilages, &c. There are:

a. Mucous sacs, *bursæ mucose, 1. synoviales*, generally closed sacs, which lie between the muscles and bones, and connected with both, particularly over joints, into which they frequently open; e.g., on the *m. subscapularis* of the shoulder joint.

b. Mucous sheaths, *vaginae mucose s. synoviales*, long (closed) sacs, through which a canal passes for a free tendon, with which it is connected; e.g., *Biceps brachii*.

I. Muscles on the Head.

A. Muscles of the Cranium, *Occipito-frontalis s. Epicranius*.

149. 1. *Occipitalis*, Occipital muscle.

Shape: obliquely four-sided, weak. Position: close beneath the skin of the occipital region. Origin from *linea semicircularis superior*, extending from close to the middle line to the base of *proc. mastoid*. Insertion: *Galea aponeurotica*. Action: draws the skin of the head backwards, rendering the forehead smooth.

Nerves: *supraorbital, supra and infra trochlearis, rr. temporal. n. facialis*.

150. 2. *Frontalis*, Frontal muscle.

Shape: obliquely four-sided, above arched, flat. Position: close beneath the skin of the forehead, from the root of the nose to the frontal eminence. Before the *Glabella* the internal borders of both meet together. Origin: root of nose and *arcus superciliiiarius*. Insertion: *Galea aponeurotica*. Action: elevates the skin of the forehead and eyebrows (making transverse wrinkles), stretches the skin of the back of the nose (by means of the so-called *procerus nasi*).

Nerves: *occipital major. and min. auricular. post.*

*Galea aponeurotica*, that is, the tendinous cap which lies between the two occipital and frontal muscles, formed of their tendons, attached besides to the root of the *proc. mastoid*. to the zygomatic arch as far as the external angle of the eye, intimately united with the skin of the head (less with the periosteum), covered with fat (in which are many nerves and vessels). Behind it is thick and brilliantly white, on the sides thinner.
B. Muscles of the external Ears.

151. 1. *Attollens auriculæ*, elevator of the ear.

Shape: triangular, thin. Position: close beneath the skin of the temporal fossa above the ear. Origin: *Galea aponeurotica*. Insertion: broad, on the posterior surface (between the divisions) of the *anthelix*. Action: raises the auricle.

152. 2. *Protrahens s. auricularis anterior*.

Figure: small, thin. Position: above the zygoma, beneath the skin; covers *art. and ven. temporalis* and *fascia temporalis*. Origin: *Galea aponeurotica*. Insertion: in front of the *helix*. Action: draws the auricle forwards and upwards.

Nerves: *temporal. superfic. (auricular. anter.) subcutan.*, *tempor. facial*.


Figure: roundish, flat, small. Position: above the origin of the *Sterno-mastoid* muscle. Origin: *proc. mastoideus*. Insertion: the external convex surface of the auricle. Action: they draw the upper portion of the auricle backwards.

Nerves: *auricular. post. vagi, occipital. minor*.

154. 4. Muscles which may serve for the movement of individual parts, but however are only perceptible as exceptions. Heli*cis major* and minor, *Tragicus*, *Antitragicus*, *Transversus auriculæ*, *Dilator conchæ* (see Ear). Hyrtl describes a *m. styloauricularis*, which passes from *proc. styloideus* to the inferior surface of the cartilaginous *meatus auditorius*, but generally represented by a tendinous cord.

C. Muscles of the Eyelids.

155. 1. *Orbicularis s. sphincter palpebrarum*.

Figure: flat, rather thin, consisting of an external and an internal layer. From the internal angle of the eyes a four-sided fasciculus passes, *m. Horneri s. Tensor tarsi s. sacci lacrymalis*, which goes behind the tarsal ligament around the lacrymal canal to the crista of the lacrymal bone. Position: beneath the skin of the lids and borders of the orbits. The internal layer arched from *lig. palpebrar. intern.* to *externum.*, and from the borders of the orbits to the tarsal cartilages, covers the roots of the cilia. The
external (red) layer upon the borders of the orbits covers corrugator supercil. parts of frontalis, temporal., zygomaticus and levator labii alæq. nasi. Origin: the internal angle of the eyes, lig. palpebrale internum. Insertion: the same, only rather farther towards the nose. The internal layers of the superior and the inferior eyelids are separated from one another. Action: the internal layer closes the eye and presses the bulb a little backwards. The external shortens at the same time the fissure between the lids, and corrugates the skin at the internal angle. Horner’s muscles merely draw the puncta lacrymalia deeper inwards; they may also compress the lacrymal sacs.


156. 2. Corrugator supercilii.

Figure: arched, narrow, flat. Position: upon the arcus superciliaris, covered by frontalis and sphinct. palpebr. Origin: the root of the nose. Insertion: to the superciliary arch as far as the temple. Action: draws the brow inwards and downwards, thereby corrugating the skin over the root of the nose lengthwise.

Nerves: as frontalis.

157. 3. Levator palpebræ superioris.

Figure: long, flat, and narrow. Position: between the roof of the orbits and the rectus bulbi sup.; above it, passes n. frontalis (trigem.). Origin: close above the optic foramen from ala parva of the sphenoid bone and sheath of nerv. opticus. Insertion: with a broad aponeurosis to the superior border of the tarsus. Action: draws back the superior lid upwards, particularly on elevation of the globe.

Nerves: oculo-motorius.

D. Muscles of the Nose.

158. 1. Depressor alæ nasi.

Position: close upon the upper jaw, covered by sphinct. oris and levat. labii alæq. nasi. Origin: before the roots of the two incisor and the canine teeth. Insertion: the posterior part of the septum mobile and the alæ nasi. Action: draws the inferior part of the nose downwards and backwards (sulcus naso-labialis becomes deeper.) Fibres from it penetrate the upper lip; these are m. Incisivus (Cowperi) superior.
159. 2. Compressor narium s. transversus nasi.

Figure: below, narrow (fleshy), above, broad, three-sided (tendinous). Position: arched upon the cartilaginous part of the nose, where both meet together. Origin: between the roots of the canine and first molar teeth, in the sulcus naso-labialis. Insertion: the back of the nose below the bony portion. Action: rather to compress the nose, drawing the skin downwards, and widening the nasal openings.

Nerves: infraorbital and ethmoidalis.

160. 3. Dilatator narium posterior.

Fig.: small. Pos.: at the posterior part of the alæ nasi, covered by depressor and compressor. Or.: the border of the proc. ascend. of the upper jaw. Ins.: below to the skin of the posterior half of the nasal openings. Act.: widens behind the nasal openings.

161. 4. Dilatator narium anterior.

Pos.: on the alæ close to the back of the nose. Or.: the superior border of the alar cartilages of the nose. Ins.: the skin of the anterior part of the border of the nasal openings. Act.: draws the anterior portion of the alæ nasi outwards.

Nerves: infraorbital and facialis.

Remarks. The rest of the nasal muscles are not independent, but continuations of neighboring muscles; viz.

a. Procerus (s. pyramidalis) a continuation of frontalis, upon the dorsum of the nose. Act.: draws the skin of the back of the nose upwards, stretching it.

b. Depressor septi mob. a portion of sphincter oris, in the fossa of the upper lip. Act.: draws the point of the nose upwards; contracting the nasal openings.

c. Pyramidalis s. Levator labii superioris alaeque nasi.

E. Muscles of the Lips, the Cheeks, and the Chin.

162. 1. Orbicularis s. sphincter oris, the muscle closing the mouth.

Pos.: round about the oral fissure in the lips, between the mucous membrane and the external skin; connected on the external circumference with the rest of the labial muscles (whose continuation it forms). Or. and Ins.: septum mobile nasi. Act.: closes, points, and presses the lips against the teeth (m. oscillatorius).

Nerves: infraorbit., mental., buccinat., facial.
2. **Buccinator, cheek muscles.**

Fig.: oblong, broad, flat. Pos.: between upper and lower jaw; behind covered by the ramus of the lower jaw, *masseter* and *temporalis*; before by *zygomatici*, *risorius*; perforated by duct. Stenonian. (opposite the three superior molar teeth); covered internally by the buccal mucous membrane. Or.: 1. Over the last molar tooth. 2. *Hamulus* of *proc. pterygoid*. 3. *Alveolus* of the upper and lower jaws. Ins.: *sphincter oris*. Act.: draws the angles of the mouth outwards; contracts the buccal cavity (in whistling, blowing).

Nerves: *buccinator*, *buccales*, *facialis*.

3. **Levator labii superioris alaeque nasi,**

(*Pyramidalis* of Theile.)

Fig.: flat, divided below. Pos.: on the side of the nose, somewhat covered above, by *sphincter palpebr.*, then, below, by the skin, above, *compressor* and *depressor alae nasi*. Or.: *proc. frontal.* of upper jaw to *lig. palpebr. intern.* Ins.: the stronger portion to *sphincter oris*, the weaker to the *ala nasi*. Act.: elevates the *ala nasi*, corrugates the nasal membrane, and raises the upper lip at the same time.

4. **Levator labii superioris proprius s. Incisorius.**

Fig.: flat, four-sided, broader above. Pos.: covered above by sphinct. palpebr., then only by the skin on the external border of this muscle, on the inner of the *zygomatic minor*, with which it is united below. Or.: above *foram. infraorbitalis*. Ins.: *sphincter oris* and skin of upper lip. Act.: elevates the upper lip.

5. **Levator anguli oris** (s. Caninus).

Pos.: vertical; external to the one last described; covered by it, below free. Or.: half an inch below *foram. infraorb.*, broad. Ins.: *sphincter oris*, *depressor labii inferior*. Act.: raises the angle of the mouth somewhat inwards.


Pos.: oblique, at commencement covered by *orbic. palpebr.*, upon the last described, free beneath the skin. Or.: *os zygomatic*. Ins.: the upper lip; mingling with *levator labii prop*. Act.: raises the upper lip and draws it somewhat outwards.
168. 7. Zygomaticus major, greater zygomatic muscle.

Pos.: oblique; external and below the last described; covered below by the fat of the cheek, above by orbicular palpebr. Or.: os zygomatic. Ins.: the angle of the mouth. Act.: draws the angle of the mouth outwards and upwards.

169. 8. Depressor anguli oris (s. triangularis menti).

Pos.: beneath the skin at the sides of the chin; covers the quadrat. menti internally, the buccinator externally. Or.: broad, from basis maxill. infer. Ins.: pointed, to the angle of the mouth (levator anguli and zygomatic. major). Act.: draws the angle of the mouth outwards and downwards (physiognomy of the simple).

170. 9. Risorius (Santorini), laughter muscle, thin, threesided.

in the fat of the cheeks, upon m. platysmam. Or.: fascia masseter. Ins.: m. zygomatic. major. Act.: draws the inferior internal part of the cheeks outwards and upwards, so that (in laughing) a small fossa is formed in the skin.

171. 10. Depressor labii inferioris (s. quadratus menti).

Pos.: close beneath the skin of the chin, covers the sphincter oris and lev. menti. Or.: the inferior border of the chin. Ins.: the under lip. Act.: draws the under lip downwards, both together stretch it.

172. 11. Levator menti.

Pos.: in the chin, bounded above by the sphincter oris, covered externally by quadratus; in the centre the fibres of both sides pass over, above, in an arched manner, into one another; below, they are united by firm fibro-cellular tissue, and free. Or.: below the corner tooth of the lower jaw. Ins.: skin and fat of the chin. Act.: draws the skin of the chin upwards, corrugates it, and pushes up the lower lip. Its most superior fibres (m. incisivus inferior) penetrate the under lip, and are said to compress it against the gums.

173. 12. Transversalis menti,—wanting in feeble subjects.

Pos.: transverse below the free border of the chin, upon m. platysmam. Or.: continuation of triangularis menti. Ins.: the internal angle of both mm. triangulares. Act.: stretches the skin on the chin.

Nerves: (for three to twelve) facialis; for the superior muscles; infra orbital. and subcutan., for the inferior; mentalis.
F. Muscles of the Lower Jaw,—of mastication, mansores s. manducatores.

174. 1. Masseter, masticating muscle; external and internal portion.

Pos.: before and upon the ramus maxill. infer., between arcus zygomatic. and angulus maxill.; above, covered by zygomatic major; behind, by the Parotis. Close to its anterior border below: art. maxillar. extern. Or.: the inferior border of the zygoma. Ins.: angle and external surface of ram. maxill. infer. Act.: draws the lower jaw (very strongly) upwards.

175. 2. Temporalis (s. crotaphites), temporal muscle.

Pos.: fills up the temporal fossa; covers m. pterygoïd. extern., buccinator (somewhat), art. maxillar. intern. and vasa temporall. præf. Or.: linea semicircularis and the walls of the temporal fossa. Ins.: process. coronoid. of the lower jaw. Act.: draws the lower jaw upwards, and the condyl. maxill. backwards into the articular fossa.

176. 3. Pterygoideus internus (s. major) thick, four-sided, (masseter internus).

Pos.: in the fossa zygomatic., along the inner surface of the ramus maxill. infer., separated from it by nn. dental., lingual., art. and vcn. dental. infer., and lig. laterale intern. External to m. circumflex. palati, gland. submaxillar. and pharynx. Or.: fossa pterygoidea. Ins.: angulus maxillæ (internal surfaces). Act.: draws the lower jaw strongly upwards, as well as rather inwards.

177. 4. Pterygoideus externus (s. minor), short and thick.

Pos.: horizontal between ala externa proc. pteryg. and collum maxill. infer.;—on the outer side of pterygoid. intern., inside of ram. maxill. and m. temporalis. Or.: by two heads (which frequently embrace art. maxill. intern.); a. from the external surface of ala extern. proc. pterygoid. and proc. pyramid. oss. palati. b. from the crista and spina alæ magne of the sphenoid bone, between fossa temporal. and zygomatica. Ins.: the depression before the collum condyli maxill., and the circumference of the interarticular cartilage. Act.: draws the lower jaw forwards and pushes it to the other side; both acting together draw it directly forwards.

Nerves: (for one to four) ramus 3 trigemini.
Fasciae of the Head.

178. 1. *Galea capitis.* See before.

179. 2. *F. temporalis,* is covered at the upper part by the *Galea,* but is not even connected, where free, with the external skin. It covers the temporal muscle, dividing inferiorly into a superficial delicate layer which is attached to the superior border, and a deep one, to the internal surface of the zygomatic arch; between the two there is fat and a branch of the *art. temporalis;* between it and the temporal muscle likewise much fat. It is very dense. (Pus does not readily penetrate it, but it gravitates towards the malar-maxillary fossa.)

180. 3. *F. buccalis:* a. Superficial layer, that is, *F. parotidea,* very dense, especially on the external surface of the Parotis, covering it like a sheath (pus does not penetrate it and the skin easily); continuing as *F. masseterica,* where behind it appears to divide, covering the *m. masseter* and *ductus Stenonianus,* above and in front losing itself in fibro-cellular tissue. (Pus behind it sinks towards the neck, that before it comes to the skin.)

181. b. Deep layer, *F. bucco-pharyngea,* covers *m. buccinator,* serving anteriorly for the attachment of this, posteriorly much thicker, for that of the *m. constrictor pharyngis super.,* since it passes away behind *m. pterygoid. intern.,* and, like a, is connected with the *F. cervicalis.* It separates the muscles from the buccal mucous membrane. (Pus does not easily find its way through these fasciae towards the mouth and the reverse.)

II. Muscles of the Neck.

A. Superficial cervical muscles.

182. 1. *Platysma-myoides* (s. *latissimus s. subcutaneous colli*).

Pos.: broad, close behind the skin, below firmly, above, united with it by fat, on the sides of the neck, before the *fasc. cervicalis.* The two diverge from above downwards. Or.: the anterior superior part of the chest (two to three ribs) before *m. pectoralis major.*

Ins.: *Basis maxill. infer.,* angle of mouth, *Masseter,* skin of the face. Act.: draws the skin of the neck, somewhat the lower jaw and under lip, downwards.

Nerves: *subcutanei, colli supraclavicularares.*

183. 2. *Sterno-cleido-mastoideus.*

Pos.: above at the sides, below on the anterior surface of the neck; covered by the skin, by *m. platysma myoid,* separated
from the last by *Vena jugular. extern.* and *Plex. nerv. cervical. superfic.* Behind it, 1. *Mm. sterno-hyoideus, thyreoid., omo-hyoid., splenius, digastricus, scaleni.* 2. *Nn. vagus and accessor., sympathetic, hypoglossus, cervicales.* 3. *Carotis communis, Vena jugular. intern.* On the anterior border above, *Parotis.* The two diverge from below upwards. The posterior border forms with the *Clavicula* an acute angle, with these and the *M. trapezius* a triangle. Or.: two portions. 1. *Cleido-mast.* from the internal extremity of the *Clavicula.* 2. *Sterno-mast.* from *manubrium sterni.* Ins.: external surface of *Proc. mastoid. oss. temporis* and *linea semicircular. superior oss. occipitis.* Act.: both together draw the head directly forwards and downwards, bowing it; one alone acting draws it in such a direction that the face looks towards the opposite side.


a. Below the Os Hyoides.

184. 3. *Sterno-hyoides* (often double).

Pos.: vertical in the centre of the neck; covered by *M. platys-mam., sterno-cleidom.* and *fascia cervicalis,* before the deep cervical muscles and *Art. thyreoidea superior.* The inner borders meet together. Fig.: flat, riband-like, thin. Or.: the posterior surfaces of the Sternal ends of the *Clavicula* (frequently the *Manubrium sterni*). Ins.: the inferior border of the body of *os hyoides,* close to the middle line, to the inside of *M. brachyoideus.* Act.: draws the *os hyoid.* downwards.

185. 4. *Omo-hyoides* (sometimes wanting).

Pos.: oblique on the side of the neck, commencing parallel with the *Clavicula,* then forming an obtuse angle upwards and inwards; covered by *trapezius, subclavius,* platysmam., sterno-cleido-mast.; it crosses *Mm. scaleni,* the *Plex. brach., Vena jugular. intern., Carotis comm.,* near *m. sterno-hyoides.* Or.: *Scapula* (the superior border) behind the *Incisura scapulae.* Ins.: external and close to the before-described muscle. Fig.: two-bellied, in the centre tendinous, angular. Act.: the superior belly draws the hyoid bone downwards. The posterior belly is said to stretch the *fasc. cervic.* which attaches it to the clavicle.

[Coraco-cervicalis (Krause), a small m. before *m. omo-hyoides,* arises from *Proc. coracoid.,* and is attached to the *fascia cervicalis,* which it stretches.]
5. **Sterno-thyreoideus.**

Pos.: behind *sterno-hyoid*, diverging from below upwards, before the thyroid gland. On the outer border: *V. jugular intern.*; behind that *Carot. comm.*; on the inner border: *V. thyreoidei media.* Or.: broad from *Manubrium sterni* (posterior surface) and first rib cartilage. Ins.: *Linea obliqua of thyroid cartilage.* Act.: draws the larynx downwards, shortening the trachea.

Nerves: (three to five) *hypoglossi ram. descendens.*

6. **Thyro-hyoiideus.**

Pos.: behind the *m. sterno-hyoiideus*, vertical before the *memb. thyreoidea.* Or.: *os hyoides* (the inferior border of the body and root of great cornua). Ins.: *Thyroid cartilage (linea obliqua).* Act.: approximates *hyoid bone* and *larynx*; assists in throwing the *epiglottis* backwards.

*[Thyroideus is a prolongation of the thyroid gland upwards; it contains no muscular fibres.]*

Nerves: *laryngeus superior* and *hypoglossus.*

b. Above the *Os Hyoides.*

7. **Digastricus (s. biventer maxillæ inferioris).**

Pos.: in the semicircle between the temporal, hyoid bone and centre of lower jaw, below the angle of the last; covered by *M. platysma myoides*; behind by the *Parotis* and *Gland. submaxill.* Internally to it lie *Carotis interna* and *N. hypoglossus*; the posterior belly perforates on the hyoid bone, the *M. stylo-hyoiideus.*


Nerves: post. belly, *facialis*; [ant. belly, *trigeminus.*]

8. **Stylo-hyoiideus.**

Pos.: between temporal and hyoid bones, covered externally by the posterior belly of the digastric muscle by which it is perforated shortly before its point of insertion. Or.: *Proc. styloideus* (the centre of the external surface). Ins.: the *Os hyoides*, at the union of its great cornu with the body. Use: to draw the hyoid
bone obliquely backwards and upwards; elevates the root of the tongue, and contracts the *isthm. faucium.*

Nerves: *facialis.*

190. 9. *Mylo-hyoides (s. transversus mandibulæ).*

Pos.: extended like a partition from the lower jaw to the hyoid bone; above *M. digastric.* (ant. belly) and Gland. *submaxill.*; beneath *Mm. genio-hyoid., hyo-, stylo-glossus,* *Nn. lingualis* and *hypo-glossus,* Gland. *subling.* and oral mucous memb. 

Or.: broad from the entire *Lin. obliq. interna* of the lower jaw. 

Ins.: pointed to the centre of the body of the hyoid bone. [Meets its fellow in the middle line of the body.] Use: draws the hyoid bone upwards, or the lower jaw downwards.

Nerves: *trigeminus.*

191. 10. *Genio-hyoides.*

Pos.: above the last *m.*, beneath *m. genio-glossus,* between chin and hyoid bone, below and behind. Or.: the chin (*spina mentalis interna*). Ins.: Hyoid bone (the superior anterior part of the centre). Use: draws the hyoid bone forwards and upwards, or the lower jaw downwards.

Nerves: *hypoglossus.*

B. *Muscles of the Tongue, of the Pharynx, and Palate.*

192. 1. *Linguales,* Tongue muscle.

a. *Longitudinalis superior,* anteriorly beneath the thick membrane of the tongue, behind beneath the glandular layer, along the entire dorsum of the tongue. Use: to shorten the tongue, curving the apex upwards and backwards.

b. *Longitudinalis inferior* (especially the *lingualis*), spindle-shaped on the under surface close to the middle line, between genio- and hyo-glossi. Use: to shorten the tongue, curving the point downwards.

2. *Transversus,* springs from the fibrous septum in the centre of the tongue; its fibres cross each other; lies between the two *longitudinales.* Use: to narrow, elongate, and point the tongue.

193. 2. *Stylo-glossus.*

Pos.: obliquely inwards, downwards, and forwards, partly on the borders, partly transverse in the tongue. Externally lie: *M. stylo-hyoides, Parotis, M. pterygoid. intern., Gland. sublingual,* *N. lingualis,* mucous membrane of the tongue. Internally: *Lig. stylo-hyoid., Tonsilla, M. constrictor pharyng. super., hyo-

Nerves: hypoglossus.

194. 2. Hyo-glossus (Basioc-, Kerato-, Chondro-glossus).


Pos.: close above M. genio-hyoides, horizontal, beneath the oral mucous membrane and the tongue. On the inside both meet together. Outside: Gland. subling., N. hypogl., and the muscles before mentioned. Fig.: thick, three-sided, large. Or.: chin (spina interna). Ins.: tongue. The posterior fibres pass to the hyoid bone, the anterior curved from the root to the apex of the tongue to the m. lingualis. Use: both extend the tongue forwards, draw it again backwards, and press it together to form a furrow.

Nerves: (three to four) lingual, trigemini, glossopharyng. and hypoglossus.

196. 5. Constrictores pharyngis, three constrictors of the pharynx,

form the posterior, muscular parietes of the pharynx, in the centre of which they meet together in a white line [raphe] formed of fibro-cellular tissue. From behind we first see:

a. Constrictor pharyngis inferior, the strongest of the three muscles, extending the lowest downwards. Its fibres pass from the raphe downwards, outwards, and forwards, blending immediately with those of the oesophagus (see Splanchnol.), and reaching above to the constrictor superior. Inferior attachments:


Nerves: glosso-pharyngeus and vagus.

197. 6. Stylo-pharyngeus (s. levator pharyngis).

Pos.: oblique from above, downwards and inwards, between m. stylo-hyoid and digastricus (behind) and m. stylo-glossus (before). Externally lie, m. stylogloss., carotis externa and parotis; internally, carotis intern. and V. jugular. int.; along the outer side, n. glosso-pharyngeus. Or.: round, from Proc. styloideus (inner surface). Ins.: between the fibres of mm. constrictor sup. and med., the last of which covers it. Use: to raise and widen the pharynx above the hyoid bone.

Nerves: glosso-pharyngeus.

198. 7. Levator palati mollis (s. peristaphylinus internus s. petro-salpingo-staphylinus).

Pos.: obliquely inwards, forwards, and downwards on the ala interna of Proc. pterygoideus. Or.: the petrous bone (apex) and cartilaginous portion of tuba Eustachii. Ins.: between the layers of the soft palate, behind m. pharyngo-palatinus. Use: to draw the velum pendulum palati upwards towards the posterior nasal openings, by which these are contracted, and the passage of the fauces widened.

199. 8. Circumflexus s. tensor palati mollis (s. peristaphylinus externus, sphen-o-salpingo-staphylinus).

Pos.: close to the outer side of the last, separated by the ala interna Proc. pteryg.; the tendon passes away below the Hamul. Proc. pterygoïd. inwards, at a right angle. Or.: Proc. spinosus of sphenoid bone, tuba Eustachii (cartilage). Ins.: before the last, with a thinner aponeurosis. Use: both draw the velum-palati in a transverse direction, outwards. Whether it serves this purpose, or for widening the posterior nasal openings and the tuba Eustachii, is doubtful.

200. 9. Azygos uvulae (s. palato-staphylinus [s. levatores uvulae.])

Pos.: vertical in the uvula, below the last. Or.: spina
nasalis posterior. Ins.: mucous membrane of uvula. Use: to raise, shorten, and also curve the uvula.

20. Glosso-palatinus (s. constrictor isthmi faucium.)
Pos.: in the anterior palatine arch [or pillar of the fauces], between the palate and tongue, small and narrow. Or.: the sides of the root of the tongue (m. styloglossus). Ins.: the soft palate (blending with m. pharyngo-palatin). Use: to approximate the palate and tongue, and thereby contract the fauces.

202. 11. Pharyngo-palatinus (s. constrictor isthmi faucium superior).
Pos.: in the posterior palatine arch, below, m. levator palati (above); internal to the other palatine muscles, covered by the mucous membrane. Or.: from the posterior border of the thyroid cartilage ascending behind the tonsil glands. Ins.: the soft palate (m. levator and circumflexus palati). Use: to draw the soft palate down, or the posterior wall of the pharynx upwards (as in swallowing).

C. Deep Cervical Muscles.

a. Anterior.

203.

1. Longus colli.
Pos.: on the anterior lateral surfaces of the vertebra, behind: Pharynx, Æsophagus, Art. carotis and Ven. jugular intern., nn. vagus and sympathicus. Or.: from the ninth to the sixth vertebral body and transverse processes with an inferior and superior portion.
Ins.: the anterior surface of the fifth to the first vertebral body (tuberculum atlantisanticum). Use: to flex the neck (and head), if both act; one alone acting draws it in such a direction that the face looks to the opposite side.

204. 2. Rectus capitis anticus major.
Pos.: close, external to and above the last muscle, before m. rect. capt. ant. minor. Or.: from the front of the Proc. transvers. verteb. from the third to the sixth. Ins.: close in front of for. magn. occipit. Use: to flex and rotate the head somewhat sideways.

205. 3. Rectus capitis anticus minor.
Pos.: oblique, behind and next to the last muscle, behind the Ganglion I. cervic. n. sympathici; in front of the articulation of the atlas with the occipital bone. Or.: Atlas (radix. anter. proc.
b. Lateral.

206. 4. Rectus capitis lateralis.

Pos.: vertical (behind, V. jugularis, before, Art. vertebral.); behind the pharynx, before obliqu. caput super., to the inside of biventer maxillae. Or.: Proc. transvers. Atlantis, outside the last muscle. Ins.: os occipitis; between foram. jugulare and stylo-mastoid. Use: bends the head to the side.

207. 5. Scalenus anticus.

Pos.: below and behind Musc. and Ven. subclavia, above and behind m. sterno-mastoid, Omo-hyoid., n. phrenicus, art. cerv. trans. and ascend.; before, a triangular space, at the base of which, below, Art. subclavia; in the apex: Plexus brachialis. Internally, Art. vertebr. and m. longus colli; externally, scalen. med.; rests upon the apex of the pleura. Or.: Proc. trans. verteb. 3 to 6. Ins.: Costa I. (superior border) even to the centre. Fig.: conical, the apex above. Act.: bends the neck forwards; or raises the first rib.

208. 6. Scalenus medius (the strongest of the three supporters of the ribs).

Pos.: behind the last muscle, Art. subclavia and Plex. brachialis; upon it lie: omo-hyoid, and above, the m. Sterno-cleido-mast. Or.: Proc. transv. Vv. 1 to 7 (the anterior tubercles). Ins.: Costa I. (superior border, outside the last muscle), and Costa II. Use: to raise the first and second rib; to incline the neck laterally; both fix the neck.

209. 7. Scalenus posticus.

Pos.: behind and outside the last muscle, before, cervical. descendens. Or.: Proc. transv. Vv. 5 to 7. Ins.: Costa II. (behind the centre). Use: bends the neck sideways, or raises the second rib.

Nerves: (1—7) rr. anterior.rr. n. cervicall.

210. Fascia cervicalis.

Arises from the anterior belly of digastric. as far as the chin, from the os. hyoides, from the lower jaw, below gland. submaxillar., to the angle between it and Parotis; from proc. styloid. and its muscles. Insertion: the superior border of the chest. Position: covered by platysmam. and jugularis extern.; upon the
muscles of the hyoid bone and larynx, between, upon, behind and external to the *Sterno-cleido-mastoidei*. We distinguish:

a. **Superficial layer**, fixed to the *lig. interclavicular., manubr. sterni*.

b. **Deep layer**, passing away behind the *sterno-cleido-mastoidei*; it forms a sheath for *jugular. interna* and *carotis commun.*, enveloping and attaching the omo-hyoid to the superior border of the first rib; and uniting itself with the fibro-cellular tissue upon the *scalecti and levator scapulae*, which is:

211. **c. Fasciculus prævertebralis**, which surrounds the *longus colli* and *rect. capitis. antic. major*, contains below much fat and fills up the *fossa supracleavicularis*. It attaches itself to the superior part of the clavicle as far forward as the *acromion*, and forms a boundary between the *fossa supracleavicular* and the cavity of the axilla; behind, it embraces the *cucullare* [Trapezius m.]. Anteriorly it is covered by *Trachea, pharynx*, and *æsophagus*.

### III. Muscles of the Chest, Regio thoracica.

212. 1. **Pectoralis major**, great pectoral muscle.

**Pos.**: beneath the skin and mammae, on the anterior surface of the thorax and before the axilla; covering the *subclavius* and *pect. minor*. **Or.**: 1. *Clavicula* (one-third to one-half of the anterior border). 2. *Sternum*. 3. *Cartilagines Costar.*, 2 to 7. **Ins.**: *Humerus* (spina tubercul. major); between *biceps* (cap. breve) and *triceps*, with a tendon two inches broad, under that of the *Deltoides*. **Use**: to draw the arms inwards, so that they may be crossed over the chest; fixing the humeri, to draw the ribs outwards and expand the thoracic cavity (as in inspiration).

213. 2. **Pectoralis minor** (s. *serratus anticus minor*).

**Pos.**: behind the last muscle, and the *Nervi* and *Vasa thorac.*; its superior border separated from the *Clavicula* by a triangular space, behind which, *Art. axillaris*, separated from *Pectoral. major* and *serratus* by fat. **Or.**: *Costa III. to V.* (superior border and external surface). **Ins.**: *Proc. coracoideus* (internal border and apex). **Use**: to draw the shoulder forwards, inwards and downwards; if this is fixed, to elevate the third to the fifth ribs (in inspirator).

**Nerves**: (1—2) *thoracici, interco.tul., supracleavicular.*

214. 3. **Subclavius** (costa-clavicularis).

**Pos.**: along the inferior surface and behind the *Clavicula*, above the *Vasa axillaria*, *Plex. brachial.* and first *rib*. **Or.**:
first rib. cartilage. Ins.: Clavicula (the external end of the inferior surface). Use: to draw the acromial end of the clavicle downwards, and press the sternal end against the sternum, on which account in fracture of the clavicle the outer end projects over the inner. Elevates also the first rib (m. inspiratorius), the Clavicula being fixed.

Nerves: pectoral. anterr.

215. 4. Serratus anticus major (costo-scapularis).

Pos.: on the side of the thorax, covered, above, by pectorales, below, by latissim. dorsi and the skin, behind, by subscapularis. Or.: Costae 1 to 8, external surface (with nine or ten dentations). Ins.: Basis scapulae (inner lip), above and below very thick; united with rhomboidei and subscapular. by strong fibro-cellular tissue. Use: to draw the scapula forwards and outwards; or the first to the eighth ribs upwards and inwards.

Nerves: thoracici, intercostales.

216. 5. Intercostales externi and interni.

Pos.: in the intercostal spaces. The fibres of the external pass forwards and downwards, those of the internal backwards and downwards. Or.: the inferior border of each rib. Ins.: the superior border of the following inferior rib. Mm. externi reach from the neck of the rib to the cartilage. Mm. interni commence at the angle, terminate at the sternum. Use: both the same. They approximate the ribs, either upwards in fixing the first rib (by means of Mm. scaleni) inspiratio; or downwards in fixing the twelfth rib (by m. quadratus lumb.), exspiratio.

Nerves: intercostales.

217. 6. Infracostales,

variable in number and direction, lying on the internal wall of the chest between ribs and diaphragm, vertical or oblique in shorter or longer striae; and serving to assist the Mm. intercostales.

218. 7. Triangularis sterni.

Pos.: behind the sternum, before the diaphragm; separated from the rib cartilages by Vasa mammaria. Or.: Corp. sterni (the external border) and Proc. ensiform. Ins.: Costae, two to five, together with the cartilages (the inferior border). Use: to draw the second to the fifth ribs downwards.

Nerves: intercostales.
219.  

**Fasciae pectorales.**

1. The intercostal muscles, a fascia cover externally, which is behind the continuations of the *Mm. externi*, before those of the *interni*; in the thorax they are separated by a serous layer from the diaphragm.

2. *F. coraco-clavicularis* (see *f. Humeri*) invests *m. subclavius* and *pectoralis minor*.

3. *F. superficialis*—the *m. pectoralis major*, and the inferior part of *serratus anterior major*.

220.  

IV. **Muscles of the Neck and Back.**

We may distinguish from the skin of the back, forwards, five layers of muscles.

A. **First layer.**

Two muscles.—Origins: *Proc. spinosi*.

221.  

1. *Cucullaris s. trapezius*.

Pos.: on the neck and back: meets along the inner border (*proc. spin.*) with the corresponding muscle of the other side. Its external superior border bounds the *interstit. supra-clavicularare*. Covers above, the *spleenii*, in the centre, the *Rhomboidei, supra-spinatus* and *levator scapul.*, then a portion of the *extensor spinæ* and *latissim. dorsi*. Or.: 1. *Proc. spinosi* of the dorsal vertebrae and *lig. nuchæ*; 2. *Spina occipital. ext.* and *Lin. semicirc. super.* (the inner third). Ins.: *Spina Scapulae, Acrion, Clavicula* (the outer third). Fig.: triangular, the base turned towards *Proc. spin.*; both together quadrangular. Use: to draw the shoulder backwards and inwards; the superior portion draws it upwards, the inferior downwards.

Nerves: *accessor. Willis., cervical. and dorsalis*.

222.  

2. *Latissimus dorsi*.

Pos.: below in the lumbar and sacral region; above and externally behind the cavity of the axilla. Or.: 1. From external ramus of *cristi ilei*, tendinous. 2. From the *aponeur. lumbo-dorsal*, between *crista ilei* and the twelfth dorsal vertebra, fleshy. 3. From *proc. spinosi* of the sixteenth to the nineteenth vertebrae. 4. Fasciculi from the ninth to the twelfth ribs.—All the fasciculi converge towards the axillary fossa. Ins.: *Spina tuberculi minor. oss. humeri* (2" broad), above the tendon of *m. pectoral. maj.*; behind *teres major*, united with it. Use: to draw the
shoulder down, rolling the arm inwards and behind (m. aniscalptor); draws the arm, when raised, downwards, or the trunk towards it, or expands the thorax.
Nerves: dorsales, lumbales, and sacrales.

B. Second layer.

223. Seven muscles; some covering others.—Origin: Proc. spinosi (except m. levator anguli scapulae). Direction of fibres from within, outwards.

224. 1. **Splenius capitis.**

Pos.: oblique upwards and outwards, covered by m. cucullaris and sterno-cleido-mast. Above, before it: trachelo-mastoid., complexus, biventer from without, inwards. Or.: Lig. nuchae (third to the sixth vert.); proc. spin. (vv. seventh to the eighth). Ins.: Proc. mastoides below m. sterno-cleido-mast.; and below Linea semicircular. superior. Use: to rotate the head, so that the face looks towards the same side; both acting together draw it directly backwards.

225. 2. **Splenius colli.**

Pos.: close to the outer side of the last muscle; covered by cucullar. and serrat. post. sup. Or.: Vv. 10 to 12 proc. spin.; connected with the last muscle. Ins.: Vv. first to third proc. transv. Use: to draw the neck (also atlas and head) towards its own side; both extend the neck.

226. 3. **Levator anguli scapulae.**

Pos.: outside the last; above, covered by sterno-cleido-mast. besides by trapezius. Or.: Vv. 1 to 4 proc. transv. (3 to 4 heads) external to the splenius colli, behind the scalen. post. Ins.: Scapulae angulus superior (between rhomboidei and serrat. magn). Use: to elevate the internal superior angle of the scapula (to shrug the shoulders).

227. 4. **Rhomboideus superior s. minor.**

Pos.: transverse between vertebrae and scapula. Or.: Vv. 6 to 7 proc. spinosi (lig. nuchae). Ins.: Bas. scapulae labium externum (the superior part). Use: to draw the scapula inwards and upwards.

228. 5. **Rhomboideus inferior s. major.**

Pos.: below the last m. in a similar direction. Or.: Vv. 11 to 13 proc. spinosi. Ins.: Bas. scapulae lab. extern. (the infe-
rior part). Use: to draw the scapula (particularly the inf. angle) inwards, whereby the shoulder (humeral end) sinks.

229. 6. Serratus posticus superior.
Pos.: covered by the two preceding muscles, meeting anteriorly in the m. scalen. post. Or.: Vv. seventh to the tenth proc. spinos. Ins.: Costae second to the fifth (superior border, in the neighbourhood of the angulus). Use: to draw the second to the fifth rib upwards (m. inspirat.).

230. 7. Serratus posticus inferior.
Pos.: in the lumbar region, anterior to the m. latissim. dorsi, united with its tendon. Or.: Vv. eighteenth to the twenty-second proc. spinos. Ins.: Costae ninth to the twelfth (the inferior border). Use: to draw the ninth to the twelfth ribs backwards and downwards, and to fix them.

Nerves: (first to the seventh) rr. posterr. nn. spinalium.

231. C. Third layer.
Pos.: in the posterior fossa of the vertebral column, between proc. spinosi and transversi, or anguli costarum, separated from the layers 1 and 2 by fasc. lumbo-dorsal. Or.: Proc. transversi.

Pos.: covered above by diaphragm, below by splenii and serrat. sup.; lies upon semi-spinal cervic. and complexus. Or.: Vv. ninth to the fourteenth proc. transvers. (Apex). Ins.: Linea semicircular. superior. (in the centre), united with m. complex. cervic.—The tendon between separates the superior and inferior belly. Use: to draw the head backwards and rotate it a little; both extend it.

233. 2. Complexus cervicis.
Pos.: outside, close to the last m., covered by it, the splenii and trachelo-mast. Or.: 1. Vv. eighth to the tenth proc. transv. 2. Vv. third to the seventh proc. obliqui. Ins.: below linea semicircular. superior. between trachelom. and the central line. Use: to draw the head backwards and rotate it more strongly than the last.

234. 3. Trachelo-mastoideus.
Pos.: external to the last, and before it; below covered by splenii and lev. scapulae. Or.: 1 Vv. seventh to the eleventh proc. transv. 2. Vv. fourth to the sixth proc. obliq. with seven fasciculi. Ins.: Proc. Mastoid. (posterior part). Use: to draw the head backwards and sideways.
235. 4. Transversalis cervicis.

Pos.: external to and (above) before the last; united below with m. longissimus dorsi. Or.: Vv. eighth to the fourteenth proc. transv. Vv. fourth to the seventh proc. obliq., with seven fasciculi. Ins.: Vv. second to the sixth proc. transv. Use: to incline the neck sideways.

236. 5. Cervicalis descendens.

Pos.: lateral in the neck, before the last muscle, and behind musc. scalen. post. Or.: Vv. fourth to the sixth proc. transv. Ins.: costae third to the sixth (the superior border, opposite the angle). Use: to draw the neck sideways; or raise the third to the sixth ribs.

Nerves: rr. posterr. nn. cervicall. (from the first to the fifth).

237. 6. Longissimus dorsi.

Fig.: three-sided, below thick. Pos.: external to spinal. dorsi, internal to ilio-costalis, behind multifid., semispinalis, levator. costar., covered by fasc. ilio-dorsal and serrati postici, along the vertebral column, the neck excepted. Or.: tendinous from proc. spin. of Sacrum and the three inferior lumbar vertebrae, fleshy from the posterior part of fossa ovalis oss. ilei. Ins.: a. internal fasciculi to the lumbar vertebrae and proc. transv. of all the dorsal; b. external fasciculi to the proc. transv. of all the lumbar vertebrae and to the twelfth to the second ribs (the lower border). Use: to extend the lumbar and dorsal portions of the vertebral column, drawing the chest downwards.

238. 7. Ilio-costalis (s. sacro-lumbalis).

Fig.: long. Pos.: upon the longiss. dors. external to it, on the lumbar vertebrae and behind the ribs, ascending internally to angul. cost.; covered posteriorly by fasc. lumbo-dorsal. and serrati postic. Or.: a. labium extern. crist. ilei; b. from the origin of longiss. dorsi on the third to fifth lumbar vertebrae; c. from the sixth to the seventh inferior ribs (superior border). Ins.: first to twelfth ribs (inf. border of angle). Use: to draw the ribs downwards. The continuation forms cervical. descendens. [The origins, c, pass, also, under the name of musculi accessorii ad sacro-lumbalem.]

Nerves: (sixth to the seventh) rr. postt. nn. intercostt. and lumball.

D. Fourth layer.

Origins: proc. spinos. or transv. Ins.: proc. spinosi.
1. **Spinalis dorsi.**

Pos.: between proc. spin. and longiss. dorsi; upon multifidus, covered by serrati post. Or.: Vv. seventeenth to the twenty-first proc. spin. Ins.: Vv. fifteenth to the ninth proc. spinos. Use: to extend the back.

2. **Spinalis cervicis.**

Pos.: in the neck, close to proc. spin. Or.: Vv. eighth to the ninth proc. spin. Ins.: Vv. third to the second proc. spin. Use: to extend the neck.

3. **Semispinalis dorsi.**

Pos. before m. longissim.; behind multifid.; below and internal: spinal. dorsi; above and external: semispinal. and biventer cervicis. Or.: Vv. thirteenth to the eighteenth proc. trans. Ins.: Vv. tenth to the fifth proc. spin. Use: to draw the back obliquely backwards.

4. **Semispinalis cervicis (s. colli).**

Pos.: before m. biventer, behind multifidus. Or.: Vv. eighth to twelfth proc. transv. Ins.: Vv. fifth to the second proc. spin. Use: to draw the neck obliquely downwards and backwards.

5. **Levatores costarum s. supracostales.**

a. breves, twelve.

Pos.: before m. longiss. dors. and ilio-costal., and cervic. descend., behind the diaphragm in the post. part of the intercostal spaces. Or.: Vv. seventh to the eighteenth proc. transv. Ins.: Costæ, first to the twelfth (the superior border of the posterior part). Use: to draw the ribs backwards and upwards.

b. longi, four.

Or.: Seventh to the tenth proc. transv. Ins.: ninth to the twelfth ribs.

Nerves: rr. postt. nn. cervicall. and dorsall. (from first to the fifth).

E. Fifth layer,
close upon the vertebral column in the spaces between the processes. Small muscles.

1. **Rectus capitis post. major.**

Pos.: before complexus upon the post. arch of the Atlas. Or.: Proc. spin. epistroph. (dentatus). Ins.: Linea semicircular. infer. 1" broad, near the middle line. Use: to extend the head.
245. 2. Rectus capitis posticus minor.

Pos.: internal and close to the last, before and covered by it.
Or.: Atlas (tuberc. post.). Ins.: Linea semicircular. inferior. [In the fossa below this.] Use: to extend the head.

246. 3. Obliquus capitis superior s. minor.

Pos.: external and close to the last muscles, oblique. Or.: Atlas (proc. transv.). Ins.: Os occiput (between the lin. semic. infer. and superior,) behind proc. mastoid. Use: to draw the head backwards, or rotate it towards the opposite side.

247. 4. Obliquus capitis inferior s. major.

Pos.: oblique, outwards and upwards, covered by complex. and trachelo-mast. Or.: Epistropheus (on the side of proc. spinos.). Ins.: Atlas (proc. transv.). Use: to rotate the Atlas (with the head and face) towards its own side.

248. 5. Multifidus spinæ.

Pos.: between the spinous and transverse processes of the entire vertebral column; immediately upon the vertebrae (and rotatores dorsi; covered by longiss., spinalis dorsi, semispin. dorsi and cervicis, complexus. Or.: Lateral parts of the Sacrum; proc. transv. (inferior vertebrae) and obliqui (in the neck). Ins.: proc. spinosi (superior vert.). Use: the separate fasciculi rotate the vertebrae; the entire muscle extends the column.

249. 6. Interspinales.

In the spaces between the Proc. spinosi, of the cervical (second to the seventh) and lumbar vertebrae. Use: to extend the vertebral column.

250. 7. Intertransversales.

In the spaces between Proc. transversi; in the neck: externi and interni (generally wanting in the back). Use: to draw the vertebrae, and consequently the column, sideways.

251. 8. Rotatores dorsi.

Pos.: covered by multifidus spinæ, on the dorsal vertebrae, transverse. Or.: proc. transversi (superior border). Ins.: Arch of the vert. next above.

Nerves: rr. posterr. nn. spinalium (from the first to the eighth).
THE MUSCLES.

Fascia.

252. 1. Fascia nuchae, between the first and second layer of cervical muscles, blends before with the cucullar, in the fascia cervicalis, behind in the lig nuchae. 2. F. lumbo-dorsalis. a. Superficial posterior layer, connected above with the last mentioned, descends from the spinous process of the tenth vertebrae to the last Sacral, attaching itself externally and below to the Crista ilei, externally and above to the angul. post. scapulae; is covered above by Mm. cucullaris, rhomboideus and latissim. dorsi, below only by the skin of the back. b. Deep, anterior layer, between the twelfth rib and crista ilei, forms between Proc. transv. vertebrae lumbalis and the twelfth rib a tendinous crescentic margin, and with the superficial layer a triangular sheath for the third and fourth layers of muscles.

V. Abdominal Muscles, Mm. abdominales.

253. 1. Obliquus abdominis externus s. descendens.

Pos. in front and on the side of the abdomen, close behind the skin, broad and four-sided, oblique; before the following muscles, the anterior portion of the seventh and eighth last ribs; covered on the posterior border by latissim. dorsi. Or.: Fifth to the twelfth ribs (with seven to eight attachments forming dentations with M. Serratus magnus) 2 to 3" broad from the inferior border, fleshy. Ins.: 1. the crest of the Ilium (lab. extern.); 2. the linea alba, with a wide aponeurosis. Direction of the fibres from above downwards and from behind forwards. Use: 1. contracts the abdominal cavity; 2. draws the ribs downwards, and thereby flexes the thorax; or, 3. if this is fixed, the pelvis (m. expiratorius).

254. 2. Obliquus abdominis internus s. ascendens.

Pos.: behind the last m. covering the following; before broader than behind, where it reaches to the spinous processes; the fleshy part at the side of the abdomen. Or.: fleshy from the anterior third of the crista ilei and lig. Poupartii. Ins.: Tenth to the twelfth rib cartilages (the inferior border); and internally, Linea alba, with a broad tendon. Use: the same as the preceding muscle.

255. 3. Transversus abdominis.

Pos.: transverse around the abdomen, from proc. ensiform. as ar as symphysis pubis, on the lumbar vertebrae between ilio-costal. and quadrat. lumborum, separated from the diaphragm behind it by fascia transversalis. The fibres pass directly from
within outwards, connected above with the *diaphragm* and *tri-
angularis sterni*. Or.: 1. *Cartil. costae*, seventh to the twelfth
(the internal surface); 2. *Crista ilei labium internum* (two-thirds)
and *Lig. Poupartii*; 3. *Proc. transversi* of the lumbar vert.
Ins.; fleshy above to *proc. ensiform.*, tendinous to *linea alba.*
Use: to contract the abdominal cavity (in defecation and expira-
tion) stronger than the two preceding muscles.

256. *Arcus cruralis, s. ligamentum Poupartii, s. Fallopiae.*

The inferior sharp border, reflected backwards, of the tendon
of *obliq. extern.*, which passes obliquely from without and above,
inwards and downwards between *Spina ilei ant. sup.* and sym-
physis *pubis*, for two inches in width from *Spina Ilei*, firmly
attached to the *fasc. iliaca*, and extended like a pillar, bounds
anteriorly a triangular space, the posterior limit of which is formed
by the *os ilei* and *pubis*. This space is filled up—commencing
on the outside, with: *M. Psoas* and *iliacus, Nerv., Art. Ven.,
cruralis, m. pectineus.*

The *fascia femoris* is attached to the inferior sharp border; the
free border of the reflected portion is firmly connected externally
to the *fascia iliaca*, internally to the *fasc. transv.* Between the
two borders lies a channel above concave, which is the floor of
the *Canal. inguinalis*. It first commences on the internal border
of *m. psoas*. Before the attachment to the *Symphysis pubis*,
the *lig. Poupart.* divides into two crura or pillars, between which
the triangular abdominal ring (*annulus abdominalis*) serves as an
entrance into the inguinal canal. The superior, internal pillar,
*crus internum*, broader and longer, passes away over the *Sym-
physis pubis* by the *Spina*, and then decussates with similar
fibres from the other side. The inferior pillar, *crus externum,*
is roundish, attaches itself to *Spina pubis* of its own side, and is
connected with the *crista pubis* by means of:

257. *Lig. Gimbernati*, a triangular, horizontal, tendinous
band (about half an inch long), the external, concave, almost
sharp border of which forms the internal boundary of the *annu-
lus cruralis*. From its superior surface a tendinous band passes
to the *fascia femoris*.

258. *Annulus abdominalis* and *inguinalis externus*, abdomi-
al, external inguinal ring, between the crura of *Lig. Poupartii*
on the *Symphysis pubis*, oval or triangular, the apex directed
upwards and outwards, covered anteriorly by the delicate *fasc.
superficialis* [fascia *spermatica extern.*], formed behind of fibres
from *obliq. intern. transversalis*, and *fasc. transv.*., is the ex-
ternal opening of:

259. *Canalis inguinalis* (for the spermatic cord of the male,
the round ligament in the female), which perforates the anterior abdominal parietes formed of the three preceding muscles, is $1\frac{1}{2}$ to $2"$ long, and passes in the direction of lig. Poupartii, obliquely from above, outwards and backwards, downwards, inwards and forwards. *M. obliq. extern.* forms its inferior and anterior wall, its posterior the *fasc. transv.* and tendinous fibres of *oblq. intern.* and *transv.* (towards the annul. abdominal.); its superior, the inferior borders of *mm. obliq. intern.* and *transv.* The interior of the canal is lined by *fasc. trans.* [*fasc. spermatica intern.*], which continues down into the scrotum as a common envelope of the spermatic cord and testicle. Behind it opens into the abdominal cavity by means of the irregular

260. *Annulus inguinalis internus* (at a distance of $2"$ from the *spina ilei sup.*), on the internal semilunar sharp border of which (*plica semilunaris* of the *fasc. transv.*) the *Art. epigastria* passes upwards and inwards. Through this ring, in the mature foetus, the testicle, together with the spermatic cord, passes out from the abdominal cavity into the inguinal canal, and thence into the scrotum. At birth the *annul. inguinal. intern.* and *extern.* lie close behind one another.

251. *Linea alba* is the white stripe found in the central line of the abdominal parietes, in which the aponeuroses of the lateral abdominal muscles are associated together (or decussate, Velpeau), which passes downwards from *Proc. ensiform.* as far as *Symph. pubis,* between the *mm. recti,* above the umbilicus 3 to $2"$, at it $\frac{1}{2}"$, below it $1"$ broad. The navel ring, *annulus umbilicalis,* is a large (rhombic, Velpeau) opening in about [below] the centre, through which in the (new-born) infant the umbilical vessels (frequently also portions of intestine) pass. On the anterior surface the white line is stretched by the *m. pyramidalis;* on the posterior surface it is strengthened by the *lig. triangulare s. administrum lin. albae,* the apex upwards.

Nerves: (first to the third) *intercostales, lumbales, iliohypogastric.*

252. 4. *Rectus abdominis.*

Pos.: close to [the outer side of] the *linea alba* [on the inside of *linea semilunaris,* a curved tendinous line, extending from the cartilage of the eighth rib to the tuberosity of the os *pubis,* in the very strong vagina recto-abdominalis. Fig.: elongated, flat, with two to six tendinous transverse striae, *inscriptiones tendine.* Or.: *Symph. oss. pubis* (with two tendons). Ins.: fifth to seventh rib cartilages (anterior surfaces), *Proc. ensiform.* Use: to compress the abdominal viscera; to draw the sternum and the fifth to seventh ribs downwards (*exspiratio*), or, to flex the pelvis.
5. Pyramidalis abdominis.

Pos.: before the inferior extremity of the preceding muscle, close to the linea alba, covered by the anterior layer of its sheath. 
Or.: Symphys. pubis (the superior border); broad. 
Ins.: Linea alba, between umbilicus and symphysis; pointed. Use: to stretch linea alba.

Nerves: (fourth to fifth) iliohypogastricus.

6. Cremaster s. tunica erythroides.

Pos.: in front and on the side of the spermatic cord (in the canal inguinalis); thin, long. 
Or.: Spina pubis and M. obliq. intern. 
Ins.: Tunica vaginal. commun. funical. sperm. et testiculi. Use: to draw the testicle upwards, pressing the spermatic cord.

7. Quadratus lumborum.

Pos.: along the lumbar vertebrae, in a strong tendinous sheath, behind the kidneys, the colon, psoas and diaphragm muscles; between the Ilium and last rib; covered behind by the tendon of transversalis. 
Or.: 1. Crista iliæ labium intern. (the posterior part); 2" broad; 2. Lig. ileo-lumbale; 3. Proc. transv. of the lumbar vertebrae. 
Ins.: twelfth rib—the inferior border of the posterior extremity. Use: to draw the twelfth rib downwards (exspiratio); inclining the vertebral column sideways, or the pelvis.

Nerves: lumbales.

8. Diaphragma.

This is the transverse, muscular, dome-shaped, vaulted partition which separates the thoracic from the ventral cavity. It is tendinous in the centre (pars tendinea), fleshy in the periphery (p. carnosaa), which is attached to the ribs (p. costal.) and to the lumbar vertebrae (p. lumbal.).

Attachments: a. the bodies of the second to the fourth lumbar vertebrae (anterior surface).

b. Sternum and Proc. ensiform.; cartilage of the seventh to the twelfth ribs (posterior surface).

a. Pars lumbalis consists of six (three on each side) crura.

a. Crura interna, strong, arise from the third to the fourth lumbar vertebrae; between them lies:

aa. hiatus aorticus (for aorta, ductus thoracicus, vena azygos), 3" long, 1" broad, rather to the left of the central line.

The internal crura cross each other before the parts above mentioned, and in this way form the

ββ. Foramen esophageum for the (oesophagus, nn. vagi, and continuation of
the pleura), 2" long, 3 to 4" broad. The crura then pass into the tendinous centre.

5. *Crura Media* arising from the sides of the second lumbar vertebra, or from lig. intervertebrale, uniting above with the internal and external crura, passing into the *centr. tendin.* become perforated by *N. splanchnicus minor.* Between the central and internal crura pass through: *Nn. splanchnici maj.* between the central and external: *Nn. sympathici, Vena hemiazygos* upon the left and *Vena azygos* sometimes upon the right side.

6. *Crura externa,* very short, arise from the *first lumbar vert.* (side of the body); are united with *lig. vertebro-costale* before *m. psoas,* and *quadrat. lumb.,* losing themselves in the *Centr. tendineum.*

b. *Pars costalis* (and *sternalis*), see under "Attachments." Upon either side six fleshy heads from the rib cartilages and two from the *Proc. ensiformis* pass inwards towards the *Cent. tendineum,* which on the four inferior ribs are connected with *m. transv. abdom.* Quite in front is found a small triangular interspace in which the *Pleura* and *Peritonaeum* come in contact.

c. *Centrum tendineum s. speculum Helmontij,* the central tendinous portion, in shape like a trefoil leaf, is the most elevated portion of the diaphragm, on a level with the fifth rib (at the sternum), on the right side (over the liver) arched. In it, to the right of the central line, we find the *foram. quadrilaterum* (1 to 1 1/2" diam.), through which aperture the *V. cava inferior* ascends from the liver to the right ventricle of the heart, and the pleura and peritonæum come in contact.

The superior (thoracic) surface, which in the foetus is much more vaulted than after birth, when the lungs have fairly responded, is covered by Pleura and Pericardium, and serves for the support of the lungs and heart.

The inferior surface is covered by peritonæum, except at the point corresponding to the obtuse border of the liver (*lig. coronar. hepat.*). On the right lies the liver, left the spleen and fundus of the stomach.

Use: the diaphragm, as it contracts, widens the thoracic and diminishes the abdominal cavity. Thus in inspiration and in the evacuation of the contents of the intestines.

Nerves: *phrenicus,* branches of *Vagus, lumbal., intercostal., sympatheticus.*

**Fasciae Abdominales.**

267. 1. *Fascia superficialis abdominis* covers the anterior surface of the abdominal muscles, is thin upon the fleshy parts, firmly attached and thick upon the tendinous, particularly below the navel, consists of fibro-cellular tissue interwoven with tendinous and elastic fibres; passing before the *annul. abdomin.* over the spermatic cord into the Scrotum, it goes to join the *fasc. femor. superficialis.*
268. 2. Fasc. transv. abdominis mounts upwards from lig. Poupartii between the abdominal muscles and peritoneum; is below, particularly at the lig. Gimbernati, the strongest where a posterior layer (from the spina pubis as far as the internal boundary of the internal inguinal ring) ascends almost vertically, whilst an anterior layer passes obliquely outwards and upwards, and forms the external boundary of the internal inguinal ring. (On account of the strength of this fascia internal [direct] inguinal herniae are rare.)

269. 3. Vagina m. recti, passes outwards from the linea alba, encloses both recti abdom., splits at their external border, receives between the divisions the mm. obliq. extern., intern., and transv., and passes over into fasc. transversalis. The posterior layer above (before the rib cartilages) and below becomes somewhat separated, and terminates in the centre between the navel and symphysis, with a border concave below, linea semicircular. Douglasii.

VI. Muscles of Anus and Perineum.

Mm. ano-perinales.

270. 1. Sphincter ani (externus et internus).

Pos.: oval, round about the inferior extremity of the rectum; about one inch high. Sphincter ani internus is nothing but the last (white) circle of the muscular fibres of the rectum. Or.: 1. The lowest circle, that is externus before the coccyx from the fibro-cellular tissue beneath the skin; 2. The superior circle from the fibrous membrane at the apex of the coccyx. Ins.: 1. In the subcutaneous fibro-cellular tissue, pointed. 2. The fibrous raphé on the anterior boundary of the rectum. Use: closes the anus, and assists the urethra, compressing it behind.

271. 2. Transversus perinæi (superficialis et profundus).

Pos.: nearly transverse before the anus, close above the skin, behind levator ani; forms the posterior border of a triangle the external border of which is m. ischio-, the internal bulbo-cavernosus. It covers the bulbus urethrae above. Perin. superfic. is the posterior; profundus the anterior portion. Or.: tuber Ischii (internal surface—close below ischio-cavernosus). Ins.: tuber Ischii, the other side connected with sphincter ani and bulbo-cavernosus. Use: presses the anterior wall of the rectum towards the posterior, as in defæcation.

272. 3. Coccygeus s. ischio-coccygeus.

Pos.: flat, triangular at the inferior extremity of the pelvis; covered by M. glutæus max. at the post. border of the m. leva-
tor ani, with which it forms the floor of the pelvis. Or.: tendinous from Spina Ischii and lig. spinos o-sacrum. Ins.: Os coccygis (border and anterior surface), Os sacrum (apex). Use: assists in bending the coccyx forwards; both acting together fix it (in ejection of the semen).

273. 4. Curvator coccygis.
Pos.: upon the anterior surface of the coccyx, mostly tendinous. Or.: from the sides of the apex of the os sacrum. Ins.: apex of coccyx. Use: to bend the coccyx.

274. 5. Extensor coccygis.
Pos.: upon the posterior surface of the coccyx, mostly tendinous. Or.: from the apex of os sacrum spin. ilei poster. infer. Use: to draw the coccyx backwards.

Pos.: before the preceding muscle, anteriorly narrow, behind broad; four-sided; covered by fascia pelvis; below, by sphincter ani, and behind by M. glutaeus max.; before, by M. obturator intern. Between the anterior borders of the two decussating muscles and the pubic arch a longitudinal fissure remains, through which the urinary and genital organs pass out. Or.: 1. ramus descend. pubis (internal surface), as far as, 2. Spina Ischii. Ins.: 1. the sides of the Prostata, urinary bladder, and the Rectum. 2. the apex of the coccyx as far as sphincter ani. M. pubo-urethralis, a thin fasciculus which passes to the urethra. Use: draws the anus backwards and upwards, expands it (in the act of defecation), likewise the coccyx, contracting the pelvic outlet. [Or.: from a fibrous cord extending from the body of the Pubis to the spine of the Ischium.]

276. 7. Ischio-cavernosus, s. erector penis, s. clitoridis.
Pos.: close to the ram. ascendens oss. ischii; covered below by fibro-cellular tissue, above by corp. cavernosum; internally lies M. bulbo-cavernosus, separated from it by a triangular space. Or.: tuber ischii and ram. ascendens. Ins.: Corp. cavernosum penis; to the entire length of the Crus. Use: presses the root of the Penis against the bones, maintaining the already erect organ in a direction forwards; does not compress, but widens the root of Corp. cavernosum penis.

277. 8. Bulbo-cavernosus s. accelerator urinæ [s. ejaculator seminis].
Pos.: before the anus, below and along the bulbus and the
portio spongiosa of the urethra, which it surrounds like a kind of sheath, below covered by the skin of the perinæum. The internal borders of the two muscles meet together. Or.: lig. perin. triangular., sides of bulbus and corp. cavern. urethræ, and penis. Ins.: Corp. cavernosum urethræ; pubo-cavernosus s. levator penis, anterior portion of bulbo-cavernosus; sometimes appears, isolated, between the lig. suspensor penis and the perinaeal muscles.

[The fibres of the larger portion of this muscle form a canal through which the bulbus corp. spong. and a portion of corp. spongiosum urethræ pass. The origin of this portion of the muscle is the tendinous layer between Corp. spongiosum and the under surface of corpora cavernosa, whence the fibres descend, embracing the sides of the spongy body and bulb, and unite below in the central line or raphe, which posteriorly consists of very condensed tissue. The fibres of the smaller portion arise from the pubes by the sides of the lig. suspensor penis, and, descending upon the outer borders of the crura penis, from which likewise a few fibres arise, they unite in the middle line of, and beneath, the corp. spongiosum urethræ anterior to the fibres of the larger portion. The posterior extremity of the muscular tube is applied to the anterior surface of the deep perinaeal fascia. Trans.]

Use: to compress the bulb. urethræ and corp. cavernosum urethræ, to contract the canal of the urethra, urging forward the urine or semen by jerks, or restraining their passage.

278. 9. Constrictor cunni s. vaginae.

Pos.: circular around the entrance into the Vagina. Or.: M. sphincter ani and transv. perinæi. Ins.: Crura clitoridis (inferior surface). Use: to contract the Vagina. [Or.: from the under surface of crura clitoridis meeting below, after having embraced the sides of the vagina and nymphæ.]

279. 10. Constrictor urethræ.

Pos.: below lig. perinæale about the pars memb. urethræ. Between it and transv. perin. (profund.), the glands of Cowper. Or.: os Ischii (ram. ascendens). Ins.: isthmus urethræ (sides). Use: to compress, and shorten the membranous portion of the urethra.

280. 11. Vesicalis s. depressor vesicæ.

Pos.: at the inferior part of the urinary bladder. Or.: a. lig. pubo-vesicale; b. lig. ischio-prostaticum. Ins.: close above the Prostate on the anterior and lateral surfaces of the bladder. Use: to draw the bladder downwards (for example, while making water in recumbent position).

Nerves of anal and perinaeal muscles: pudend. common. and haemorrhoid.
281. **Fascia perinæi.**

The general subcutaneous fascia is connected before with Tunica dartos (or the fibro-cellular tissue of the labia), behind with the sphincter ani and coccyx; is near the anus membranous, contains fat, and is placed over the fossa perinæi.

282. a. The proper perinæal fascia (f. p. superficial.) has an anterior and a posterior segment.

1. Anterior segment (aponew. ischio-pubica), from arcus pubis of the Ischium and pubis as far as tuber ischii, covers in the male: m. transv. (superf.), ischio-cavern., and bulbo-cavernos., and passes over anteriorly upon the Penis; in the female it divides anteriorly, covers with the internal layer the constrictor vaginæ, reaches in the labium min. as far as the clitoris; the external lies in the entire length of the labia majora.

2. Posterior segment (upon. ischio-rectalis) connected in front with, 1.; covers the fossa perinæi; the internal layer covers the external surface of the lev. and sphincter ani; the external the posterior part of the obturator intern., and confined below to the tuber ischii, lig. tuberoso-sacrum and glutæus maximus.

Fossa perinæi [Ischio-rectal fossa], a conical fossa, the base of which corresponds with the skin, is formed, anteriorly, by transv. perin., behind by the inferior border of glutæus maximus, internally by levator ani, externally by tuber Ischii. It is filled up with fat and fibrous striae.

283. b. **Lig. perínæale, s. fascia perinæi profunda**, a threesided ligament; closes the anterior portion of the pelvic outlet (as, levat. ani the posterior), is perforated by the urethra; arises from os Pubis and Ischium, between lig. arcuatum (in front) and m. ischio-cavernos. (behind); below nerv. and art. penis. The anterior portion, covered with venous plexuses, lies above and at the sides of pars membran. urethrae (presenting an obstruction in catheterism); the posterior portion lies below the urethra.

284. c. **Fascia pelvis** lines the cavity of the small pelvis. Or.: close before arcus pubis ligamentous (lig. pubo-vesicale), ¼ inch from that of the other side, so that an oval fossa remains between the ligaments and collum vesicæ, where they unite; further, from pars horizontal. of os pubis; at the superior angle of for. obturator. an opening remains (for nerv. and vasa obturator.) ; then from linea arcuata as far as to symphys. sacro-iliaca. Ins.: as far as the origin of lev. ani single; it then divides; the anterior portion passing on the side of the urinary bladder, Prostate (vagina), and rectum; the posterior, behind the rectum, to the middle line, as far as the os coccygis.
VII. Muscles of the Upper Extremity.

A. On the Scapula.

285. 1. Deltoideus, Attollens humeri.

Pos.: envelopes like a cap the head of the upper arm and its superior third; beneath the skin; anterior, external to and behind the shoulder joint, separated from it by a tendinous layer; covers the tendons of pectoral. major and minor, coraco-brachialis, biceps, infraspinatus, teres minor, triceps brachii, Vasa et Nn. circumflexi humeri. The anterior border is separated from the external border of pectoral. major by Vena cephalica. Or.: Spina scapulae, Acromion, Pars acromialis claviculae (as M. cucullaris). Ins.: with three tendons to the extremity of Spina tuberc. majoris oss. humeri, almost in its centre. Use: 1. the central fibres raise the arm directly outwards and upwards; 2. the anterior forwards; 3. the posterior backwards. —The arms being fixed (as in climbing), it draws the scapulae towards them.

—Antagonist: m. cucullaris.

Nerves: axillaris [circumflexus].

286. 2. Supraspinatus.

Pos.: in the fossa supraspinata, below lig. coraco-acromiale, over the roof of the shoulder joint, covered by M. trapezius; above Vasa and Nn. supra scapulares. Or.: fossa supraspinata (the two internal thirds). Ins.: tuberculum majus (at the highest point). The tendon is connected with the articular capsule, separated from that of m. subscapularis by cap. long. bicipitis. Use.: assists in elevation of the arm and rotation outwards.

Nerves: suprascapularis.

287. 3. Infraspinatus.

Pos.: below the spine on the posterior surface of the scapula, covered by latissimus dorsi, cucullaris, and deltoid., and a strong fascia. Or.: fossa infraspinata (the entire surface). Ins.: tuberculum majus (the central fossa); connected with supraspin. and teres minor. Use: to rotate the arm outwards.

Nerves: suprascapular.

288. 4. Teres Minor.

Pos.: on the external border of the scapula, behind the Cap. long. m. tricipitis, before Vasa and Nn. scapular. super. above upon the capsule of the shoulder, covered by deltoid. Or.: margo
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externus scapula (behind), united with the preceding muscle. Ins.: tuberculum majus (inferior fossa); vertical, strong tendon, 1" broad. Use: like the preceding; to draw the arm backwards, and lower it, if raised; prevents the escape of the head of the humerus backwards.

Nerves: axillaris [circumflexus].

289. 5. Teres Major.

Pos.: at the inferior external border of the preceding muscle, before Cap. long. tricipitis; assists in forming the posterior border of the axillary fossa. Or.: Margo extern. and Angul. inferius Scapulae, united with latissimus dorsi. Ins.: Spina tuberculi minoris; two inches broad, behind the tendon of latissimus. Use: to rotate the arm inwards, drawing it backwards towards the central line (like ani sculptor).

Nerves: axillar. and suprascapularis.

290. 6. Subscapularis.

Pos.: on the anterior surface of Scapula, between the external third of which and it; cellular tissue and Vasa and Nn. subscapulares. Before it: M. serratus ant. magn., Vasa and Nn. axillares, Mm. coraco-brachial. and deltoides. Or.: fossa scapularis (two-thirds of the surface). Ins.: tuberculum minus oss. humeri. Its tendon glides in the concavity of Proc. coracoid., between the tendons of M. biceps and coraco-brachialis, as in a pulley. Use: to rotate the arm inwards, drawing it downwards.

Nerves: subscapulares.

Fasciæ Scapulae.

291. 1. F. supraspinata, is firmly attached to the borders of the fossa supráspinata, encloses the muscle, and loses itself externally beneath Acromion and Proc. coracoideus.

2. F. infraspinata, fixed to the borders of fossa infraspin., covers and separates the Mm. infraspin., teres minor and major; loses itself externally in the f. brachialis, since a superficial layer covers M. deltoideus, a deep, the tendon of M. infraspinatus, and attaches itself to the tendon of Caput breve m. bicipitis.

3. F. subscapularis; covers the muscle of the same name, and is connected on the borders of fossa subscapularis with the preceding and with f. lumbo-dorsalis.
B. Muscles of the Upper Arm.

a. Regio humeri anterior.

292. 1. Biceps brachii (flexor radii).

Position: on the anterior internal surface of the upper arm; the heads on the outer side of the axilla, between pectoral. major and deltoïd before, latissim. dorsi and teres major behind; the long head before m. subscapular. Behind its belly: Nerv. musculo-cutan., M. coraco-brachial., brachial. internus; along the internal border: Art., Vv. brachiales, Nerv. medianus. Or.: 1. Caput longum—cavit. glenoid. scapul. (at the upper edge). 2. Cap. breve—Proc. coracoideus (apex). Ins.: tuberositas radii; the tendon is surrounded by Supinator brevis; an aponeurosis passes over from it into the fascia cubiti. Use: to flex and draw the fore-arm rather inwards; stretches the fascia anti-brachii.

293. 2. Brachialis internus, flexor of the elbow.

Pos.: behind the last muscle; upon the inner border: N. Median., Art. brachial., below M. pronator teres; on the outer border: N. radialis and M. supinator longus.

Or.: Os humeri (inner surface); surrounding the insertion of M. deltoideus. Ins.: Proc. coronoideus ulnæ.

Use: flexes the fore-arm, and draws it rather outwards.

294. 3. Coraco-brachialis (s. perforatus Casserii).

Pos.: above, under deltoideus, in the centre between pectoral. maj. and latissim. dorsi, below at a similar elevation as the tendon of deltoideus; covers above, Art. axillar. and brachial., Nn. medianus and musculo-cut., lies below to the outer side of Art. brachialis. Or.: Proc. coracoideus (apex). Ins.: Os humeri (inner border and centre) between anconæus quartus [short head of triceps] and brachial. internus. Use: presses the scapula and humerus towards one another; assists in drawing the arm to the chest. Antagonist to the rotators.

Nerves: (first to third) musculo cutaneus;

b. Regio humeri posterior.

295. 4. Triceps (s. brachialis externus, s. anconæus magnus).

Pos.: on the posterior external surface of the upper arm, separated from the skin by fasc. brachialis, covers the nerv. radialis
and art. humeri profunda. The long head lies before M. deltoid.
and teres minor, behind M. subscapularis, teres major, latissim.
dorsi. Or.: 1. Caput longum from external border of Scapula, close beneath the articular fossa; between teres major and minor.
2. Cap. externum from the external border of humerus to below the centre. 3. Cap. internum from the internal border; as far almost as the condyle. Ins.: Olecranon (posterior surface and lateral borders). Use: to extend the fore-arm.

Nerves: axillar., radialis.

296. 5. Anconæus parvus.

Pos.: behind the elbow, short, triangular, continuation of Cap. extern., M. tricipitis. Or.: close behind Condylus externus humeri. Ins.: the superior external third of the Ulna. Use: to extend the fore-arm.

Nerves: radialis.


A thin muscular fasciculus. Or.: above the fossa intercondyl. poster. Ins.: Capsule of the elbow articulation. Use: to stretch the capsule.

298. Fascia brachialis s. humeri, arises, above, from Clavicular, Acromion, and Spina scapulae, internally, from the tendons of pect. major. and latissim. dorsi and the uniting tissue of the axilla, envelopes the arm and terminates at the articulation of the elbow. It consists almost entirely of circular fibres. The external surface is separated from the skin by vessels and nerves which the fascia provides with sheaths.

From the internal surface two septa (ligg. intermuscularia) pass off, which separate the flexor from the extensor muscles (anconæi), and are attached to the external and internal angles of the upper arm.

299. Lig. intermuscul. externum arises from the anterior border of the bicipital groove, and from the tendon of Deltoides, separating the brachialis intern. from the triceps; is perforated by nerv. radialis and art. brachial. profunda, which, at their commencement, run in the posterior, then in the anterior region of the arm. Lig. intermuscul. intern. by nerv. ulnaris, which runs first before, then behind it. The particular sheaths which pass off from these two large ones are:

1. For M. deltoideus, arises from the posterior border of bicipital groove below teres major, and from the tendon of coraco-brachialis; is thicker and triangular. 2. Sheath between M. biceps and brachialis intern. 3. Canalis brachialis, for Vasa
brachialia and nerv. medianus, forming on the inner side, below the centre of the upper arm a semilunar fissure, receives Ven. basilica and Nn. ulnaris and cutaneus intern., and connects the uniting tissue of the axilla with that at the bend of the elbow.

4. Sheath for caput long. m. tricipitis at the superior half. It is stretched by m. pectoral. maj. and latissim. dorsi.

B. Muscles of the Fore-arm.

a. On the anterior or flexor surface.

a. First layer.

300. 1. Pronator radii teres.

Pos.: oblique from above to below, from within to without; external to M. palmar. long. and flex. carp. radialis; covered by N. median. and Art. ulnaris. Or.: Condylus internus humeri [and ulnar border of coronoid process]; externally M. brachialis intern. and biceps. Ins.: Centre of the radius (in front and on outside) covered by M. supinator longus. Use: rotates the radius inwards. [Nerv. median. perforates the muscle.]

Nerves: medianus.

301. 2. Flexor carpi radialis (s. radialis internus).

Pos.: next to the last described muscle, internally; with a strong tendon projecting out beneath the skin, on its external border the Art. radialis (Pulse). Or.: Condyl. intern. humeri; internal to M. pronat. teres. Ins.: Basis of os. metacarp. II. Use: to flex the hand towards the radial side.

Nerves: medianus.

302. 3. Palmaris longus (sometimes wanting).

Pos.: the spindle-shaped belly in a groove upon flex. digitor. sublim., and close to the last muscle, internally, with a long superficial tendon in a strong sheath. Or.: Condyl. intern. humeri. Ins.: Aponeurosis palmaris. Use: stretches the aponeurosis palmaris and flexes the hand.

Nerves: medianus.

303. 4. Flexor carpi ulnaris (s. ulnaris internus).

Pos.: on the inner border of the Ulna. Art. ulnaris at first beneath it, then along the outer border of its tendon. Or.: Condyl. intern. humeri, and Olecranon (internal border; beneath it nerv. ulnaris). Ins.: Os pisiforme. Use: to flex the hand towards the ulnar side.

Nerves: ulnaris.
β. Second layer.

304 5. **Flexor digitorum communis sublimis** (s. perforatus).

Pos.: beneath the four muscles last described. Covers the following muscle and nerv. medianus; passes under Lig. carpi volar. propr. The four tendons are perforated in the region of the first phalanx by those of the following muscle. Or.: 1. Condyl. intern. hum. 2. Inner side of Proc. coronoid. Ulnæ. 3. Anterior border of Radius. Ins.: Lateral surfaces of Phalanx II. of the second to the fifth finger. Use: to flex the second phalanx of the second to the fifth finger.

γ. Third layer.

305. 6. **Flexor digitorum communis profundus** (s. perforans).

Pos.: beneath the before mentioned muscles, covering the Ulna, in the palm of the hand, the Mm. interossei and adductor pollicis. Or.: 1. Angulus intern. Ulnæ (above and internally). 2. Lig. interosseum (two-thirds). Ins.: Basis Phalang. III. of the second to the fifth finger. Use: to flex the ungual phalanx of the second to the fifth finger.

Nerves: (5) medianus, (6) median. [et ulnaris].

306. 7. **Flexor Pollicis longus**.

Pos.: external and close to the last muscle; covers the radius and lig. inteross. Or.: 1. Margo intern. Radii (three-fourths). 2. Lig. interosseum. Ins.: Basis Phalang. II. of the thumb. Use: to flex the ungual phalanx of thumb.

Nerves: interosseous internus.

δ. Fourth layer.

307. 8. **Pronator quadratus**.

Pos.: at the inferior extremity of the anterior surface of the forearm, close upon the bones, beneath Ar. radialis and ulnaris. Or.: Angul. intern. Ulnæ (the lower fourth). Ins.: angul. anticus et Marg. intern. Radii. Use: rotates the inferior extremity of the radius upon the ulna, thus pronates the hand.

Nerves: interosseous internus.

b. Muscles upon the outer surface of the fore-arm.

308. 9. **Supinator longus** s. brachio-radialis.

Pos.: between the volar and dorsal surface of the arm; in the upper arm, internal and close to it, brachial. intern., separated by nerv. radial., then upon it; covered by the skin, upon pronat. teres, flex. pollic. long., along the inner border, upon the fore-
arm, \textit{Art. radial.}, which commences beneath it. Or.: 1. \textit{Marg. extern. oss. humeri} (inferior one-fourth). 2. \textit{Lig. intermuscular.} and \textit{Condyl. extern.} Ins.: \textit{Basis proc. styloid. Radii.} Use: rotates the radius outwards until, at last, it rather flexes the forearm.

Nerves: \textit{radialis, inteross. extern.}

309. 10. \textit{Extensor carpi radialis longus} (\textit{s. radialis externus longus}).

Pos.: For two-thirds of its length covered above by the last muscle, above and upon the carpus by \textit{M. abductor} and \textit{extensor pollic. long.}, on its inner edge passes \textit{Art. radial.} Or.: \textit{Angul. externus humeri—Lig. intermusculare externum.} Ins.: \textit{Os Metacarpi II.} (Basis, dorsal surface).

310. 11. \textit{Extensor carpi radialis brevis.}

Pos.: beneath the last muscle, covers the outer surface of the Radius; to the inner side of \textit{m. extensor digit. commun.} Or.: 1. \textit{Condylus extern. humeri.} 2. \textit{Fascia cubiti.} Ins.: \textit{Os metacarpi III.} (Basis, dorsal surface). Use: to extend, like the former muscle, the hand, and draw it towards the radial side (that is, it abducts it).

Nerves: (tenth and eleventh) \textit{radial. superfic. and profund.}

311. 12. \textit{Supinator brevis.}

Pos.: broad, on the superior half of the \textit{radius}, winding around it, obliquely from above downwards; beneath \textit{anconeus parvus, extensor digit. commun.} and \textit{carpi ulnar.} Or.: 1. \textit{Lig. laterale extern.} 2. \textit{Margo extern. Ulnæ} (below fossa sigmoid.). Ins.: \textit{Radius} (anterior inner surface one half). Use: rotates the upper half of the \textit{radius} outwards.

Nerves: \textit{inteross. extern.} [This muscle is perforated by a branch of the radio-spiral nerve.]

c. Muscles upon the dorsal surface.

a. Superficial layer.

312. 13. \textit{Extensor digitorum communis.}

Pos.: between \textit{m. extens. carpi radial. breve and ulnaris}, covers \textit{M. supinat. brevis, abduct. long.} and \textit{brevis, extensor long. pollicis, extens. indicis}, the back of the carpus, the metacarpus, and fingers. Or.: \textit{Condyl. extern. humeri.} Ins.: \textit{Phalang. II. and III.} of the second to the fifth finger; four tendons, each of which divides into three portions. The tendon of the second finger is more free than the rest. Use: to extend the second, third, fourth, and fifth fingers.

Nerves: \textit{inteross. extern. and radial. dorsal.}
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14. **Extensor digiti minimi proprius.**

Pos.: internal and close to the former, to the outer side of the following muscle. Or.: united with the former muscle from *Condyl. extern.* Ins.: united with the tendon of the M. extens. commun. on the fifth finger. Use: assists in extending the fifth finger. This muscle is often wanting.

15. **Extensor carpi ulnaris (s. ulnaris externus).**

Pos.: on the ulnar border, covers the *Ulna, M. supinat. brevis,* and the deep layer. Or.: *Condylus externus humeri* and the *Ulna* (the central third of the posterior border). Ins.: *Basis oss. metacarpi V.* Use: to extend the metacarpus and draw (adduct) it rather inwards.

**β. Deep layer.**

16. **Abductor pollicis longus [Extens. primi internodii].**

Pos.: the most external, covered by *extens. com., upon lig. inteross., Radius,* the tendons of *Mm. extens. radial.* and the outer side of the carpus. Or.: 1. *Crista ulnæ* (below *supinator brevis*) on the second fourth. 2. *Lig. inteross.* and *Radius* (posterior surface). Ins.: *Basis oss. metacarp i.* Use: to extend the thumb from the other fingers; assists in extending the hand and drawing it backwards.

17. **Extensor pollicis brevis [Ext. secundi internodii].**

Pos.: internal, and close to the former muscle, only separated from it by a tendinous sheath. Or.: 1. *Angulus extern. Ulnæ.* 2. *Lig. inteross.* and *Radius.* Ins.: *Basis Phalang. I. pollicis.* Use: to extend the first phalanx, and then abduct the Os metacarpi I.

18. **Extensor pollicis longus [Ext. tertii internodii].**

Pos.: between *abduct. longus* and *extens. brevis pollic.* Its tendon crosses over *extens. raditall.* (tendons), and is, on the carpus, separated from the tendon of *abductor longus* by a fossa. Or.: *Ulna* (external surface, inferior half) and *lig. inteross.* Ins.: *Basis phalang. II. pollicis.* Use: extends the ungual phalanx of the thumb.

19. **Extensor indicis proprius.**

Pos.: along the inner border of the former muscle, below it and *m. extens. carpi ulnari.* and *digit. commun.* Or.: *Ulna* (external angle, middle) and *lig. inteross.* Ins.: the inner side of the tendon of *extens. comm.* of second finger, on the second and third phalanx. Use: to extend the index finger.

Nerv. (fourteenth to nineteenth) *interosseus externus.*
319. Fascia antibrachii s. vagina cubiti, passes off from the f. brachii, enveloping the entire fore-arm as far as the Crista ulnae, serving at the upper part more especially for the attachment of muscles. Fibrous striæ serve to strengthen it which come off behind, from the triceps, on the outside, from brachial intern., and in front and internally from biceps, as well as those from the condyles of the Humerus. Aponeurosis bicipitis passes over pronator teres like a bridge at the bend of the arm, from the outer border and the anterior surface of Biceps tendon, inwards and downwards; covering art. brachialis. Besides several vascular and nervous openings, one should be observed in the fascia antibrachii at the bend of the arm (on the outer border of aponeurosis bicipitis), through which the uniting tissue beneath the skin communicates with that under the fascia, and which leads to a fossa in which the following parts are situated: Tendon of m. biceps, Art. brachialis, commencement of Art. radial., Nerv. medianus. The fossa is formed: on the outside by supinator long., extensores carpi radial., flexor sublimis; on the inside by pronator teres; and communicates above with the canal of the Art. brachial., below with those of the Art. radial., ulnaris, interossea, and Nerv. medianus. In consequence of the attachment of the f. antibrachii to the internal angle of Radius and the internal surface of Ulna, a sheath arises from the muscles of the Volar and another for those of the Dorsal surface, and besides, by inversions, sheaths for the individual muscles.—At the Carpal articulation it forms,

320. a. Lig. carpi volare; arises internally, 1. from Os pisiforme, 2. from Os hamatum, and continues externally, as it passes over befors the Volar surface of the carpus, to the Os naviculare and Trapezium. Behind it lie, with one (or two) synovial capsules, the nine tendons of the flexor muscles and nerv. medianus in one bundle. Its superficial layer, lig. carpi volare commune, is thin, its deep layer, lig. carpi volare proprium, strong. From both the aponeurosis palmaris springs.

321. b. Lig. carpi dorsale commune, very fibrous, passes obliquely from crista radii over the radio-ulnar articulation to the os triquetrum and the basis of the five metacarpal bones, and then passes into the fasc. manus dorsalis. Prolongations which pass off from the internal surface of Lig. dors. form the following tendinous sheaths, from without inwards: 1. for abductor long. and extens. brevis pollicis. 2. and 3. for extens. carp. radiales and extens. pollicis longus (associated together below in one sheath). 4. for extensor digit. commun. and indicator. 5. extens. digiti V. proprius. 6. for extensor carp. ulnaris.—Each tendon enjoys its own synovial capsule.
D. Muscles on the Hand.

321. a. Muscles of the ball of the Thumb (thenar).

a. Attached to the outer side of Os Metacarpi I. or Phalanx I.

322. 1. Abductor pollicis brevis.

Pos.: the most superficial on the outer border of os metacarp. I., separated from opponens beneath it, by a fascia. Or.: Lig. carpi volare propr. (radial side) Tuber Trapezius. Ins.: Basis of I. phalanx. Use.: abducts the thumb from the index finger.

323. 2. Opponens pollicis.

Pos.: beneath the former muscle; internal portion only covered with skin; above flex. pollicis brevis and tendon of the longus. Or.: like the former muscle. Ins.: Radial border of os metacarp. I. Use: to draw the thumb inwards and forwards (towards the little finger).

324. 3. Flexor pollicis brevis.

Pos.: oblique downwards and outwards, on the external border covered by abduct. brevis, on the internal united with adduct. pollicis. Or.: the same as before, and from the tendinous sheath of flexor radial carpi. Ins.: Os sesamoideum externum and Phalanx I. (covered externally by the tendon of adduct. pollicis). Use: to draw the phalanx inwards and forwards (M. opponens internus).

325. 4. Adductor pollicis.

Pos.: triangular, between Os metacarpi I. and II. covered by the tendons of flexor dig. prof. and lumbricales. The deep portion (Cap. profund. M. flex. poll. brev.) close to the former muscle; the superficial close beneath the skin. Or.: 1. Os metacarpi III. (the entire anterior border). 2. Os trapezium (anterior superior part). Ins.: Os sesamoideum internum and Phalanx I. Use: to draw the thumb towards the index finger.

Nerves: (first to the fourth) medianus and ulnaris.

b. Muscles on the ball of the little finger (hypothenar.). Attached to the ulnar side.

326. 5. Abductor digiti minimi.

Pos.: on the internal (ulnar) border of Os metacarpi V., covers oppon. dig. V. Or.: Os pisiforme and aponeurosis of
M. flex. ulnar. carpi. Ins.: Basis phalan. I. digiti V. Use: to draw the little finger inwards (that is to say, from the fourth finger).

327. 6. Flexor digiti V. brevis.
   Pos.: on the outer border of the last muscle, separated from it by Vasa and Nn. ulnares. Or.: Os hamatum (the process. unciniform.) and lig. carp. vol. propr. Ins.: Basis phalan. I. digiti V. Use: to flex a little the first phalanx of the fifth finger.

328. 7. Opponens digiti V.
   Pos.: covered by the last muscles, above the interosseus and the tendon of flex. digit. comm. of the fifth finger. Or.: Os Hamatum (the process). Ins.: capitulum and the whole ulnar side of os metacarpi V. Use: to draw the fifth metacarpal bone outwards and forwards (that is, towards the thumb in making the hand hollow).

Nerves: (fifth to the seventh) ulnaris r. profund. volaris.

c. Muscles in the middle of the palm of the Hand.

   Pos.: close beneath the skin, in the fat over the muscles of the little finger and Art. and Nerv. ulnaris; transverse, one inch broad and long. Or.: Aponeurosis palmar. media. Ins.: the skin of the ulnar border, from os pisiforme onwards. Use: wrinkles the skin on the ball of the little finger.

Nerves: ulnaris r. sublimis volar.

330. 9. Lumbricales.
   Pos.: beneath Aponeurosis palmaris on the four tendons of the flexor digit. profundus, in the hollow of the hand. Or.: the radial side of the three tendons of flex. profund. Ins.: the radial side of first phalanx of the second to the fifth finger; blending with the tendons of extens. digitor. communis. Use: flexes the first phalanx of the second, third, fourth, and fifth fingers.

Nerves: medianus, for the fourth ulnaris r. superficial.

331. 10. Interossei volares s. interni, 3.
   Pos.: in the spaces between Ossa metacarpi, second to fifth, in the palm, covered before by the flexors, behind by the m. interosso. dorsales. Or.: sides of os metacarpi (two-thirds of the anterior surface) II., IV., V. Ins.: Phalanx I. of second (ulnar side), fourth, and fifth (radial side) fingers, and the tendon of m. extens. digitor. communis. Use, to draw the second, fourth, and fifth fingers towards the middle finger.
332. 11. Interossei dorsales s. bicipites, 4.

Pos.: in the spaces between Oss. metacarpi I. to V., to be seen from the back and palm of the hand. Or.: sides of Ossa metacarpi II. to V., with two heads, which Art. perforans separates. Ins.: 1. on the radial side of Phalanx I. of index finger; 2. the same on the middle finger; 3. on the Ulnar side of the middle finger; 4. the same on the ring finger. Use: draws the Index from the Middle finger, the Middle finger from the Ring and Index, the Ring finger from the Middle; they spread out the second and the fourth from the middle finger.

Nerves: ulnaris r. profund. volar.

333. 1. Aponeurosis palmaris, close beneath the skin of the hollow of the hand, it forms a sheath for all its muscles. The central portion is triangular and strong, arises from the anterior surface and the inferior border of Lig. carpi volare and the tendon of palmaris longus (between the two points Art. ulnaris enters into the palm of the hand); it divides in the region of the Capitul. oss. metacarpi into eight parts for the second to the fifth fingers, and is strengthened by transverse fibres. By this four arches arise for the tendons of Mm. flexores, and three between them for Vasa and Nn. collaterales of the fingers and Mm. lumbricales. Loose uniting tissue separates the middle part from the subjacent structures: Arcus arterios. superficial. volæ; Nn. median. and ulnaris tendin. mm. flexor. Externally, as a continuation of the tendon of abductor pollicis longus, the external portion of the Aponeur. palm. envelopes the muscles of the ball of the thumb; internally, as a process of the tendon of flexor carpi ulnaris, the inner portion, the muscles of the ball of the little finger; here the m. palmaris brevis is connected. It loses itself on the first phalanx in the sheaths of flexor digit. and ligg. capit. os. metacarpi.

334. 2. F. dorsalis manus.; a. the superficial is a thin layer, covering the tendons of extens. digitor. comm., and attached to the second and fifth metacarpal bones; b. the deep, covers the interossei, and attaches itself to all the metacarpal bones, consisting of loose elastic uniting tissue, which serves instead of synovial capsules.

335. 3. Pulleys (trochleæ) of the flex. digitor. comm.; consist of fibro-cartilaginous portions with transverse fibres, lying transversely before all three phalangeal articulations of the second to the fifth fingers. On the first joint they form a connected flat surface (one inch long), to which the aponeurosis palmar. is attached.
SPECIAL ANATOMY.

336. Tendinous sheaths of the flexors on the fingers; they consist of separate ligaments, as:
   1. Transverse ligaments, annuli, narrow, passing before each joint transversely in front of the tendons, attached to the basis phalang. and the pulley.
   2. Ligamentous sheaths; broader, transverse before the bodies of the first and second phalanx.
   3. Crucial ligaments, ligg. cruciata, before the first and second phalanx, descending obliquely from the edges of the body to the capitulum of the phalanx.

VIII. Muscles of the Inferior Extremity.

A. Muscles of the Thigh.

337. 1. Flexor Femoris.

   a. Psoas Magnus (Internal Head).

   Figure: at commencement flat, then round and spindle-shaped. Pos.: on the sides of the bodies of the lumbar vertebrae, between the external and central crura of the diaphragm, before plex. lumbalis, quadratus lumbarum, behind the kidneys, then on the boundary between the great and small pelvis, covered by peritoneum; on the outer side nerv. cruralis passes. Behind it meets with quadratus lumbarum. Or.: first to the fifth lumbar vertebra (lateral surface of bodies). Ins.: Trochanter minor. The tendon passes in front of the hip-joint (with a synovial capsule).

b. Iliacus (External Head).

   Fig.: broad, three-sided. Pos.: fills up the whole venter Ilii, covered by a fascia, fat and peritoneum. Passes out from the pelvis, united with psoas, in a groove between spina ilei anter. infer. and eminent. pectin., underneath lig. Poupart. Upon it, to the right, are placed the cæcum and the termination of the small intestines; to the left, the colon. Or.: Fossa Iliaca and lig. ileo-lumbale. Ins.: Trochanter minor.

   On the thigh they lie, both united together, behind n. cruralis (in one sheath), internal to Sartorius and rectus femoris, external to the adductores and art. cruralis. Use: to elevate (flex) the thigh towards the trunk, or to bend the trunk forwards over the thigh.

   Nerves: cruralis and plexus lumbalis.

338. 2. Psoas Minor (often wanting).

   Pos.: on the internal border and before the lumbar portion of the former muscle, the tendon on the inner edge of fascia iliaca, crossing the Psoas major. Or.: bodies of last dorsal and first
lumbar vertebrae. Ins.: Fascia iliaca at the posterior part of linea arcuata. Use: stretches the fasc. Iliaca; may flex the pelvis towards the trunk (as in climbing), or draw the trunk sideways.

340. 3. Glutæus maximus.

Pos.: one inch thick, close beneath the skin of the buttocks; broad, four-sided; covers glut. med., pyriform., gemelli, obturat. intern., quadrat. femor., incisura ischiad. maj., tuber ischii, Mm. semitendin. and membranos., cap. long. bicipit.; trochanter major, adductor magn., Nn. et vasa glutæa, ischiadic., pudenda interna. Or.: 1. posterior surface of Ilium, behind lin. semicircul. poster. 2. spina iliæ poster. super. as far as cornu sacrale. Ins.: Linea aspera, the external crus, close under trochanter major femoris, and fascia lata. Use: extends the thigh backwards, draws and rotates it outwards; or draws (when standing upon one leg), the pelvic half of the other side, backwards; stretches the fascia lata, and maintains the os. coccygis in its situation.

Nerves: glutæus infer.

341. 4. Glutæus medius.

Pos.: behind the last, covered before and above by fat and skin, and rather by m. fasciæ latæ. Along the posterior border, m. pyriform.; on the outside, Vasa and nerv. Glutæi.

Or.: fossa Iliaca externa; the anterior portion from Spina oss. Ilii anter sup. and (three fourths) Crista iliæ: the posterior from linea semicirculæ superior. Ins.: trochanter major (from the apex to the base). Use: extends and abducts the thigh; the anterior portion rotates it inwards (and helps to flex it).

Nerves: glutæus superior.

342. 5. Glutæus minimus.

Pos.: Three-sided; covered behind, slightly, by pyriformis, above by vasa glutæa, entirely by glutæus med., meets anteriorly with tensor fasciæ, covers the upper part of the capsule of the hip joint. Or.: fossa iliaca externa below linea semicircul. infer.; Crista Iliaca (anterior portion), incisura ischiadica (external portion). Ins.: trochanter major (anterior surface). Use: draws the thigh directly outwards; the anterior portion rotates it inwards, the posterior outwards.

343. 6. Pyriformis.

Pos.: covered by glut. med., in the incisura ischiadica major, almost horizontal along the lower border of glut. med.; in the
pelvis, behind the rectum, Plex. ischiadic, Vasa hypogastrica; outside, behind the hip joint; at the superior border, Vasa and Nn. glutaei.

Note. The superior border commonly reaches the top of the incisura ischiad.; between it and the bone the hernia ischiad. passes through.

At the inferior border, Vasa and Nn. ischiatici. Or.: 1. Os sacrum (anterior lateral surface, close to foramina sacral. ant. second and third, the n. ischiad.). 2. Lig. sacro-tuberos. (anterior surface). 3. Incisura ischiadica, superior part. Ins.: Trochanter major (superior edge of the fossa).

Nerves: glutaeus superior and ischiadicus.

344. 7. Obturator internus.

Pos.: triangular, in the pelvis, behind membrana obturatoria, covered before by fasc. pelvis and levator ani; passes through incis. ischiad. min. around os ischii and horizontally outwards, in the groove between gemelli, behind the neck of the femur, covered by glutæus max. Or.: membr. obturatoria and the whole circumference of foram. obturatorium. Ins.: trochanter major, the lin. intertrochant. post., below pyriformis.

Nerves: Ischiadicus.

345. 8. Gemellus superior.

Pos.: above the tendon of the last muscle, horizontally outwards. Frequently wanting. Glutæus max. covers both gemelli. Or.: Spina Ischii (inferior border, external surface). Ins.: like the last muscle.

346. 9. Gemellus inferior.

Pos.: stronger, below the tendon of obturator intern. Sometimes double. Or.; Tuber ischii (quite above lig. tuberoso-sacr.) Ins.: like the last muscle. Uses: (of 6. to 9.), they rotate the thigh outwards.

Nerves: ischiadicus, for 8. and 9.

347. 10. Quadratus femoris.

Pos.: transverse, immediately below 9.; covers before obturator extern. and trochanter minor; between tuber Ischii and trochanter major, covered by Glutæus max. Or.: tuber ischii (external border) covered by semi-membranos., adductor magnus. Ins.: the vertical line between basis trochant. major and linea aspera. Use: rotates (even the flexed) thigh outwards; rotates (when standing upon one leg) the trunk to the other side.

Nerves: ischiadicus.
11. Obturator externus.

Pos.: behind the last muscle and pectineus, adductor brevis, psoas and iliacus; before, foram. obturator. and collum femoris; meets above and externally, gemellus infer. Or.: foram. obturator (anterior circumference). Ins.: fossa of trochant. major (the lowest part). Use: rotates the thigh outwards; assists in flexing the trunk.

Nerves: obturator.

349. Fascia iliaca, s. lumbo-iliaca,
envelopes mm. psoas and iliacus, arises from the lumbar portion of the diaphragm above, from the bodies of the lumbar vertebra internally, from labium intern. of ilium and the linea arcurata of the pelvic cavity outwards as far as crista pubis. a. The external portion divides between spina ilei ant. superior, and the outer angle of the femoral ring into an anterior and posterior layer (between which the Vasa circumflexa ilei pass). 1. The anterior layer turns upon the posterior surface of the abdominal muscles, and above passes into the fasc. transv. 2. The posterior layer unites with the outer portion of lig. Poupartii (that is, fasc. ilio-pubica). b. The internal portion descends over the m. psoas-iliacus upon the thigh, and unites externally with fasc. femoris.

B. Muscles of the Thigh.

a. On the posterior surface.

350. 1. Biceps femoris s. flexor fibularis.

Pos.: on the outer part of the thigh; its long head covered above by Glutæus max. and skin; lies upon the short head, adductor magnus, and behind semi-tendinosus; the short head on vastus externus, in the lower half of the thigh, then behind the popliteal vessels. Forms the outer border of the popliteal space. Or.: 1. Caput long. from tuber. Ischii. 2. Caput breve from linea aspera oss. femor. Ins.: Capitulum fibulæ (and condylus externus tibii). Use: flexes the leg, and accordingly by means of the long head it extends the thigh. The short head rotates the leg outwards.

351. 2. Semitendinosus.

Pos.: covers the following muscle between it and cap. long. bicip.; its long tendon is, at the commencement, behind, then between the following muscle and gastrocnem. internus. The tendon commences four or five finger breadths above the knee-joint, winds around the condyl. intern. tibiae forwards, behind the tendo sartor., on the inferior border of tendo gracilis (“pes anse-
rinus" tendinosus). Or.: tuber ischii (united with biceps). Ins.: spina tibiiæ (internal surface of superior extremity) and fasc. cruris. Use: like the last muscle: in semiflexion it rotates the thigh a little inwards.

352. **Semimembranosus.**

Pos.: before the last muscle, behind adduct. magn., gastrocnem. intern., art. and ven. poplitæa. Along the outer border, art., ven. poplitæa, nerv. ischiadicus; on the internal border, gracilis. Or.: tuber ischii (the highest, external part, before biceps and semitendinosus). Ins.: Condyl. intern. tibiiæ. Use: like the last muscle.

Nerves: (first to third) ischiadicus.

**Remark.** Between semimembranosus (within) and biceps. fem. (without) a longitudinal space exists along the whole posterior surface of the thigh, in which the uniting tissue of the pelvis, by means of the incisura ischiad. major, communicates with that of the popliteal region.

b. Upon the outer surface.

353. 4. **Tensor fasciæ latæ (Fascialis).**

Pos.: in the upper third; inside the thick envelope of the thigh, on the outer border of Sartorius and rect. femor.; covers glut. med., minim., and vastus extern. Or.: Spina ilei anter. super. as far downwards as spina ilei infer. Ins.: fascia lata femor. This is attached to the condyl. extern. and Spina tibiiæ. Use: maintains vastus ext. in its situation; rotates inwards, and abducts the thigh.

[Nerve: Gluteus superior.]

c. On the anterior surface.

354. 5. **Sartorius** (s. longus, because the longest muscle in the body).

Pos.: the longest muscle, Sigmoidal, from the outer side of the thigh to the inner of the knee, under the skin; forms at the superior third of the thigh with pectineus an isosceles triangle (base, above), in the centre of which lies Art. cruralis. In the second third Art. cruralis at first passes on the internal edge, then on the posterior surface, and lastly on the external edge. In the last third it lies between gracilis and vastus internus; under the anterior edge the n. saphenus passes forth, on the posterior Ven. saphena (near the knee-joint). Above between tensor fasciæ and iliacus, then upon rect. femor., adduct. long., vast. intern. and gracilis. Or.: Spina ilei anter. super. (and rather below this). Ins.: Crista tibiiæ labium internum (below lig. patellæ, before tendd. mm. semitendin. and gracilis). Use: flexes at the same
time thigh and leg (in squatting) or both alone. It only slightly assists in crossing the legs (the position of tailors when at work).

Nerves: cruralis.

355. 6. Extensor cruris.

Or.: see a. to d. Ins.: the tendinous expansion around the patella; tendo extenso cruris. Use: to extend the leg or thigh (when the one or the other is fixed, as in rising from the sitting to the standing posture).

[Remark. To examine the insertion accurately, make a vertical section of the tendon, patella, and ligam. patellæ in the centre. Trans.]

a. Rectus femoris.

Pos.: vertical in the centre of the thigh, between Spina ilei anter. super. and patella; above rather covered by Sartorius, in general by the skin. Covers above the flexor, below the three following muscles. Or.: from superior border of acetabulum; from Spina ilei anter. infer.

b. Vastus externus.

Pos.: behind the last, externally covered by skin, before cruralis. Or.: trochanter-major and labium externum lineæ asperæ (superior half).

c. Vastus internus.

Pos.: on the inner part of the thigh, grooved; behind, the inferior extremities of the adductores lie upon it. Or.: from labium intern. lin. asperæ, before m. adductores (from trochanter minor) as far as the inferior fourth of the thigh.

d. Cruralis.

Pos.: close upon os femoris, surrounded as if in a capsule by vastus externus and internus. Or.: os femor., close under vastus intern., as far as above condylus intern. femoris. The lowest fasciculi have been named Subcruralis.

Nerves of extensor fem.: cruralis (for vast. intern.), besides, nerv. obturatorius.

d. Internal surface.

356. 7. Gracilis.

Pos.: close under the skin, directly downwards; covers the adductores, below semitendinos.; at the inferior extremity of the internal surface crossed by Ven. saphena interna. Or.: from Spina pubis ram. ascend. oss. ischii. Ins.: Crista tibiae (within and above), below tendo Sartorii and above tend. semitendinosi.
The long tendon winds around the condyl. intern. femoris (and tibiae). Use: flexes the leg, and draws it inwards.

Nerves: obturatorius (for the seventh to the tenth). [Except the eighth. —Trans.]

357. 8. Pectineus (adductor superficialis I).

Pos.: on the upper, anterior and inner part of the femur, on the inner border of flex. femoris (and Art. cruralis), at the external border of adductor longus; before the foram. obturator, m. obturator extern. (Vasa obturatoria) and articular capsule; covered by fascia cruralis and Vasa cruralia. Or.: Crista pubis (and a portion of the fascia below lig. Gimbernat). Ins.: linea aspera (two inches below trochanter minor).

[Nerve: Cruralis. Trans.]

358. 9. Adductor longus (superficialis II., Caput longum tricipitis).

Pos.: covered externally by the last muscle, above by the skin, below by Sartorius, before adductor brevis and magnus; separated from Sartorius by art. and ven. cruralis. Or.: os pubis (between symphysis and crista). Ins.: centre of linea aspera.

359. 10. Adductor brevis (caput breve tricipitis).

Pos.: covered by the last muscle; at the commencement uncovered by, then behind pectineus. Or.: ram. descend. oss. pubis (outside of gracilis). Ins.: linea aspera (superior third).

360. 11. Adductor magnus (caput. magnum tricipitis),

great adductor.

Pos.: behind the two muscles last described (forms almost alone the thick flesh on the inner part of the thigh), before semitend., biceps, semimembran., gluteus maximus. On the internal border above, gracilis; below, Sartorius. At the superior border internally, obturator extern.; externally, quadrat. fem. At the inferior extremity perforated by art. and ven. cruralis. Or.: from tuber ischii to symphysis pubis. Ins.: the whole labium extern. lin. asperæ to condylus internus femor. Use: eighth to eleventh draw the thigh inwards (especially in riding on horseback); eighth to tenth also flex it a little.

Nerve: Obturator.

361. Fasciae femoris s. lata,

arises from the whole circumference of the outer surface of the Ilium, envelopes the Gluteus maximus (fascia glutæa), the anterior and posterior surfaces of the thigh; consists on the anterior surface, of very dense fibres descending from spina anter.
super. (that is, proper fascia lata), divides, at the internal border of gracilis, into a superficial and deep layer, and unites with fibres which are attached to os femoris. These are, a. the superior layer between m. rectus and tensor fasciae; it passes from the anterior border of os Iléi, anteriorly above the hip-joint and neck of the femur like a ligament, and continues with fascia lata below the trochanter major. b. The external intermuscular ligament on the linea aspera, from trochanter major downwards to condylus externus, separates the flexor from the extensor muscles on the outer side. c. The internal reaches from trochanter minor as far as condylus intern. femoris, is not so strongly marked, separates vastus internus from adductores.

362. Separate sheaths: 1. for the femoral vessels, vagina vasor. crur., a three-sided sheath, between the anterior and internal muscular sheaths; they help to form the femoral canal.

363. 2. The three great muscular sheaths:
   a. The posterior, common to m. biceps, semi tendinosus and semi-membranosus.
   b. The anterior divides into the following sheaths: 1. For Sartorius. 2. For rectus femoris. 3. For vast. extern. and intern. 4. For tensor fasciae.
   c. The internal divides: 1. For gracilis. 2. For pectineus and adductor longus. 3. For adductor brevis and obturator externus.

364. 3. The femoral ring, annulus cruralis, this is, the three-sided opening, an inch and a half broad, through which the crural vessels pass out, behind ligam. Poupartii, from the abdominal cavity upon the anterior surface of the thigh. Directed obliquely from above downwards and from behind forwards, it is bounded before, by the femoral arch (which supports the spermatic cord, or round ligament), behind, by the horizontal ramus of the pubes (with m. pectin. and the deep layer of fascia lata), externally, by the sheath of m. psoas and iliacus; here the vasa epigastrica ascend. Its posterior angle corresponds to eminent. ileo-pectinea; between flexor femor. and pectineus. Its external angle arises from the junction of the lig. Poupartii with the sheath of the Psoas, in which lies nerv. cruralis. The lig. Gimbernati forms the internal; it is obtuse, in the normal course of the art. obturator free from vessels, but between V. cruralis and lig. Gimbernati a large, deep inguinal gland lies. (Hernia cruralis passes out at this point.) Towards the abdominal cavity the crural ring is covered by loose uniting tissue (septum crurale).

365. 4. Femoral canal, canalis cruralis, is the excavated
space, which reaches from the femoral ring as far as to the spot
where the anterior layer of the three-sided sheath of the Vasa
cruralia commences; it consists of a three-sided fossa (fossa
ileo-pectinea), between m. pectineus (internally) and psoas (ex-
ternally), which by an incomplete anterior wall, the tendinous
proc. falciformis, is formed into a canal. It goes downwards
and inwards, is on the outer side an inch and a half, on the inner
half an inch long. The superior border of proc. falciform.
attaches itself to lig. Poupartii, and reaches as far as lig. Gim-
bernati; here, at the free, crescentic, internal border of proc.
falciform. is a large anterior interval, oval fossa (fossa ovalis),
through which V. saphena interna (and the place at which the
hernia cruralis generally) passes; it is covered by the superficial
layer of fasc. superfic. (here lamina cribrosa, on account of the
numerous openings for vessels, nerves, and lymphatic glands),
superficial inguinal glands, and skin. The femoral canal termi-
nates below in a small opening, at the entrance to the sheath of the
vasa cruralia.

C. Muscles of the Leg.

a. On the anterior surface.

366. 1. Tibialis anticus s. hippocus.

Pos.: beneath the skin, along the outer surface of the tibia;
close to it on the outer side: extens. digitor. ped. commun. and
(below) propr. hallucis (separated from Vasa and Nn. tibiales
antici). Or.: the two upper-thirds of the outer surface of the
tibia; the ligam. interosseum. Ins.: Os cuneiforme I. and
basis oss. I. metatarsi (internal surface); projecting strongly.
The tendon passes over the inferior extremity of the tibia to-
wards the inner side of the foot. Use: flexes the foot, that is to
say, approximates the back of the foot to the leg, and rather
raises the inner border of the foot.

367. 2. Extensor hallucis longus.

Pos.: between 1. and 2.; external to tibial. antic., separated
from it behind by Vasa and N. tibial ant.; on the outer side of
its tendon: art. pediæa. Or.: internal to and behind the last
muscle, from the centre of the inner surface of the fibula and
from lig. interosseum. Ins.: Basis Phalangis II. hallucis.
The tendon passes at a right angle over the dorsum of the foot
upon the first metatarsal bone. Use: extends both phalanges of
the great toe, flexes and raises the inner border of the foot a little.

368. 3. Extensor digitorum communis longus.

Pos.: beneath the skin, between tibial ant. and extens. halluc.
long. (internally), and peronæus long., and brevis (without), covers the fibula, lig. inteross., artic. tibio-tarsalis, m. pediæus, and the toes. Or.: condylus externus tibix: inner surface of fibula, (four-fifths;) lig. interosseum. Ins.: Phalanx II. and III. of the second to the fifth toe. Each of the four tendons is fissured into three portions, the two lateral of which go to the third phalanx, the central to the basis of the second phalanx. Use: extends the third phalanx of the second, third, fourth, and fifth toes.

369. 3. Peronæus anticus s. tertius.

Pos.: on the outer side of the anterior surface of the leg (inferior third); between 3. and peronæus brevis. Or.: inferior half of fibula (anterior internal surface). Ins.: Basis oss. V. metatarsi. The tendon passes obliquely outwards under lig. cruciat., over the back of the foot. Use: to flex the foot, and raise it rather outwards.

Nerves for 1. to 4.: peroneus profundus [tibialis ant.].

b. On the outer surface.

370. 5. Peronæus longus (s. primus).

Pos.: under the skin of the peroneal region, along the fibula; in front, separated by a fascia from extens. digitor. longus, behind and above from soleus, below from flex. halluc. long.; covers peronæus brevis externally. In the foot the tendon lies between skin and os calcanei, in the sole it is covered by the soft parts. Or.: capitulum and superior third of external surface of fibula (by two heads); the inferior as low as the inferior fourth. Ins.: Basis oss. I. metatarsi. Its tendon passes round the external malleolus, in a groove (also with the following muscle), curves forwards and downwards to the outer border of calcaneus, and passes once again curved in the groove of the os cuboid, obliquely forwards and inwards into the sole of the foot, to the first cuneiform and first bone of metatarsus. Use: extends the foot and draws the external border outwards and upwards. (In fractures of the fibula the talus therefore passes inwards—the outer malleolus more prominently outwards—dislocation inwards.)

371. 6. Peronæus brevis (s. secundus).

Pos.: under the last muscle, covers fibula above, on the anterior, below, on the posterior angle, in the centre upon the outer surface. Before it peron. 3., behind it peron. long. and flexor. hallucis long. Or.: external surface of the fibula (inferior third). Ins.: the tendon passes forwards in the groove of the external malleolus upon the calcaneus, over tendo. peron. longi and os
cuboid, to the dorsal surface and tubercul. metatarsi 5. Use: extends and draws the foot outwards; abducts somewhat the little toe.

Nerves for 5. to 6.: peroneus.

C. On the posterior surface.

a. Superficial layer.

372. 7. Gastrocnemius s. gemelli suræ.

Pos.: above, by its two heads, it bounds the poplitæal region, forms the posterior thick flesh of the calf, close under the skin; the external head covered by biceps, the internal by semitendinos. Or.: 1. The external head from condylus femor. extern. (gemell. extern.) 2. The internal head from condylus intern. (gemellus intern. stronger.) Both heads unite in the form of the letter V. Ins.: tendo Achillis (to tuber calcanei). Use: to extend the foot, rather flexing the leg.

373. 8. Plantaris (in man rudimentary, often wanting).

Pos.: above and to the inner side of the external head of the last muscle passing between soleus and gemell. intern. Its long tendon first between Gastroc. and Soleus lies on the inner side of tendo Achillis. Or.: condylus externus femoris (from capsular ligament), connected with gemell. extern. Ins.: tuber calcanei (before or close to the tend. Achill.).

374. 9. Soleus.

Pos.: covered, particularly, by gemell. intern. behind; before by flex. digit commun. and hallucis propr., tibial postic., Vasa and Nn. tibial. postic. and fibulares. Or.: 1. tibiae lin. oblign. poster. (under poplitæus). 2. Capitul. fibulæ (posterior surface). Ins.: tendo Achillis. This arises from the junction of the tendons of 7., 8., and 9.; is one and a half to two inches long, is fixed broad to the posterior surface of tuberc. calcanei, and lies in a double sheath; the external is thick and red, the internal, thin, colourless, and more tense. Use: 7. to 9. extend the foot; 8. extends, in the lower animals, the fascia plantaris.

b. Deep layer.

375. 10. Poplitæus.

Pos.: small, thin, triangular, oblique from without, downwards and inwards upon the knee joint, covered by planarlis and gastrocnemius, separated by Vasa poplit. and n. poplit. intern. Or.: fossa behind [at the side of] condyl. extern. femoris (under m. gemellus. extern.). Ins.: the triangular, posterior (and supe-
rior) surface of *tibia*. Use: to flex the leg and roll it somewhat inwards.

**376. 11. Tibialis posticus s. nauticus.**

**Pos.:** the deepest, between *tibia* and *fibula* upon *lig. interosseum*, covered by *flexor commun. long.*, *halluc. propr.* and *soleus*. Its tendon in front of that of the *flex. comm. longus*, goes under the internal malleolus. **Or.:** *tibia* (posterior surface), *fibula* (internal angle), *lig. interosseum*. **Ins.:** *tuber oss. navicularis* (inner border); and with aponeurotic appendages to *oss. cuneiform*. **2. and 3.** Use: extends the foot, rotates the sole inwards.

**377. 12. Flexor digitorum communis long. s. perforans.**

**Pos.:** the most internal, along the posterior surface of the *tibia* and sole of the foot, penniform; between *tibial. post.* and *tibia*, covered above by *soleus*, behind *Vasa* and *Nn. tibiales postici*. **Or.:** *linea obl. tibiae* (under *m. poplit.* and *soleus*), and three-fifths of the centre of the *Tibia* (posterior surface). **Ins.:** *Basis phalang. III.* of the second to the fifth toe (plantar surface). The tendon lies: on the *internal malleolus* behind that of the *tibial post.*, on the inner border of the foot rather externally; passes between *calcis* and *abductor. halluc. long.* into the sole of the foot; in the *metatarsus* upon the *interossei*. **Use:** flexes the four outer toes, and after that extends the foot.

**Remark.** Pulleys and tendinous sheaths like the flexors of the fingers.

**378. 13. Flexor hallucis longus.**

**Pos.:** the most external and strongest, covered behind by *soleus* and *tendo Ach.* behind *fibula*, *tibial. post.* and *Art. peronea*, (below) *lig. inteross.* On the outer border: *peron. long.* and *brev.*; on its inner border: *flex. communis long.* The tendon curves towards the sole, passing obliquely over the *flex. commun. long.* **Or.:** *fibula* (posterior internal surface from the two inferior thirds). **Ins.:** *Basis phalang. II. hallucis* (plantar surface) united (by *fascia*) with the last muscle. **Use:** to flex the second phalanx of the great toe; assists (when the foot is raised) to extend the foot.

[In the sole of the foot the tendon of this muscle is connected, by a tendinous slip, with that of the last.]

**Nerves for 7. to 13.: tibialis.**

**379. Fascia s. vagina cruris.**

Invests only those parts of the leg covered by muscles, is connected above and behind with the *fascia femoris*, strengthened by tendinous expansions from the *biceps*, *sartorius*, * gracilis,
semitendinosus; above and before, in front of the Patella, likewise with the fasc. femoris, below with the ligaments of the bend of the ankle. Its external, cutaneous surface forms a sheath for vena and nerv. saphèn. extern.; the internal attaches itself to the crista tibicæ and fibulae, and forms three principal sheaths for the anterior, external and posterior muscles, and several secondary sheaths (e.g., between the superficial and deep layer on the posterior surface). On the malleoli it forms the following ligaments:

380. 1. Lig. transversum, an inch and a half broad, passes from the anterior angle of the tibia to that of the fibula, and covers the inferior portion of the muscles.

381. 2. Lig. cruciatum tarsi, consists of striæ one half to one inch broad, crossing over the tarsal joint. a. The superior passes from the internal malleolus to the superior and outer surfaces of proc. anter. calcanei, develops two tendinous sheaths, an internal (for tibial. antici.), an external (for extens. digit. comm. long. and peron.), and a central, incomplete, for extens. halluc. long. and Vasa and Nn. tibiales antici.) Retzius describes underneath a sling-shaped ligament, lig. fundiforme tarsi, which lies in a crescentic form over the tendon of extens. commun. long. and peronæus tertius. b. The inferior, from the external malleolus to the internal border of the foot, continues into the aponeurosis plantar. (interna), and forms, likewise, upon the back of the foot, sheaths for the before-described muscles.

382. 3. Lig. laciniatum tarsi intern., from the inner malleolus to the inner side of Calcaneus, forms four sheaths: a. for art., ven., and n. tibial. post. (the most superficial); b. for m. tibial postici. (the anterior); c. m. flex. digit. comm. long. (the posterior). Both behind the malleolus intern.; d. for m. flex. hallucis long. (the most inferior).

383. 4. Lig. laciniatum tarsi externum, from the external malleolus to the calcaneus, forms at the commencement a common sheath, afterwards divided into two, for m. peronæus longus and brevis.

D. Muscles on the Foot.

a. Upon the dorsum of the foot.

384. 1. Extensor digitorum brevis s. pediæus.

Pos.: oblique from without, inwards, and from behind, forwards, under the tendons of the long extensor of the toes, over the anterior row of the tarsal and metatarsal bones. On the inner border: Art. pediæa. [extens. hallucis brevis is the strongest]. Or.: Proc. anterior calcanei (external surface). Ins.: Phalanx I. of the first to the fourth toe, on the external border of the long
extensor of the toes and the extens. hallucis. Use: extends the first phalanx of the four inner toes.

Nerves: peroneus profundus [tibial. ant.].

b. On the internal region of the sole of the foot.

a. Attached to the inner surface of the first phalanx of the great toe.

385. 2. Abductor hallucis.

Pos.: on the internal border of the foot, beneath the skin, under the flexor muscles of the great toe, on the outer border of flex. halluc. and communis brevis. Or.: 1. The long (posterior) head from the posterior and inner surface of the tuber calcanei. 2. The short head from os cuneiforme I. and fasc. plantaris. Ins.: Os sesamoideum on the basis of first phalanx of great toe. Use: to draw the great toe from the second, and flex it.

386. 3. Flexor hallucis brevis.

Pos.: on the first os metatarsi, between abductor and adductor. Or.: Os cuboideum and os cuneiforme III. Ins.: Os sesamoideum internum. Use: flexes the first phalanx of great toe.

β. Attached to the external surface of the first phalanx of the great toe.

387. Adductor hallucis.

Pos.: strong, triangular, in the concavity between the second and fifth os metatarsi, above flexor longus, lumbricales, under interossei and Art. plantar. externa; on its inner border: tendo peronæi longi and flex. halluc. brevis. Or.: 1. Os cuboideum with flex. hallucis brevis. 2. Tendo peronæi longi, oblique to the insertion: into Os sesamoideum externum. Use: draws the great toe outwards towards the centre of the foot, and flexes it.

388. 5. Transversalis pedis (s. adductor transversus).

Pos.: small, and transverse between os metatars. IV. and hallux in the anterior part of the concavity of the metatarsus, above lumbricales, under interossei; is the anterior short head of the last muscle. Or.: Capitul. oss. metat. IV. and V. Ins.: Os sesamoideum externum. Use: approximates the great to the little toe, making the sole hollow (like mm. opponentes of hand).

c. On the outer region of the sole of the foot.

389. 6. Abductor digitii minimi.

Pos.: close above fasc. plantar. extern., under the following muscle; on the outer edge of the foot. Or.: tuber. extern. calcanei and aponeur. plantar. ext. Ins.: Basis phalang. I. of the
fifth toe (outer side). Use: draws the fifth toe from the fourth, and rather flexes it.

390. 7. *Flexor brevis digiti minimi* (s. *interosseus V*).


d. In the centre of the sole of the foot.

391. 8. *Flexor digitorum brevis* s. *perforatus.*

Pos.: close above *fascia plantar.*, under *Vasa* and *Nn. plantar.*, *tendo flex. long.*, *musc. accessor.*, *lumbrical.* Or.: from *tuber intern. calcanei,* and *fasc. plantar.* (centre). Ins.: each of the four tendons (perforated by *flexor long.*) passes divided to the borders of the second phalanx of the second to the fifth toe. Use: to flex the second phalanx of the second, third, fourth, and fifth toes.

392. 9. *Quadratus plantæ s. Caro quadrata Sylvii* s. *musculus accessorius.*

Pos.: above the last muscle, the vessels and nerves of the sole of the foot; under *Calcaneus* and *lig. calcaneo-cuboid.* *infer.* Or.: 1. Groove upon the under surface of *Calcaneus.* 2. *Lig. calcaneo-cuboidæ.* Ins.: the external border and the inferior surface of the tendon of *m. flexor. comm. longus.* Use: assists in flexion, and draws the tendons of *flexor longus* outwards.

393. 10. *Lumbricales IV.*

Pos.: on the inner border of the tendons of *flexor digitor. longus.* Or.: the angle of division of the tendons of *flexor digit. long.* (inner edge). Ins.: *Basis phalang. I.* of second to the fifth toe. Use: to flex the first phalanx of the second, third, fourth, and fifth toes.

394. 11. *Interossei interni plantares, 4.*

Pos.: between the metatarsal bones of the first to the fifth toe; covered by the following muscles. Or.: the internal (tibial) side of the second to the fifth *os metatars.* Ins.: first phalanx of the second to the fifth toe (tibial side). Use: to draw the four outer toes inwards towards the first.

395. 12. *Interossei externi s. dorsales, 3.*

Pos.: between the metatarsal bones of the second to the fifth toe; perforated at the posterior extremity by *Artt. perforantes.*
Or.: by two heads from the surfaces of two metatarsal bones as they are turned to one another. Ins.: the fibula (external) border of the second to the fourth toe. Use: to draw the four outer toes from the great toe.

Nerves for 2. to 12.: plantaris extern. et internus.

396. Fascicu musculares pedis.—a. fasc. dorsalis, a thin membrane which, commencing behind from the fascia cruris, covers the back of the foot, in front on the first phalanx of the toes passing over into the sheaths of these, and at the sides into the fascia plantaris; a superficial layer covers the tendons of extens. digit. longus; a central the extens. digit. brevis (before); a deep the interosseal.—b. Aponeurosis plantaris, a thick, shining membrane, which commences behind on the tuber Calcanei, at first narrow, then broader, terminating in the region of the anterior extremities of the metatarsal bones in four lappets, lacinæ plantares, which are divided, and form four sheaths for the tendons of the flexor muscles of the second and four outer toes. These sheaths are separated by three arches, under which the mm. lumbricales and interossei and the plantar vessels and nerves pass away. The borders curve round from above and below, surround the flexor digitor. brevis, and form septa between the muscles of the centre and the outer and inner region of the sole of the foot. Externally an apon. plantaris externa (attachment of M. abduct. digiti minimi) passes off, which is attached in front to the basis oss. metatarsi V., and forms a sheath for abductor and flexor brevis digiti V. Internally a thinner, f. plantar. intern., which commences behind between Malleolus intern. and Calcaneus, is attached to the inner border of the Tarsus, and forms a tendinous sheath for flexor and abductor brevis hallucis, and art. and ven. plantar. intern. The central sheath encloses: M. flexor digitor. brevis, tendo m. flexor digitor. and hallucis longus, Caro quadrata Sylvii, lumbricales, adductor hallucis, and transversal. pedis, Vasa and nerv. plantares externi. Mm. interossei lie in separate sheaths.

c. The ligaments and sheaths of the toes are analogous to those of the fingers.

Summary of the Actions of the Muscles.

I. Head.

397. A. The whole head, the neck being fixed, moves:


b. Backwards (extension): cucullaris, splenius capitis, biventer
and complexus cervicis, tracheo-mastoid., rectus postic. and obliq. sup. of both sides.


D. The head rotates sideways at the same time with the Atlas: splenius capitis, tracheo-mast., obliq. cap. infer. of the one and sterno-cleido-mast. of the other side.

398. B. The skin moves upon the skull:

a. Forwards: frontales, which at the same time put the skin of the forehead into transverse wrinkles.

b. Backwards: occipitales, which at the same time make the skin of the forehead smooth.

399. C. The ear is drawn:

a. Upwards: attollens; forwards: attrahens; backwards: retrahentes.

400. D. The eye:

a. The eyebrow is drawn inwards and downwards with longitudinal wrinkles: corrugator superc.

b. The fissure between the lids contracted and closed by: sphincter palpebr.

c. The upper lid raised: levator palpebr. super., by which the skin passes backwards.

d. The globe of the eye is directed outwards, inwards, upwards, downwards: recti.

e. The same is rotated upwards and inwards: obliq. super.; downwards and outwards: obliq. infer.; upwards and outwards: obliq. infer. and rect. extern. together.

401. E. The nose:

a. Is drawn down and the nasal openings contracted by: depressor alæ and compressor.

b. Drawn outwards and widened by: dilatator posterior and anterior.

c. Turned up by: levator alæ et labii (s. pyramidalis).

402. F. The mouth:

a. The fissure of the mouth is shortened and closed: by sphincter oris.

b. The angle of the mouth is drawn downwards and backwards, by which the cheeks are pressed against the rows of teeth (as in mastication) and the cheeks are expanded (as in blowing and whistling): buccinator.

Upwards by: lev. anguli oris and zygomat. major.
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Downwards (it is pretended) by: triangular. with transv. menti.

c. The upper lip is raised by: levator labii, alæ nasi et labii super., zygomatic. minor.

d. The under lip drawn downwards and everted by: quadratus menti. It is raised, when the skin of the chin is stretched, by: levator menti.

403. G. The lower jaw is:

b. Drawn upwards by: masseter, temporalis, pterygoideus internus.
c. Pushed forwards and to the opposite side by: pterygoideus externus.

404. H. The soft palate is:

a. Raised and stretched transversely by: levator palati mollis;
b. Depressed (thereby elongated and stretched) by: pharyngo-palatin., glosso-palatinus.
c. Shortened (the uvula thereby elevated and curved backwards) by: azygos [levatores] uvula.
d. Stretched (it is pretended) by: circumflex. palati mollis.

405. I. The Pharynx is:

a. Contracted by: three constrictores pharyngis.
b. Raised and widened by: stylo-pharyng., salpingo-pharyngeus.

406. K. The os hyoides is:

a. Raised forwards by: digastricus (anterior belly), mylo-hyoideus, genio-hyoideus.
b. Backwards by: stylo-hyoid., digastricus (posterior belly).
c. Drawn downwards by: omo-, sterno-hyoideus, hyo-thyreoideus.

407. L. The tongue is:

a. Compressed against the floor of the mouth by: genio-, hyoglossi.
b. Base and borders raised backwards by: stylo-glossi.

408. M. The larynx is:

a. Drawn downwards (trachæa shortened) by: sterno-thyreoideus.
b. Drawn upwards, towards the os hyoides (Epiglottis curved backwards), by: hyo-thyreoid.
c. The epiglottis bent back (and the entrance shut) by: reflector epiglottidis.
d. The vocal cords removed from one another, and the entrance widened by: crico-arytenoidus posticus.

II. Trunk.

409. A. The neck is:
   a. Flexed by: longus colli and scaleni (3) of both sides.
   b. Extended by: splenius colli, transversal. (and spinales, semi-, inter-spinales, multifidi).

410. B. Thorax. 1. The thoracic portion of the vertebral column is:
   a. Flexed by: recti, obliq. and pyramidales abdominis.
   b. Extended by: multifidi, interspinales, spinales and semispinal. dorsi, sacro-lumbales and longissim. dorsi.
   c. Drawn sideways by: multifidus on one side; rotated by: rotatores dorsi and multifidus of one side.

411. 2. The ribs are:
   a. Elevated and the chest widened as the lungs expand, and the diaphragm contracts downwards (descends) by: intercostales, levatores costarum, scaleni (they fix the first ribs), serratus posticus superior. As in inspiration.

   Note. Deep inspiration is effected by sterno-cleidomast., subclavius, pectorales, serratus anticus, latissim. dorsi, cervicalis descend. The intercostales (and infra-costales) approximate the ribs, since they draw them upwards (inspiration) or downwards (expiration).
   b. Drawn downwards by: intercostales, serratus post. inferior, triangularis sterni, quadratus lumborum (fixes the twelfth rib), abdominal muscles. As in expiration.

412. 3. The sternum is:
   b. Downwards by: recti abdominis.

413. C. The lumbar portion of the vertebral column is:
   a. Flexed by: psoas major et minor of both sides.
   b. Extended by: longissim. dorsi, ileolumbalis.
c. Inclined sideways by: *quadrat. lumar., multifidus* and *inter-transversarii* of one side.

414. D. The coccyx is:
   a. Flexed by: *sacro-coccygeus anticus, coccygeus; levator ani.*
   b. Extended by: *sacro-coccygeus posticus.*

415. E. The pelvis is drawn and rotated forwards, backwards, and sideways by the flexors, extensors, and rotators of the thigh.
   a. The anus is closed by: *Sphincter ani; anus and prostate* elevated by: *levator ani.*
   b. The urethra is compressed by: *constrict. isthmi urethr.; the corp. cavernosa* by: *erector penis; the bulb* by: *bulbo-cavernosus.*
   c. The bladder is drawn down by: *the vesicalis; the vagina* contracted by: *constrictor vaginae.*
   d. The testes raised towards the external abdominal ring by: *cremaster.*

III. Superior Extremity.

416. A. The clavicle is:
   a. Raised by: *cucullaris, cleido-mastoideus.*
   b. Drawn down by: *subclavius, pectoral. major, deltoideus.*

417. B. The scapula is drawn:
   a. Upwards by: *lev. anguli scap., and cucullaris.*
   b. Forwards, inwards, and downwards by: *pectoral. minor, coraco-brachialis.*
   c. Forwards and outwards by: *serratus ant. major.*
   d. Backwards by: *rhomboidei, cucullaris.*
   [The shoulder is rotated by: *cerratus ant. major.*

418. C. The humerus is:
   a. Abducted by: *deltoides, coraco-brachial, supra-spinatus.*
   b. Adducted by: *pectoral. major., latissim. dorsi, teres major.*
   c. Rotated outwards by: *infra- and supra-spinatus, teres minor; inwards by: subscapularis and teres major.*

419. D. The fore-arm is:
   a. Flexed by: *biceps and brachialis internus.*
   b. Extended by: *triceps and anconæus.*
   c. Proned by: *pronator teres and quadratus.*
   d. Supined by: *supinator longus and brevis.*

420. E. The hand is:
   a. Flexed by: *flexor carpi radial. and ulnaris, palmaris longus.*
b. Extended by: extensores carpi radiales and ulnaris.
c. Adducted, that is, moved towards the ulnar border of the arm by: flex. and extens. carpi ulnaris; abducted (towards the radial border) by: extens. and flexor radiales carpi; Proned and supined, see D.

421. F. The fingers are:

a. Flexed by: flexor digitor. (sublimis second phalanx of the second, third fourth, and fifth fingers); by flexor digitor. profundus (third phalanx of the same fingers; by lumbricales (first phalanx of the same fingers); first phalanx of thumb, by flexor pollicis brevis, second phalanx by fl. poll. longus; of little finger, by fl. digit. minimi.
b. Extended by: extens. comm. (second, third, fourth, and fifth fingers); the thumb by: extens. pollic. long., brevis and abductor longus; the index finger by: extens. indicis; the fifth finger by: extens. dig. minimi propr.
c. Adducted (towards the middle finger) by: interossei and adduct. pollicis.
d. Abducted by: interossei, abduct. pollic. and digit. minimi.
e. The thumb and little finger approximated by: opponens pollic. and digit. min., whereby the hand is made hollow.

422. IV. Inferior Extremity.

A. The thigh is:

a. Flexed by: psoas and iliacus [and pectineus].
b. Extended and abducted by: glutæi (3).
c. Adducted by: adductores (3) and pectineus.
d. Rotated outwards by: pyriformis, gemelli, obturatores, quadratus femoris.
e. Rotated inwards by: tensor. fasciæ lat., and the anterior part of glutæus med. and minimus.

423. B. The leg is:

a. Flexed by: biceps, semitendinosus, semimembranosus, popliteus, sartorius gracilis.
b. Extended by: vastus externus and internus, cruralis and rectus femoris. These muscles assist at the same time to flex the pelvis upon the thighs.
c. Rotated, outwards, by: biceps; inwards, by: sartorius, gracilis, semitendinosus, popliteus.

424. C. The foot is:

a. Extended by: gastrocnemius, solæus, plantaris longus; tibialis posterior and peronei long. and brevis; assisted by the flexors of the toes.
b. Flexed by: *tibialis anticus* and *peronæus tertius*; assisted by the *extensors* of the toes.

c. Adducted by: *tibialis anticus* and *posticus*.

d. Abducted by: *peronæi* (3). Neither *pronators* nor *supinators* are found on these bones.

425. D. The toes are:

a. Extended by: *extens. digitor. comm. long.* and *brevis* (second, third, fourth, and fifth toes), *extens. halluc. longus*.

b. Flexed by: *lumbricales* (first phalanx); *flex. comm. brevis* (second phal.), *comm. long.* (third phal.) and *caro quadrata*; the great toe by *flex. halluc. prop. long.* (second phal.), *brevis* (first phal.).

c. Adducted by: *interossei interni, adduct. hallucis*.

d. Abducted by: *interossei externi, abduct. hallucis and digit minimi*. 
SPLANCHNOLOGIA.

OF THE VISCERA.

"The best means of avoiding the errors which have now been referred to, (viz., the construction of hypothetical theories, or the assumption of principles which are altogether gratuitous and imaginary, and the deduction of general principles or conclusions from a limited number of facts,) will probably be, to keep in mind the important principle, that the object of physical science is, 'to ascertain the universality of a fact.' A considerable number of medical doctrines, there is reason to apprehend, will come out of the examination in rather an unsatisfactory manner, if we apply to them the tests which this rule would furnish, namely—are they facts, and are these facts universal?"—Abercrombie. *Path. and Pract. Researches on the Diseases of the Stomach, &c.*, Preface.
THE VISCERA.

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Colles. Surgical Anatomy, 1811, for Perineal Fascia.
Guthrie. Anat. and Descrip. of the Neck of the Bladder and Urethra, 1834, for “Guthrie’s Muscles.” And Anat. and Dis. of the Urinary and Sexual Organs. 1843.
are very compound organs, consisting of various tissues, several of which together form a system destined to the performance of some particular function. Belonging to this division we have the Organs of Digestion, Respiration, Generation, Micturition, and the Senses.

427. A. Organs of Digestion, Organa digestionis, consist of one canal, which extends from the opening of the mouth to that of the anus, and several appendages (as: oral and salivary glands, liver, ventral salivary glands, spleen).

a. Parts above the Diaphragm.

428. 1. Cavity of the Mouth, together with its appendages.

_Cavum oris_, mouth, is situated at the inferior part of the face between the two jaws and the cheeks, behind the lips and before the pharynx. Its roof forms in front the hard palate, behind the soft; its floor the tongue and _mm. genio-, hyo-glossi, genio- and mylo-hyodei_. Before, it opens externally between the lips; behind, through the fauces, _isthmus faecium_, into the pharynx. The anterior, or buccal cavity, is the space between the cheeks and the dental alveoli; the proper mouth, the space between the dental alveoli and the fauces.

The Lips, _labia_, form the moveable anterior wall of the cavity of the mouth, separated by the transverse oral fissure, _os_, into the upper and under lips, placed (in man) vertically over one another, before the alveoli and the teeth. Their thick, everted, red edges, _prolabia_, are bounded laterally by the angle of the mouth, _angulus oris_. On the anterior surface covered by the external skin, the upper lip is bounded by the skin of the cheek at the projecting internal border of _m. levator labii super. alaeque nasi_, the under lip at the inner border of _m. triangularis_. The _linea naso-labialis_ (_s. abdominalis_) thence arising (the strongly-marked furrow of intestinal disorder), commences at the _ala_ of the nose, and terminates at the sides of the chin. On the upper lip we observe: the mustachios, _mystax_; in the centre a longitudinal furrow, _philtrum_; on the under lip: the beard, _pappus_; upon the transverse groove or the boundary between the under lip and chin, _sulcus mento-labialis_.—The posterior (internal) surface of the lips is covered with mucous membrane, which applied to the gums, is beset with glands, _glandule salivales labiales_, and in the centre, particularly of the upper lip, forms a fold, _frenulum_. Between the external skin and the mucous membrane is placed the proper foundation of the lips, namely, _m. orbicularis oris_ (see before), together with fibres from the muscles bordering it.

Vessels of the lips.—Arteries: 1. _Artt. coronarie_ from _art. facialis_. 2. _Artt. buccales, infraorbitales, alveolares_ for the upper lip,—from _Art. maxillar. interna, mentales_ for the under lip from _art. facialis_. Veins: _plexus labialis_, opens
into *Ven. facialis anterior*.—Lymphatics: open into the glands at the base of the chin.

Nerves: first division of fifth and seventh cerebral nerves, from plexus infraorbitalis and mentalis.

Uses of the lips: Sucking, Speech, &c., expression of the affections. The under lip more especially prevents the efflux of saliva.

Cheeks, *buccae, gene*, bounded above, by the *Basis orbitae*, below, by the basis and externally by the posterior border of the lower jaw, consist of the following parts:

Skin, very vascular, delicate, particularly in the region of *eminencia malaris* (malar bone), where it is firmly fixed; beset with the whiskers, *julius*. A deposit of fat, thick in the central region, between *m. masseter* and *buccinator*.


Salivary glands: *glandula*, *buccales*, between the muscles and the mucous membrane opening upon the last; two larger, *gl. molares*, lie between *m. buccinator* and *masseter*, and open in the region of the last molar teeth.

The mucous membrane is perforated in the region of the first and second superior molar teeth by *ductus Stenonianus*. *Ductus Stenonianus*, accompanied by *nerv. buccal. med.*, below *art. transv. faciei*, curves inwards at the anterior border of *m. masseter*, perforates the fat which covers the *m. buccinator*, and the muscle itself at a distance of five lines from *m. masseter* and four from the inferior border of *os. zygomatic*.

Vessels.—Arteries: 1. Branches of *art. maxillar. externa* and *transversa faciei*. 2. Branches of *art. maxillaris interna*, as: *infraorbitalis, dentalis infer.*, *buccalis, masseter, alveolaris*. Veins: *plexus buccalis*, which opens into the *v. facialis anterior*. Lymphatics: they pass into the glands in the *parotis* and of the neck.


Uses: Chewing, Sucking, Speech, &c.

The Palate, *palatum durum*, is formed by the *processus palatini* of the upper jaw and the horizontal of the palate bones, covered by a spongy thick membrane, perforated by vessels, nerves, and glands, *membrana pulposa palati*, which, especially anteriorly, in the rough places, is firmly connected with the periosteum. It is vaulted, presents in the middle line a suture, and at the anterior termination of this the opening of *canalis incisivus* (for nerv. nasopalatinus).

Salivary glands: *glandulae palatine* are particularly numerous at the posterior extremity of the raphé.


The soft palate, *palatum molle s. mobile*, *velum palatinum*, *velum pendulum*, *palati*, is the membrano-muscular valve which separates the oral from the nasal cavities and pharynx. It hangs downwards in a curvilinear form from the posterior border of the hard palate, in swallowing (during the passage of food) horizontal; it presents an inferior concave and a superior convex surface which elongates the floor of the nasal fosse. From the centre of the inferior border, the *uvula* is dependent, the apex of which may sometimes rest upon the basis of the tongue, a few lines before the opening of the larynx, and sometimes it is fissured. The lateral borders of the *velum*, between the
posterior extremity of the superior and that of the inferior alveolus, correspond to the anterior border of the *m. pterygoïd. internus*, consisting, to a great extent (especially behind the last inferior molar tooth), of a series of glands. From the *Uvula* two folds pass downwards on either side, the palatine arches, and form the *Isthmus faucium*.

1. *Arcus palatinus anterior s. glosso-palatinus*, the anterior palatine arch, arises from the base of the *uvula*, is connected at the borders of the tongue, in the region of the anterior extremities of the *papille calcine*, which are arranged in the figure of the letter V with these, and contains the *mm. glosso-palatini*.

2. *Arcus palatinus posterior s. pharyngo-palatinus* arises from the apex of the *uvula*, passes obliquely downwards, backwards and outwards to the sides of the pharynx, is smaller, but reaches farther inwards; it contains the *mm. pharyngo-palatini*, and is uneven in consequence of a circle of glands. Between the two arches are situated on either side in a depression, one of the

3. Tonsils, *tonsilla*, *amygdale*, that is, a group of mucous follicles, compound glands, which, directed obliquely downwards and forwards, is turned towards the internal (free) surface of the perforated mucous membrane, covered externally by the *fascia pharyngea* and the angle of the lower jaw. The tonsils consist chiefly of uniting tissue disposed in channels in which the numerous vessels pass, and between which the granular glandular mass is placed with many excretory ducts. Arteries come from *art. labialis, pharyng. inferior, lingual, palatina infer. and superior*. Veins: *plexus tonsillaris* from *plexus pharyngeus*. Nerves: are branches of *N. lingual*, and *glosso-pharyngeus*, on the outer border. Function: to secrete mucus which lubricates the faucæ.

4. *Isthmus faucium*, the faucæ, that is, the opening between the palatine arches, which may be contracted by the tonsils and by the play of the muscles.

The mucous membrane of the soft palate is covered with little glands (*gl. salivares*), at the free extremity more delicate. The numerous arteries come from *Art. palatina ascendens* and *descendens*. Veins: of the same name. Nerves: branches of *rami palatini* from *Ganglion Meckelii* and *n. glosso-pharyngeus*. (The uvula contains much loose uniting tissue, which is easily infiltrated with blood or serum). Muscles (see before).

Uses of the soft palate: in deglutition, speech and singing.

429.

1. The Tongue, *Lingua, γλῶσσα*,

the muscular organ for taste, is situated above, before and at the sides, free and moveable, in the cavity of the mouth, attached by ligaments to the hyoid, bone and by muscles to this, to the *Proc. styloidei* and lower jaw; before horizontal, then curved and towards the hyoid bone almost perpendicular. Here at the root, *radix s. basis linguae*, it is also connected with the *epiglottis*. Its point, *apex*, is placed close behind the incisor teeth. The superior free surface, *dorsum linguae*, divided by a groove into two lateral halves, is rough, covered with numerous mucous glands and lingual papillae; the inferior surface is free in the anterior third only; it presents in the centre a groove, at the sides of which the *Vv. raninæ* and *Mm. linguæles*, and the *frenulum*,

...
that is, a fold of the oral mucous membrane, which, abstractedly of the muscles, attaches the tongue to the floor of the mouth. On either side of the frenulum behind the excretory ducts of the salivary glands *burseae mucosae* are placed (according to Fleischmann the seat of *ranula*).

a. The substance of the tongue, *caro linguae*, consists for the most part of *m. lingualis*, which forms, on the superior and inferior surfaces, a longitudinal layer extending from the hyoid bone to the apex of the *m. stylo-glossi*, the internal fibres of which are transverse, and *mm. genio-glossi*, the fibres of which, curved above, pass vertically, and *mm. hyo-glossi*, which likewise enter the tongue vertically between *m. lingualis* and *stylo-glossi*. In the centre of the root, attached to the anterior surface of the *Basis oss. hyoidei*, a thin lamina of cartilage is found, the inferior border of which lies between *mm. genio-glossi*.

b. The lingual membrane, *involutrum s. cutis linguae*, thicker than the mucous membrane of the mouth, and firmly attached to the places where it is beset with papille, is covered with Epithelium (*periglottis*). It forms besides the *frenulum linguae*, 3 *ligg. glosso-epiglottica*, from the root of the tongue to the Epiglottis, and several triangular folds, *fimbriae linguae*, under the borders of the tongue.

c. *Lingual*, or gustatory papille, *papille linguae*, are small elevations upon the back and edges of the tongue, composed of condensed uniting tissue, and provided with capillary vessels and delicate nerve filaments.

1. *Papilla vallatae*, *s. truncatae s. calicinae*, 7—16—20, in the form of a capital *V* (the apex behind—the last called *foramen oecum s. Meibomii*) at the root of the tongue, like an inverted cone, surrounded all round with a fossa and a wall.

2. *Pap. conice, filiformes*, the smallest and most numerous, lying on the apex and the anterior part of the back of the tongue, in an oblique direction from before, backwards.

3. *Pap. lenticulares s. fungiformes*, which, shaped like a club, are found dispersed between the *Pap. conice*. At the edges obliquely inwards towards the root of the tongue, we find four or five parallel fissures beset with nervous papille; these are *rurseae transversae Arnoldii* (*s. pap. lingualis foliata, Mayer*).

Uniting and adipose tissue is dispersed particularly at the posterior part of the tongue.

Vessels: *Artt. and Ven. linguales, palatinae and pharyngae inferiores.*


Movements: (see Muscles, before.)

### 430. 2. Salivary glands of the mouth, *glandulae salivales oris.*

a. The parotid, *gl. parotis*, is larger than the other salivary glands, irregular in shape, and placed before and below the auricle of the ear.

*Basis, or external surface*: broad, oblong, covered by *fascia parotideae, m. risorius*, and skin.

Anterior surface: concave, surrounds the posterior border of *ramus maxillar. infer.*, separated from it by uniting tissue; behind *m. pterygoideus intern. lig. stylo-maxillare, m. masseter*, from the external surface of which it is separated by *romi n. faciales*, loose uniting tissue, and *art. transversa faciei*.

Posterior surface, likewise concave, lies against the cartilage of the external
auditory meatus, firmly united to it, before Proc. mastoideus, Mm. Sterno-cleido-mast. and digastric. (post. belly.)

The internal edge is bounded by Proc. Styloideus and the muscles arising from it. Between this and m. pterygoideus internus we find a prolongation, with a groove for Art. carotis externa. The superior border lies under Arcus zygomatic, and Artic. temporo-maxillar. The inferior extremity fills the space between angulus maxillar. inf. and m. sterno-cleido-mast. separated from the gl. submaxillaris by a fibrous septum.

Withinside the gland are situated, Artt. temporali, transv. faciei, auriculares anterr.; V. facial. posterior; N. facialis and its plexus anserinus; N. auricular. from plexus cervicalis, but superficial; (red) lymphatic glands.

Structure. Single acini are united into lobuli, which are held together by the dense general envelope of the gl. parotis.

The Excretory duct, ductus Stenonianus, arising from the associated ducts of all the acini, passes out from the centre of the anterior border of the gland, crosses horizontally forwards (below art. transv. faciei) five or six lines under the zygoma, over the external surface, to the anterior border of the m. masseter, curves at this point around a mass of fat, perforates it and m. buccinator vertically, and passes for some lines between it and the mucous membrane, until it opens in the region of the first and second molar teeth. It is thicker at the anterior than at the posterior extremity; it consists of an internal (mucous) and an external coat, and is rather extensible. At the posterior extremity a small lobule is sometimes attached, parotis accessoria.

The vessels of the Parotis are numerous: Artt. are branches of the temporal., transvers. and auricularis. Vv., like the nerves, form a plexus parotideus, and fall into V. facial. posterior. Vas. lymph. enter the lymphatic glands at the angul. maxill. and those before the external auditory meatus.

Nerves: they are branches of plexus anserinus and N. auricular. anter.

b. The submaxillary gland, glandula submaxillaris, oblong, flat, bipartite, placed, partly, on the internal surface of the basis max. inf., covered externally and below by fasc. cervical., v. facial. ant., m. platysma myoides, and skin; internally, by nerv. lingualis and hypoglossus and m. hyo-glossus, with a groove (behind) for Art. maxillar. externa; meets behind with the post. belly of m. digastricus; surrounds in front the posterior border of m. mylo-hyoideus; and connected, above the last, with gl. sublingual., it gives off at this point its excretory duct, the

Ductus Whartonianus, shorter, more delicately membranous, but wider than the d. Stenon., passes obliquely from below upwards, and from without inwards, parallel with n. hypogloss, and lingualis, at the commencement between m. mylo-hyoideus (above this) and hyo-glossus, then between m. genio-glossus and gl. sublingualis, on its internal surface, always close beneath the mucous membrane, and opens at the sides of frenulum linguae in the papillae caruncula sublingualis, behind the inferior incisor teeth.

Vessels: Artt. are branches of maxillar. externa., Vv. pass into the ven. facialis anter.

Nerves: they come from the gangl. maxillare nerv. lingualis.

c. The sublingual glands, glandula sublingualis, small, oblong, flat, in a fossa of the lower jaw close to Spina interna menti, projects inwards into the cavity of the mouth, covered at this spot with mucous membrane only, close to the frenulum; they rest upon m. mylo-hyoideus (between the two gangl. sublingual); the internal surface is directed towards m. genio-glossus and separated from the last by N. lingualis, ductus Wharton., V. ranina. The anterior extremity of
one sublingual gland meets that of the other; the posterior extremity and the
inferior border surround the nerve, lingualis.

The excretory ducts: 1. d. Bartholinianus opens upon the caruncula sub-
lingualis, or unites with the duct Whartonianus. 2. d. Riviani; from seven
to twelve small ducts open along the frenulum upon the mucous membrane of
the mouth, or are associated with the ductus Bartholin.

Vessels: Artt. and Vv. are branches of sublingualis.

Nerves: branches of ram. lingualis trigemini with gang. sublinguale.

431. 3. The teeth, dentes, mordices, are bone-like bodies,
fixed (per gomphosin) into the alveoli of the jaws, thirty-two in
number (in the full-grown adult), consisting of a soft nucleus sur-
rounded by a hard, brittle, osseous substance (dentine) and the
enamel. The crown, corona dentis, projects freely into the mouth,
covered with enamel; the neck, collum, is a smaller portion sur-
rounded by the gums; the root, radix, is fixed into the alveolus
(socket). Both the alveoli and the roots of the teeth are covered
with a delicate, highly vascular periosteum, which enters the
cavity in the interior of the tooth through a fine foramen at the
extremity of the root, and surrounds the nucleus.

a. Incisor teeth, d. incisivi s. primores,

4 superior,
4 inferior,
in the centre, at the anterior part of the arcus alveolares. The crown is chisel-
shaped, convex in front, concave behind, the free edge sharp and broader
than the basis, which is thicker; the root is single (rarely double), conical, flat
at the sides, obtuse at the point. The superior incisors are stronger than the
inferior, the central (superior) stronger than the external. The superior
converge downwards; the external inferior diverge upwards.

b. Corner, canine teeth, d. canini s. cuspidati,

2 superior (eye teeth),
2 inferior,
the one by the side of the external incisors, are the longest, especially the
superior. The crown thick, irregular, conical, triangular, pointed; the root
longer (especially the superior) and thicker than the rest of the teeth, single.
The inferior canine teeth are received (when the teeth are closed) between
the superior canine and external incisors.

c. Back, masticating teeth, d. molares.

10 superior,
10 inferior,
five upon each side, next to the canine tooth. The crown is short, almost
cubical, the free extremity quadrangular and uneven; root compound.

We distinguish: 1. dent. molares minores; these are the two anterior next
the corner teeth. Their crown is small, with two tubercles (bicuspidati);

4 superior,
4 inferior;
their root single, flat, or (rarely) slightly bifurcated. The superior are stronger; the root of the second superior bicuspid is usually bifurcated.

2. D. molares majores, the three posterior back teeth (the last called dens sapientis), have a low broad crown with three or four tubercles (tri, quadracuspidati,) and two, three, or four at one time parallel, at another diverging, or hooked, curved roots; those of the wisdom teeth are united into a single root. Lent. molar, major.

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<td>3 2 1 2</td>
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<tr>
<td>Incisors</td>
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<td>4 1-1</td>
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Elements of the teeth.

1. Dentine, substantia ossea s. ebur, forms the principal mass and the foundation of the teeth, is marrowless and non-vascular, formed of layers not of canals, harder and more transparent than the (common) substance of the bones, of which a thin layer covers the external and internal surfaces of the root of the tooth. It is yellowish white, iridescent, consisting of concentric layers and parallel longitudinal fibres and especially rich in Chondrin. This last is wanting in

2. The Enamel, subst. vitrea s. corticalis, which covers the crown, is bluish white, very hard (resisting the file) and heavy, presents horizontal fibres, and is said to be deposited from a peculiar organ, membrana adamantina (Purkinje).

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<tr>
<td>Phosphate of lime</td>
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<td>85.3</td>
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<td>Magnesia</td>
<td>Carbonate of lime</td>
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<td>Carbonate of lime</td>
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<td>5.30</td>
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<td>Fluoride of calcium</td>
<td>Membranes, soda and water</td>
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<td>2.10</td>
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<td>Soda and common salt</td>
<td>Cartilage and water</td>
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<td>1.40</td>
<td>28.00</td>
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3. The nucleus, germ of the tooth, *nucleus s. pulpa dentis*, lies in the cavity of the tooth, *cavum dentis*, the shape of it being determined by that of the cavity; it is a reddish body, consisting of uniting tissue, capillary vessels and nerves, surrounded by a thin and very sensitive membrane. The arteries come from *Art. maxillar. interna*; (*Art. alveolar. anter., poster., and infer.*); the veins open into *Ven. facialis ant. and post.*; the nerves are branches of *ram. maxillar. super. and inferior* (*N. alveolar. ant., poster. and inferior*).

432. The tissue of the gums, *gingiva* (*ōνλον*), thicker and more firm than the mucous membrane of the mouth, the continuation of which is, covers the alveolar processes of the jaws, and is connected with the *periosteaum* by a very vascular, loose uniting tissue. It turns over the free edge of the alveolus for about a line broad, and then passes into the periosteaum of the alveoli. It is provided with the *glandul. tartaricae*, mucous glands, which deposit the so-called tartar; little sensitive when cut, more when pressed; becomes hard like cartilage after the teeth have fallen out, when it covers over the *alveoli*. Arteries: *coronar. super.*, *submental.*, *sublingual*. Nerves: from *n. quintus*.

433. Development of the Teeth.

a. Before their eruption. The jaws of a two to three months' foetus present a broad and deep fossa, which is divided by thin septa into cells, and closed upon the free border by a whitish and firm fibrous tissue (dental cartilage).

At the time when the dental sacculi form, prolongations of the dental cartilage go to the floor of each cell, line it from without, and leave a small opening, only, for the entrance of the vessels and nerves.

The dental sacculi, *folliculi dentium*, are closed membranes, filled with a reddish, viscous fluid, four of which appear in the middle of the third month, and six in the fourth month, in each jaw.

The tooth germ, *pulpa dentis*, elevates itself at first in the fourth month, from the flood of the sacculus, as a papilla-shaped body, the thin pedicle of which forms the dental vessels and nerves, increases by degrees into the sacculus, it becomes the nucleus about which the tooth (the crown first) forms. In the fifth month ossification commences, that is to say, thin elastic discs of *dentine* are deposited upon the surface of the *pulpa*, and indeed, so many as the tooth at a later period is said to have tubercles. At a later period they coalesce and become strengthened by new discs annexed to them from within. But the enamel is not deposited from the *pulpa*, nor even from the reddish fluid which washes round it, but from the lamina of the dental sacculus turned towards the cell, and, indeed, from an enlargement at the top of the crown to which last it is applied, at first (even in the mature foetus) as a soft and moist mass.

In the fifth month the central, then the external, incisor teeth form and become ossified; in the sixth month, the first molar, the canine, the second molar teeth.

b. Eruption of the (milk) teeth, *dentition, eruptio dentium, dentitio prima*. When after the birth of the child the roots of the teeth have reached the floor of the dental cells, the gum, in consequence of their farther growth, is pressed upon, inflames, and thence becomes perforated.
It happens in the following order. At the seventh month the central inferior; after them the remaining (generally, the central superior, first) incisor teeth; at the end of the first year the first molars; in the middle of the second year the inferior canine, later the superior, and, at the end of the second year, the second molars; in the whole twenty teeth.

\[
\text{Formula: incisors } \frac{4}{4}; \text{ canine } \frac{1-1}{1-1}; \text{ molars } \frac{2-2}{2-2} = 20. \text{ TRANS.}
\]

These milk temporary teeth, \textit{d. lactantes s. temporarii}, remain until the or seventh year, when they make room for the permanent, \textit{d. permanentes}. The milk teeth are smaller and narrower, the crown and root do not pass gradually into one another, but are separated by a kind of circle; the (superior) first temporary molar has three roots (the permanent only one); the (inferior) first temporary molar, a crown with several and sharp points, and a double root; the second temporary molar a broad crown and five points, with a double or three-fold root.

c. The change of teeth, \textit{mutatio dentium, dentitio secunda}. The (thirty-two) permanent teeth are also developed from dental sacculi, of which those which ought to occupy the places of the twenty temporary teeth are situated in the same cell with them, the twelve to be newly added in their own proper cells. The germs form in the following order: in the fifth month of embryonic life the germ of the third molar tooth arises, in the eighth month that for the remaining incisor teeth, at the end of the first year that for the canine, and rather later that for the fourth molar; in the eighth month after birth the germ for the first and second; in the fourth year that for the last molar.

The decadence of the temporary teeth is preceded by a diminution of the artery which passes to each, whereby the root of the tooth is first absorbed, and the bony canal of the artery contracted; then, in the ninth year, quite closed.

The eruption of the permanent teeth takes place in the following order:

- In the seventh year appear \{ The middle pair of the superior, later, that of the inferior Incisors. \\
- The three Molar teeth. \\
- The inferior external, later, the superior external Incisors.

- In the eighth year \{ The first and second Molars (below and above). \\
- The Canine.

- In the ninth year \{ The fourth Molar, and \\
- Between the twentieth and thirtieth \{ The last or wisdom teeth.

- d. The decadence of the teeth in old age is normal, and appears to be effected by the pulp of the tooth, by degrees, ossifying, and the nourishing vessels becoming obstructed. The cells also in which the teeth are seated fill with bone earth (the teeth become apparently longer), their edges become absorbed, and, in consequence, the jaws lower, the gum, after the decadence of the teeth, draws over the free surface, and becomes cartilaginous (as it was before in the suckling). The decay of the teeth appears also to be in connection with the grinding away and loosening of the enamel; the crown is already worn even before the teeth are completely perfect.

Anomalies in the number of the teeth. Most frequently the wisdom,
sometimes the first molar, rarely the external incisor teeth, remain undeveloped. Occasionally some molar teeth exceed the number (more frequently in Negroes). With many children the eruption of the milk teeth takes place before birth. A third mutation sometimes occurs with the posterior molar and the incisor teeth.

5. The Pharynx,
a funnel-shaped muscular semi-canal behind the nasal and oral cavities and the larynx, in the central line before the five superior cervical vertebrae, at the superior part called the fauces, is closed above, behind and at the sides, but before and below (where it passes into the esophagus) open. Narrower than the mouth, but wider than the esophagus, its breadth measures above (between the posterior borders of the internal wings of the P. pterygoidei) about one inch, farther down (between the posterior extremities of the alveoli) two inches [during contraction of the muscles only one inch], still deeper (between the inferior cornua of the thyroid cartilage) rather above one inch [to almost complete closure during contraction of the muscles]. Length: four to four and a half inches [may be elongated to about five and a half, shortened to two and a half inches].

The external surface is formed of a muscular coat, behind, united with the fascia cervicalis (profunda) by loose uniting tissue, and is situated before mm. recti capitis anterior, and longus colli; is at the sides separated from m. pterygoideus internus by a triangular (below broad) space, in which are found: Carotis interna, V. jugularis interna, Nn. vagus, glosso-pharyng., hypoglossus, accessor. Willis., farther down many lymphatic glands and Carotis externa. Above (the roof) it is attached to the pars basilaris, ossis occipitis.

The internal surface is covered with mucous membrane. The anterior wall is wanting; instead, we see: 1. The two posterior nasal openings. 2. The superior surface of velum pala- tinum, above which the fluid from the nose flows into the posterior part of the mouth. 3. The semicircular isthmus faucium. 4. The superior opening of the larynx closed by the epiglottis. 5. The posterior surface of the larynx. The posterior wall is even broader above than below. The lateral parietes with the opening for the tuba Eustachii (at the same elevation as the posterior extremities of the inferior turbinate bones).

The limit between the pharynx and esophagus is indicated by: the narrowness of the tube, the paleness and the altered direction of the muscular fibres of the latter.

Muscles (see Myology). Fascia: 1. F. pharyngea posterior arises from the inferior surface of pars basilaris, tuba Eustachii, and serves for the attachment
of the mm. constrictor pharyng. 2. F. pharyngea lateralis arises from os petrosum (at the internal border of the inferior opening of canal. caroticus), passes to the lateral wall of the Pharynx, attaches itself in the fossa pterygoïd. between m. pterygoïd. intern. and circumflex. palati, with a process to the m. buccinatorius, covers the tonsils, and attaches itself to the superior border of os hyoideum.

Vessels: Branches of Art. pharyngea ascendens, thyreoidea super. and infer., palatina ascend. and pterygo-palatina.

Veins: they form plex. pharyngeus.

Nerves: plex. pharyngeus superior and inferior (from N. vagus, glossopharyngeus, accessor. Willis. and sympathetic), and ganglion sphenopalatinum.

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6. The Ösophagus,

a flat, extensible, muscular canal, from eight to nine inches long, reaches from the fifth cervical vertebra as far as the tenth dorsal, that is, from the inferior opening of the pharynx to the superior of the stomach; narrowest in the cervical region, widest at the inferior extremity; and closed in the remaining portion, since the anterior comes in contact with the posterior wall.

a. Cervical portion: 1. covered in front by the trachœa, to the left (as the œsophagus deviates to the left) by m. sterno-thyroideus (sinister), the thyroid gland, N. recurrens (sinist.), Art. and Ven. thyreoidea infer., connected above by condensed uniting tissue with the trachœa; 2. behind, attached by loose uniting tissue to the vertebral column; N. recurrens dexter; 3. at the sides: the thyroid gland, Carotis communis, Ven. jugularis interna.

b. The thoracic portion passes along the posterior mediastinum.

1. Before it are placed: the trachœa, and farther down the bronchus sinister, arcus aortæ, and lastly the pericardium (with the basis and posterior surface of the heart); below n. vagus sinister. 2. Behind it: the vertebral column; separated from it by uniting tissue, lymphatic glands, Ven. azygos and ductus thoracicus (above); quite below: Aorta thoracica and N. vagus dexter. 3. At the sides: the lungs, separated from it by the middle mediastinum; the whole length of N. vagus; to the right (from the fourth dorsal vertebra) on ven. azygos, duct. thorac.; to the left: Aorta thoracica. In the thoracic portion the œsophagus projects in a more marked manner to the right.

c. The abdominal portion, very short (rarely an inch), passes through foram. æsophageum of the diaphragm, and is immediately enveloped by peritonœum before and to the right of the left lobe of the liver, behind embraced by lobulus Spigelii.

Structure. 1. Muscular coat, tunica externa, thick, above red, below paler; consists of an external layer of longitudinal fibres, which descend from the posterior surface of Cartilago cricoidea, and are lost in the first layer of the
muscular coat of the stomach; and of an internal layer of circular fibres, which are lost in the third layer of the muscular coat of the same organ.

2. Mucous membrane, tunica interna, is connected with the last by a thin layer of uniting tissue (tun. propria s. nervae) of a whitish and wrinkled (rugous) appearance, with long folds beset with oblong mucous glands and pavement epithelium. The oesophagus is surrounded externally by lymphatic glands (gland. mediastinae postic.).

Vessels: Artt. asophagae come to the cervical portion from thyroïd. infer.; to the thoracic: 1, direct from the Aorta; 2, from bronchiales; 3, from intercostales (sometimes mammaria interna; to the abdominal portion: from coronar. ventric. and phrenica inferior.

Veins correspond to the arteries, and open besides into Ven. cava. sup. and azygos. Lymphatic vessels enter the numerous glands around the asophagus.

Nerves: vagus and ganglia thoracica of nérv. sympathetic; form plexuses before and behind the asophagus.

b. Parts below the Diaphragm.

436. 1. The Stomach, ventriculus, stomachus,
a membranous, curved sac, the shape of a flattened cone, which is situated transversely in the superior region of the abdomen, below the diaphragm, filling up the left regio hypochondriaca, and extending as far as the right (passing through the reg. epigastrica).—Direction: oblique from above downwards, and from left to right. In this position it is maintained by Æsophagus, Duodenum, and a fold of Peritoneum which attaches it to the Liver and Spleen.

Parts of the Stomach: 1. Anterior wall; this is directed forwards and somewhat upwards, covered above by the heart, to the left by the six last ribs, separated by the Diaphragm, to the right by lobul. quadrat. of the liver, and before by the anterior abdominal parietes (reg. epigastrica).

2. The posterior wall looks downwards and backwards, is placed above the Colon transversum, before the Duodenum and Pancreas; and rests upon Mesocolon transvers.

3. Curvatura Major, that is, the inferior convex border which, in the distended stomach, looks forwards, and to which the two anterior laminae of the great omentum are attached (at this point Artt. gastro-epiploicæ).

4. Curvatura Minor, that is, the superior concave border between Cardia and Pylorus. In the full stomach it looks upwards and backwards, separated from the vertebral column by the Aorta and Diaphragm; surrounds the small lobes of the liver, the tripus celiacus (Halleri) [cæliac axis] and plexus solaris; to it is attached the small omentum.

5. Fundus ventriculi, base of the stomach. This includes the entire portion of the stomach situated to the left of the Cardia,
and terminating in a cul-de-sac. It is round, large in circumference, separated by the Diaphragm above, from the lungs, before, from the six last ribs, applied, outwards, against the spleen (thence portio splenica), and united with it by Lig. gastro-splenicum and Vasa brevia; behind, against the Pancreas, left Kidney, and Caps. supra-renalis.

6. Pars pylorica, at the right extremity of the stomach, is bounded at its junction with the wider central portion of the organ by a slight contraction, but at its union with the Duodenum, in which it terminates, by a stronger; before which, at the distance of one inch from the stomach, it takes a considerable curve (upwards), and forms a small blind sac; it looks to the right, backwards and upwards; lies under the liver and the small omentum, above the great, before the Pancreas, behind the abdominal walls between reg. epigastrica and hypochondriaca dextra; not uncommonly close to the gall-bladder.—Pylorus s. ostium duodenae is situated behind the lobulus quadratus of the liver, leads into the Duodenum, from which it is shut out (inwardly) by a valve, valvula pylori.

7. Cardia s. ostium æsophageum, the mouth of the stomach, lies at the left superior portion of the stomach between Curvatura minor and Fundus ventriculi, close under foram. æsophagi of the Diaphragm (with lig. phrenico-gastricum), embraced in front by the left border of the liver, behind by the lobulus Spigelii (behind the so-called cardiac fossa; yet not always). The width of Pylorus and of Cardia measures about one inch.

Structure of the Stomach.

a. The mucous membrane, villous coat, a continuation of that of the æsophagus, forms the most internal coat of the stomach. Very thin and extensible, thicker and more solid than in the pars pylorica; it presents on its internal free surface, covered with thin epithelium, a number of delicate linear elevations, villi, and between them innumerable openings of gastric juice glands (surrounded by pentangular or hexangular vascular meshes), which are particularly strongly developed in the pars pylorica; on the Cardia the laminated glandul. lenticulares, which do not open upon the surface. Besides numerous folds which pass from the Cardia towards the Pylorus longitudinally, in straight or wavy lines, intersected by others in an oblique direction, and which serve for the enlargement of the stomach. A similar circular fold of mucous membrane, between the layers of which the m. sphincter pylori lies, forms the Valvula pylori.

Besides the gastric juice, it secretes the common mucus.

b. T. vasculosa s. nervea is connected very firmly with the following, and only loosely with the mucous membrane.

c. T. musculosa consists of three layers of pale red muscular fibres:

1. The external layer, formed of longitudinal fibres, which spread themselves out from the æsophagus upon the cardia, and thence, in a radiated form, upon fundus and curvatura major, arranged along the curvatura minor like a band, are thicker and coarser at the pylorus, and pass over upon the duodenum.
2. The middle, strongest layer, consists of circular fibres, which pass from the oesophagus to the valvula pylori, and terminate in the last with a thick ring, as m. sphincter pylori.

3. The internal layer consists of oblique fibres (continuations of the circular fibres of the oesophagus), which pass with a parabolic curve from the cardia, and surround, especially, the fundus.

c. Serosa, the most external coat, is firmly attached, at some distance from the curvatures, to the muscular coat; it consists of two layers of peritoneum, which pass from the liver to the stomach at the curvatur. minor, cover its anterior and posterior surfaces, unite again at the curvatur. major, and form at this point the great omentum (see Peritoneum).—Ligaments: omentum minus (gastro-hepatic.), lig. phrenico-gastricum, splenico-gastricum.

Vessels. 1. Art. at the small curvature: coronaria ventric. sinistra (from A. oesophageus); coron. ventr. dextra (from hepatica); on the great curvature: gastro-epiploica (from hepatica and lienalis); at the fundus: Art. breves (from A. lienalis); at the pyloric end: gastro-duodenalis. 2. Veins, the same names taking a like course, collect in V. lienalis and coronar. ventr. dextra and open into the V. porta. Lymphatics: pass into the glands along both curvatures.

Nerves. 1. N. vagus sinister, forms a plexus gastricus on the ant. surface; nerv. vagus dexter, a similar on the posterior surface of the stomach; shortly (both) around the Cardia, and they are lost in the muscular coat. 2. Plexus caeliacus, formed by Nerv. sympatheticus.

Development. In the foetus the fundus is small, the whole stomach directed vertically; in old age the pyloric portion, and especially m. pylori, is greatly developed.

Function. Chymification, that is, the metamorphosis of the food into Chyme, by means of the acid of the gastric juice (see Pepsin).

437. 2. Intestinal canal, canalis s. ductus intestinalis,
a tubular, membranous, greatly convoluted conduit, reaching from the Pylorus to the Anus, and filling up the largest portion of the lower belly. It is divided into a superior, longer, and at the same time narrow portion (small intestines), and an inferior and also wider (large intestines). Their coats are, from within outwards.

1. Mucous membrane. 2. Tunica propria s. nervea, a thin, brilliant, white uniting tissue, firmly connected to the mucous membrane and the interposed uniting tissue of the muscles, and on this account is not generally expressly mentioned. 3. The muscular coat, consisting of an internal layer of delicate circular, and an external of longitudinal fibres (according to Mussy four layers). 4. The serous coat or peritoneal investment.

438. a. The small intestine, intestinum tenue s. angustum,
extends from the regio umbilicalis and hypogastrica, through the reg. lumbalis as far as reg. iliaca dextra, where it enters the
commencement of the large intestine \textit{(cæcum)}, and is separated from it by a valve \textit{(valvula Bauhinii)} \textit{[Ileo-cæcal and Ileo-colic]}. We divide it into: Duodenum \textit{[equal to the breadth of twelve fingers] and mesenteric intestine \textit{(that is, Jejunum and Ileum associated together)}. The small intestine is distinguished by its greater length \textit{(fourfold)}, its narrowness, and its structure, from the large.

The mucous membrane of the small intestine is paler than that of the stomach, and presents on its internal free surface, \textit{valvula conniventes, villi}, and glands.

1. \textit{Valvulae conniventes Kerkringii} consist of folds of the mucous membrane, inside of which loose uniting tissue, vessels and nerves only are found. They are placed vertically to the axis of the intestine, form one-half, two-thirds, or three-fourths of a circle, are broadest in the centre \textit{(two to three lines)}, and lie more or less parallel, close to, or in, the empty intestine, in an imbricated manner over one another. They commence one to two inches below the \textit{Pylorus}, increase in number to about two-fifths of the mesenteric intestines, and then decrease, until at the termination of the last they are altogether wanting. The superﬁcies of the intestine is said to be increased by their presence about two, three, or even six fold.

2. \textit{Villi \textit{(papillæ)} cover the entire small intestine, the valv. conniventes as well as the depressions between them. Number: undetermined; \textit{4000 upon one square inch}. Length = \textit{0·2 to 0·8 of a line}. Shape: \textit{foliaceous \textit{(in man)}, filiform \textit{(in the dog, cat)}; different in other animals. Structure: each villus consists of uniting tissue, like the papillæ of the corium and tongue, extending into a sheath of \textit{Epithelium \textit{(Henle)}; but containing, instead of nervous plexuses, a minute ramification from the lymphatic rete, surrounded by capillary vessels \textit{(according to Lieberkühn a cavity, \textit{ampulla}, at the basis, and an opening at the point, from which the Chyle-vessels proceed)}. The absorption of the Chyle in all probability takes place without an opening in the villus.}

3. \textit{Glands: a. Gland. solitaria}, simple mucous follicles, are dispersed through the whole of the small intestine; they are the size of a millet seed, push forward the mucous membrane beset with papillæ, are hollow, \textit{(generally)}, closed, but surrounded by a coronet of obliquely placed open tubules \textit{(gland. Lieberkühnianæ?)}), which are said to communicate with their cavity \textit{(Krause)}. They contain a clear, white, or granular substance, and are sometimes open, in a congested condition, appearing then as invasions of the \textit{Mucosa \textit{(Henle)}}.

\textit{b. Gland. Peyerianæ} are distinguished from the solitary, merely by their occurring in masses \textit{(gl. agminated)}, and possessing thinner walls which, like those of the latter, are also structureless. These accumulations of glands are elliptical, lying in the longitudinal axis \textit{(of the small intestines)} on the convex border, opposite to the attachment of the mesentery; particularly abundant at the termination of the \textit{Ileum}, decreasing in number towards the \textit{Duodenum}. They are also surrounded by a coronet of tubules, and are sometimes open.

\textit{c. Gland. Brunnerianæ \textit{(pancreas secundarium)} are flat, oval, lenticular, racemose glands, divided into lobules \textit{(gl. acinorum compositæ)}, which project more outwardly than towards the mucous membrane. Disseminated in masses they are found in the \textit{pars horizont. super.} of the \textit{duodenum}, but only singly. They open with wide mouths.
d. Gland. s. crypta Eberkühlmiaae are very small eversions of the mucous membrane externally, which give to the last a cribriiform appearance, lie between the basis of the villi, and are said to contain the commencements of the lymphatics.

439. a. Duodenum, the bile intestine, equal in length to about the breadth of twelve fingers (eight to eleven inches), commences at the Valvula pylori and terminates without any definite boundary line to the left of the lumbar vertebrae, behind the art. and ven. mesenterica superior. Figure: in the form of a horse-shoe, with the concavity directed to the left, in which we find the head of the Pancreas.

1. The superior portion, pars horizontalis superior, about two inches long, passes to the right and backwards, from the pylorus to the neck of the gall bladder, which lies over it and is attached to it by a fold of peritonæum. It is more moveable than the following parts. Before it lie the lig. gastro-colic. and the abdom. walls. Behind it, Vasa hepatica and lig. gastro-hepatic.

2. The descending portion, p. descendens (s. renalis), two to two and a half inches long, describes above, with the last portion, an acute angle, descends vertically rather to the left (of first to fourth lumbar vert.), behind the right extremity of the Colon transv., crossing with it, before the concave border of the right kidney, close to Ven. cava and duct. choledochus. Below the centre of the posterior internal surface the duct. choledoc. and pancreat. open into it. On its right side, Colon ascendens; on the left, the head of the Pancreas.

3. The inferior portion, p. horizontalis inferior, passes off at a right angle with the last portion backwards and to the left, separated, before, from the stomach by a layer of omentum; behind, from the vertebral column by the Aorta, V. cava, and the crura of the Diaphragm; along its superior border, Pancreas; at the inferior border, meso-colon transversum.

Structure. a. The mucous membrane of the Duodenum is distinguished from that of the rest of the small intestines by:

1. In the pars horizontal. sup., the valv. conniventes are wanting.
2. The villi are cup-shaped, or in the form of a chaplet.
3. Gland. Brunner. predominate, especially in the superior half, and are lost at the inferior extremity, where they pass as gland. solitariae over the rest of the small intestines.
4. Gland. Peycriana are (almost) entirely wanting.
5. On the posterior internal wall (at the inferior extremity) we find the opening of duct. choledochus and pancreaticus united together or separate (diverticulum Vateri).

b. The muscular coat is thicker in the Duodenum than in the remainder of the small intestine.

c. The serous (Peritoneum) covers the p. horizontal. sup., above and below only, and passes, in front, into the large, behind, into the small omen-
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tum; the descending and inferior portions are only covered by it in front, their posterior surface being attached by uniting tissue to the parts lying behind. The Duodenum is therefore little moveable.

Vessels: Art. and Ven. gastro-duodenalis (from the Hepatica) for the superior portion, Art. mesenterica super. for the inferior.—Lymphatics: they pass into the glands above the Pancreas.

Nerves: they come from Plex. coeliacus and hepatic.

Function of the Duodenum: the metamorphosis of the Chyme into Chyle by the bile and the succus pancreaticus.

440. b. The Jejunum (the empty) and Ileum (the convoluted) mesenteric intestine, the most moveable, attached by a fold of peritonæum (mesenterium) to the vertebral column and the longest portion of the small intestine, passes from the termination of the duodenum at first backwards and forwards and from right to left, winds in many convolutions (gyri) through the reg. umbilicalis and hypogastrica into the small pelvis, whence it ascends, lying between rectum and bladder, transversely from left to right, and (before m. psoas), to enter vertically the large intestine. Commencement: to the left of the second lumbar vertebra; termination: in the fossa iliaca dextra. The interval between the two points being four inches in length. The length of the mesenteric intestine measures nineteen feet; the width in the superior part = 6—4 inches, in the centre = 4—2, at the terminal portion = 3—5, and at the termination itself = 4—5. The greater the width the more deficient in length. Shape: cylindrical. To the posterior concave border the mesenterium is attached. The anterior convex border is separated from the abdominal parietes by the great omentum. Each convolution is almost entirely circular.—It is not uncommon to find at the inferior part of the mesenteric intestines finger-shaped appendages (diverticula), two to three inches long, which occasion herniae (herniae Littricæ).

Structure. a. The mucous membrane is distinguished by:

1. Valv. conniventes Kerk.
2. Glandul. Peyeriane, on the anterior intestinal wall.
3. Valvula Bauhini s. Fallopiae s. Tulpii s. Ileo-caecal consists of a fold of mucous membrane which projects into the large intestine at the termination of the small, becomes reflected, and passes over upon the cecum. Between the two layers of the fold (valve) lie circular muscular fibres. The ends of the valve are called Frenula Morgagni.

[Another fold projects towards the colon, V. Ileo-colic.]

b. The muscular coat is thinner at the commencement than farther down.
c. The serous coat (Peritonæum) completely covers the mesenteric intestine, except a small stripe at the part to which the two layers of the mesentery are attached.

Vessels: Art. intestinales from the a. mesenterica super.; Veins: they open in the V. mesenterica major (branch of Ven. porta); the Lymphatics are the Lacteals, and go into the glands of the mesentery.

Nerves: from plexus mesentericus.

Function of the mesenteric intestine: absorption of the Chyle.
441. c. The large intestine, *intestinum crassum s. amplum*, extends from the *Valvula Bauhini* as far as the *Anus*, surrounding the small intestine almost like a ring, since it ascends from the inferior part of *reg. iliaca dextra* into the *r. hypochondriaca dextra* as high as the liver, passes from this point with a sudden turn transversely across, below the stomach, to the left side as far as the spleen, curves once more and descends vertically as far as the *reg. iliaca sinistra*, whence it sinks down into the small pelvis forming the *sigmoid flexure*, and terminates with the *rectum*. Its length measures four to five feet, its width varies (see below).

**Shape:** tubular with irregular surfaces.

**Structure:** 1. Mucous membrane, whiter, thicker, and coarser than that of the small intestine, contains no *villi*, but, instead, irregularly arranged folds, between which numerous mucous glands open (*gl. Lieberkühn*); no *valvula conniventes*, but, instead, crescentic transverse and longitudinal folds.

2. The muscular coat is stronger than in the small intestine.

3. Serous coat (*Peritonæum*) less complete than in the mesenteric intestine; the *Colon transversum* alone has a complete mesentery. It forms in several places, especially on the *Colon*, semi-circular, depending folds, beset with fat (*appendices adiposæ s. epiplóicae*), which wind around and tie together the intestine.

**Function:** For the formation, keeping, and expulsion of the *faeces*. In the *faeces* the large intestine is filled up with *meconium*.

442. a. The *Cæcum*,

is the most superior portion of the large intestine, ending in a cul-de-sac. It lies in the *fossa iliaca dextra*, covered on the anterior surface only by *peritonæum*, and therefore little moveable; (it nevertheless sometimes sinks down into the pelvis, and contributes to form *herniae*;) generally in a vertical direction (that is, in the same as *Colon ascenden*s;) next to the stomach the thickest part of the alimentary canal; of an oblong, sacciform, and irregular shape, provided below (behind and to the left) a few lines beneath the *valv. Bauhini* and above its terminal cul-de-sac, with a process, *proc. s. appendix vermiformis* (one to six lines long), about as thick as a goose-quill, and terminated by a closed end, which is attached by a triangular fold of *peritonæum* (*mesenteriolum appendicis*), and is frequently pushed between *colon ascend.* and kidney.

In front the cæcum touches the abdominal parietes. (The small intestine often passes between them.)

Behind it rests upon *M. iliacus intern.*, separated from it by *fasc. iliaco-lumbalis*, and from this by loose uniting tissue.

Internally the *Cæcum* receives the small intestine at an obtuse angle above.
Structure. The mucous membrane presents: 1. Pocket-like recesses which correspond to the elevations, and transverse folds corresponding to the indentations on the outer surface of the intestine.

2. Valvula Bauhini s. ileo-cæcalis (see small intestine). The fold which passes from the Cæcum, has entirely the characters of its mucous membrane. [Depressions, or alveoli, are seen on the surface of the m. membrane of Cæcum.]

3. The opening of the vermiform process.

4. The muscular coat consists of longitudinal fibres, which are bound up in three flat stripes (teniae) as broad as a finger, and with transverse circular fibres, by which the vesicular and cellular elevations (cellulae, loculamenta) are formed.

5 Serous coat (peritoneum) is wanting on (upper part) the posterior surface of the intestine.

Vessels: branches of Art. and Ven. ileo-colic (appendicularis, &c.), from mesenter. superior.

Nerves: come from plexus mesenteric. sup.

443. b. The Colon,

encircles the mesenteric intestine in the shape of a horse-shoe, commencing without any distinct boundary line in the reg. iliaca dextra, making a first curvature in the reg. hypochondriaca dextra, a second in the reg. hypochond. sinistra, and a third in the r. iliaca sinistra, in which it terminates with a sigmoid flexure. Hence four portions arise.

1. Colon ascendens s. dextrum bounded below by the Cæcum, terminates as high as the gall bladder; is covered before by the peritoneum and the abdominal walls (from which it is sometimes separated by the small intestine), behind by M. quadrat. lumb. and the right kidney (without peritoneum and only fixed to the uniting tissue). On the inner side lie small intestines (as on the external), m. psoas and p. transv. duodeni.

2. Colon transversum passes off at a right angle from the last, below the stomach to a point under the spleen, is convex before, concave behind, and very moveable (is often found in herniae). It corresponds above with the liver and gall bladder, the stomach and the inferior extremity of the spleen; below, with the small intestines; before, with the abdominal walls (separated from it by the two anterior layers of the great omentum); behind, with the mesocolon transv. (mesentery, by which it is separated from Doudenum and Pancreas).

3. Colon descendens s. sinistrum passes first backwards, then forwards, on the posterior abdominal wall, before m. quadrat. lumbor. and left kidney; commences rather deeper than 1., and terminates in the

4. Sigmoid flexure, s. flexura iliaca, which lies in the fossa iliaca sinistra, before, covered by the abdominal walls (in a state
of distension), at the sides by the small intestines; is attached, behind, by mesocolon, and is very moveable. At the commencement it rises somewhat upwards and backwards (to musc. iliac. intern. sinist.), then descends vertically; the termination curves right or left, forwards or backwards as high as the basis oss. sacri, where the rectum commences.

Structure. The external surface of the Colon presents, like that of the Cæcum, the tenia and loculamenta. On the Colon descend. and Sigmoid flexure there are only two rows of elevations; these disappear lower down.

Mucous and muscular coat (see large intest.).

Serous coat (peritoneum) covers the colon ascendens and descendens on the anterior wall, only, on which account the last is little moveable. On the contrary the Colon transvers., completely enveloped (mesocolon trans.), and, like sigmoid flexure, is very moveable.

Vessels: For colon ascend. and right half of transv. branches of Art. mesentrica superior, Ven. mesent. major; for the remainder of the Colon: Art. mesent. infer. and Ven. mesent. minor.

Lymphatics: open into the glands on the attached border.

Nerves: Branches of plex. mesentericus sup. et inferior.

444. c. The Rectum,

the most inferior part of the intestinal canal, lies on the posterior wall of the lesser pelvis in the curvature before the sacrum and coccyx, commencing to the left of basis oss. sacri, and terminating with the anal opening, anus, under fundus vesicæ (or vagina in the female), surrounded and attached all round by uniting tissue. Curved, in front concave and behind convex, it inclines at the apex of the coccyx rather backwards, and is removed from the vagina (in the female) and from the urethra (in the male). Posterior surface: above to the left, before the Symphys. sacro-iliaca sinistra, separated by m. pyramidalis, plex. sacral. and vasa hypogastrica, attached by mesorectum, below to the left of os coccyg., covered by m. levator ani. From its middle (on three false vertebrae of the sacrum) to its termination before the middle line. The anterior surface (above free) corresponds in the male: 1. To the posterior surface of the urinary bladder (from which it is separated, when filled up, by the small intestines), below to the undus vesicæ (separated by the two vesicul. seminales). 2. The Prostata, which projects over one of the two sides or both. 3. The pars membran. urethrae (separated by a triangle, the apex backwards and upwards). In the female: 1. The superior free portion, the lig. latum, Ovarium, tuba Fallopiz sinistra, Uterus and Vagina. 2. The inferior part close behind Vagina.

At the sides are situated, above, small intestines, below, uniting tissue.

Structure. 1. The mucous membrane is stronger and more red than in
the rest of the intestines; it presents longitudinal folds (columnae rugarum recti) which disappear by distension; besides at the commencement and anus a circular fold (plica annularis).

2. The muscular coat, like the mucous, is similar to that of the esophagus; it forms m. sphincter ani internus.

3. The serous coat (peritoneum) covers the anterior surface (of the superior half only). From the promontorium to the rectum there is a fold; this is, meso-rectum.

Vessels: A. haemorrhoidalis interna (from A. mesent. infer.), haemorrh. med. (from hypogast.), haemorrh. inferior (from pudenda intern.).—Vv. form plex. haemorrh., from which arise Vv. haemorrh. (connection with Ven. por.[ae].—

Nerves: branches from plex. hypogastricus and sacralis (for voluntary motion), and of N. sympathetic (for involuntary).

The Anus, Orificium Ani,

a narrow fissure, dilating in a circular form, lies in the central line at the posterior part of the perinaenum, one inch in front of the coccyx, between the tuberosities of the Ischia, and is generally closed. Its skin is brownish, rich in sebaceous glands (in the male beset with hair), and passes in wrinkles into the mucous membrane of the rectum.—Muscles: see sphincter and lev. ani.—

Arteries: branches of Haemorrhoidales.—Veins: very numerous, convoluted, plexiform; the most external roots of ven. portarum.—Nerves: numerous from plex. sacralis and sympathetic.

Meconium, a thick, viscous, scentless, dark green mass, fills the large intestine of the fetus, and the younger the subject so much the more in quantity. In the small intestine we find, instead of it, a thin, yellow, sometimes colourless mucous fluid.


The liver is a glandular organ, for the purpose of secreting bile. Very large, oblong, quadrangular, it lies close under the diaphragm, enveloped by peritoneum, protected externally by the seventh and eighth last ribs, in reg. hypochond. dextra, and reaches in a transverse and oblique direction as far as reg. hypochond. sinistra. Weight: four to five pounds. Transverse diam.: ten to twelve inches. Length (from behind forwards): six to seven inches. Thickness: four to five inches. Spec. grav.: 1.5.

a. Surfaces. 1. The superior surface, pars gibbo, smooth, convex, to the left more flat, lies close under the vault of the diaphragm, and before on the abdominal walls, divided by lig. suspensorium into a larger right and a smaller left portion (lobes). They are separated by the diaphragm from the concave basis of the right lung, from the heart, and from the (seventh and eighth last) ribs; touches the abdominal walls in the reg. epigast. and under the right short ribs (where it comes forward, especially in sitting, when the body is inclined forwards).

2. The inferior surface, pars sima, concave, directed backwards and outwards, lies over the right kidney, the flexura coli dextra, colon. transvers., pars pylorica ventriculi, duodenum, and small omentum. It presents in the centre two longitudinal grooves (fossae longitudinales), which are unite 1 by a transverse groove (foss. transv. s. Porta), whereby an H-shaped excavation is formed,
and the inferior surface is at the same time divided into four lobes, viz., a left, an anterior central, a posterior central, and a right lobe.

REMARK. Many anatomists distinguish only a right (six times larger than left) and a left inferior lobe, the boundary between them being the left longitudinal fissure.

a a. The lobes. 1. The left lobe of the liver, lobus hepaticus sinister, smaller (also on the superior surface) than the right, lies on the left side of the H, is before concave (for the convexity of the stomach), as well as behind (for the lobul. Spigelii, which the small omentum separates from it). It reaches sometimes as far as the Spleen.

2. Anterior central, lobulus quadra tus, before the transverse fissure, in the centre of the H, quadrangular, small, terminates behind (frequently), nipple-shaped.

2. Posterior central lobe, lobulus Spigelii s. caudatus, behind the transverse fissure, between the posterior part of the right and left lobes of the liver, to the right of the Cardia, on the Curvatura minor; flat, crescentic, convex on the free inferior border, which corresponds to the superior border of the Pancreas; in the centre provided with a tubercle, tuberculum papillare s. triangulare, surrounded by an anterior vascular ring (A. coronar. ventric., hepatic., splenica); a small longitudinal projection (tuberc. caudatum) passes on the anterior part, obliquely, from the Porta to the right lobe, forwards, and separates the impressio renalis from the impress. colica.

4. Right lobe of the liver, lobus dexter, smaller than upon the superior surface, to the right of the two last described, separated from it by the right longitudinal fissure, thicker than the left lobe, presents behind an impressio renalis, to which is applied the superior third or half of the right kidney, and before an impressio colica, for the flexura coli dext., and sometimes the duodenum.

b b. Fosse or fissures: 1. The transverse fossa, porta, porta s. sinus vena portae (hilus hepatis), lies rather behind the centre, between the two longitudinal fosses, and separates the lobulus quadratus from l. Spigelii; is fifteen to eighteen lines long and deep. It contains: Vena portae, Art. hepatica, the roots of duc tus hepaticus, numerous lymphatics, plex. hepaticus from Nerv. sympatheticæ, surrounded by uniting tissue, capsul Glissonii. Here commences also the lig. gastro-hepaticum.

2. The right longitudinal fossa:

a. Anterior half, fossa vesica felleæ, lies between lobus dexter and quadratus; is not deep, and does not reach so far as the anterior border of the liver; receives the gall bladder.

b. Posterior half, fossa ven. cava, is sometimes closed in the form of a canal; it contains the inferior Ven. cava, into which the hepatic veins open.

3. The left longitudinal fissure:

a. Anterior half, fossa umbilicalis, is sometimes closed up like a canal, lies between lobus sinister and quadratus, and contains: the umbilical vein of the Embryo (that is, lig. teres, after birth).

b. Posterior half, fossa ductus venosi, between lobus sinister and Spigelii; containing in the embryo the duc tus venosus Arantii, which, connected with the umbilical cord and the left branch of the ven. porte, the blood of which it carries into the vena cava inf., sinks behind lob. Spigelii into Ven. cava inferior. It is obliterated after birth.
c. The Borders. 1. The anterior border is thin, sharp, oblique from below upwards, and directed from right to left; it presents to the left a deep incision, *incisura interlobularis*, where lig. teres (*V. umbilicalis*) lies; farther to the right a notch, at which point the *fundus vesicae fellee* is seen; it projects under the cartilages of the seventh to the tenth ribs into the *epigastrum*.

2. The posterior border is short and obtuse, rounded, attached to the diaphragm, being connected by uniting tissue; to it the lig. coronar. *hepatis* attaches itself from the diaphragm above and underneath. To the left a deeper notch, for *Ven. cava. infer.*; to the right, for *ductus venosus Arantii*. The right extremity of the liver is smooth, rounded, massive (with lig. triangular. dexter.); the left extremity terminates in an angular or obtuse process (with lig. triangular. sinister).

Structure. The proper substance (Parenchyma) of the liver is reddish or yellow; in other persons, darker (of a clouded colour, between olive green and chamois); close and lacerable. It divides into lobes, lobules, and gland granules, *acini*; these are accumulations of closed, yellow, nucleated cells, two to three lines long, half a line thick. The acini are seated like vine leaves upon pedicles, which are ramifications of the *vena hepatica*, which spreads itself out in their axis like the veins of a leaf. The surface of the acini is surrounded by a capillary network of the most delicate branches of *vena portae*, which are in connection with *ven. hepatica*. From the blood of the *ven. portae* the elements of the bile pass, probably, into the closed nucleated cells; but the connection of these with the biliary passages (ducts) has hitherto remained unexplained. The ducts are best considered, with Henle, as intercellular passages, which at first appear between the acini. The lobes and lobules are connected by uniting tissue, which enters in from the surface. The particular elements of the liver are:

Membranes: 1. The serous covering (*Peritoneum*) of the liver covers it as far as that part of the posterior border which is attached to the diaphragm, and to the floor of the grooves. From it the following folds pass off: lig. coronarium and suspensorium, lig. hepatico-gastricum, duodena, and renale.

2. A fibrous investment covers the entire liver; is connected on its external surface with the serous coat; in the interior, with the parenchyma. It shows itself most distinctly in the porta, where it forms sheaths for the vessels, that is, *Capsula Glissonii*, and cells for the lobes and lobules, since prolongations extend from it into the interior of the organ.

Vessels: 1. *Ven. portae* forms a trunk in the *Porta*, from which, after the manner of arteries, right and left branches pass off, which ramify through all parts of the interior of the liver, dividing at acute angles, but not dichotomously, in a transverse direction, and are surrounded by sheaths of the *Capsula Glissonii*. Its capillary rete surrounds the acini, and passes over into the commencement of the hepatic veins.

2. *Art. hepatica*, a (small) branch of *art. celiaca*, passes with the portal vein and the biliary canals. Its capillary rete spreads out upon the parietes of the vessels and biliary ducts almost exclusively, and unites with the rete of the portal vein.

3. *Ven. hepaticae*, which arise in all points of the liver as *Venulae centrales*, pass (in opposite directions from the lobes 1, 2, and 4) backwards towards *Ven. cava infer.*, to which they convey the blood from the portal vein, and from *Art. hepatica* (They are without sheaths, and therefore remain patent when divided transversely.)

4. The biliary passages, *ductus biliferi*, are narrow canals, which terminate in a cul-de sac (?), spreading, like the branches of a tree, through the liver,
are surrounded by a network of the capillaries of the ven. porta and hepatic artery, and pass together into two large ducts (which, coming from the right and left hepatic lobes, and covered in the porta by sheaths of the Capsula Glissonii, unite together). According to E. H. Weber's latest researches, they form, like the blood-vessels, an uninterrupted and just as close rete, the inter-spaces being filled up with the vessels, so that the two together produce the hepatic parenchyma; in the porta, blindly ending vasa aberrantia of the liver are present.

5. Lymphatics: very numerous; first discovered in the liver; they open, partly, directly into the ductus thoracicus.


446. Apparatus for the excretion of the Bile.

a. The bile duct, ductus hepaticus s. excretorius hepatis, arises by the association of the two biliary ducts before mentioned, is from one to one inch and a half long, and from two to two and a half lines thick. It passes out from the Porta behind the right branch of Art. Hepatica, passes downwards and backwards in the lig. gastro-hepatic., and divides into two ducts, one of which, the left, ductus cysticus, leads into the gall bladder, the right, ductus choledochus, into the Duodenum. Situation: to the right of art. hepatic., to the left of ductus cysticus; before ven. portae.

447. b. The gall-bladder cystis s. vesica fellea, is a pear-shaped sac, three to four inches long, situated on the inferior surface of the liver, in the fossa cystica, it extends obliquely from before backwards, from below upwards, and from right to left, contains about eight to nine drachms.

We distinguish:

a. The fundus, the closed globular extremity which projects at the anterior border of the liver, touching, in that place, the abdominal walls (to the outer border of m. rectus, close to the anterior extremity of the tenth rib). Behind, the fundus of the gall bladder passes into the conical.

b. Body, corpus. This rests below upon the pars super. duodeni and the right extremity of the colon. transv. (not uncommonly also upon the right kidney or upon the pylorus). Above it is attached by loose uniting tissue to the liver.

c. The neck, collum, is twisted like a screw. It lies, generally, to the left, and passes under the Porta into the ductus cysticus, at which point a contraction marks the limit between them, as occurs, also, at its junction with the body.

Membranes. 1. A serous membrane (Peritoneum) covers the inferior surface, only, of the gall bladder.
2. A fibrous (muscular) coat, consisting of an internal stronger layer of longitudinal fibres, and an external of circular, similar to that of the vessels, is united with the serous by areolar tissue, is little extensible, and connected with the muscular coat of the intestinal canal.

3. Muco...wards and to the right, is thinner and shorter than the hepatic duct, passes downwards upon the right side of ductus hepaticus, and unites with this at a very acute angle in the d. choledochus. Situation: in the lig. hepatico-duodenale, before ven. cava inferior, to the right of art. cystica.

448. c. The duct of the gall-bladder, ductus cysticus, formed by the united ductus cysticus and hepaticus, passes in the same direction as the last, obliquely downwards, rather backwards and to the right, has a thickness equal to a moderate goose-quill, and a length of from two to two inches and a half. At the superior part it lies in the lig. hepatico-duodenale, before ven. portae, below art. hepatica, along the right side of art. gastroepiploica dextra, surrounded by uniting tissue and lymphatic glands; then behind and on the internal border of the pars descend. duodeni in a groove on the head of the Pancreas; lastly, it perforates very obliquely the muscular coat of pars descend. duodeni at its centre, passes six or seven lines between the muscular and mucous coat, on the right side of duct. pancreaticus, perforates the mucous membrane on the internal wall of the inferior portion of the pars desc. duodeni with a round opening (so that a retrograde course of the bile, &c., is impossible), after having received, shortly before, the duct. pancreatic.

Structure. It is like the duct of the gall bladder.

This is a long, flat, greyish white gland, which is placed transversely behind the greater curvature of the stomach, before the twelfth dorsal and first lumbar vertebra, and extends from the concavity of the duodenum as far as the spleen. In length: seven to eight inches; thickness: half to one inch; breadth: one and a half to two inches and three quarters; weight: three to four ounces. The right extremity (caput, extrémitas duodenalis), thick and broad, lies coiled in the curvature of the duodenum (and on the ductus choledochus); partly before the P. horizontalis inferior duodeni, close before the art. and ven. mesenterica, aorta and v. cava infer.; it is called, when separated from the rest, Pancreas parum Winslowii.

The left, splenic extremity (cauda) is narrow, and lies on the internal surface of the spleen.

The superior thick border has a groove for art. lienalis, and looks towards the pars super. duodeni, lobul. Spigelii and art. cæliaca. The inferior border lies along the p. horizontalis duoden. infer., separated to the left by art. and ven. mesenterica superior.

The anterior convex surface, covered by the peritonæum, looks towards the posterior wall of the stomach, the commencement of the duodenum and the flexur. coli dextra.

The posterior concave surface is not covered by peritonæum; separated from the vertebrae by V. lienalis, mesenterica superior, and commencement of Ven. portæ, cruræ of the diaphragm, V. cava inf. (on the right), Aorta (to the left). To the left of the vertebral column it rests upon the caps. supra renales, renal vessels and nerves. The Pancreas follows the movements of the Duodenum.

The excretory duct, duct. pancreaticus seu Wirsungianus, arises in the splenic end, by the conjunction of several canaliculi which come from the lobules of the gland, always becoming wider, as all the canaliculi open directly into it, and passing in the central part of the gland to the right extremity, where it makes its exit, lying to the left of the ductus choledochus, which it perforates, and opens in common with it in the pars descend. duodeni. Its walls are very thin, extensible, milk-white, and inwardly smooth. Two pancreatic ducts are frequently present, one of which opens in an isolated manner into the duodenum.

Structure: The Pancreas consists; like the salivary glands, of conglomerated lobules connected together by uniting tissue, these again of vesicles (acini), in which the canaliculi commence.

Vessels: Art et Ven. are branches of lienalis, pancreatico-duodenalis, and mesenterica superior.

Nerves: They come from plexus lienalis, gastricus, mesentericus superior.

Function: Secretion and excretion of succus pancreaticus (that is, a colourless, transparent, and viscous mucus, in which we find soda, common salt, phosphate of lime).
3. The Spleen, lien, spleen,
a spongy organ very rich in blood (blood gland) which lies deep in the reg. hypochondr. sinistra, behind and to the left of the fundus of the stomach, above the left kidney, in a fold of the peritoneum, and becomes displaced by the movements of the diaphragm and stomach. Figure: semi-oval (also prismatic). Colour: bluish or brownish red or even pale grey, by long exposure to the air, rosy red. Weight: two to eight ounces (in hypertrophy = ten to thirty pounds); specific grav.: 1.16. Length: four to five inches; breadth: two and a half to three and a half; thickness: one to one and two-thirds.

The external, convex, smooth surface, separated by the diaphragm from the ninth to the eleventh ribs, looks upwards and backwards.

The internal concave surface looks obliquely forwards towards the Pancreas and fundus of the stomach, and presents, in about the centre, a superficial oblong excavation, hilus lienalis, where the splenic vessels enter and pass out, and lig. gastro-lienale is attached. Before, the hilus is in contact with the fundus of the stomach; behind that, the left kidney and caps. sup. renales and the tail of the Pancreas.

The superior thick extremity lies under the diaphragm; the inferior pointed extremity rests upon the angle of the colon (transv. and descend.). The borders are sometimes deeply indented, and thus present traces of a second spleen (lien. succenturiatus) or several, which in the foetus and children are frequently observed. The posterior border, thick above, is adjacent to the kidney, the anterior is applied to the stomach.

Structure: 1. The proper substance of the spleen is a pultaceous, reddish brown, granular mass, pulpa lienis, which consists of pencillate tufts of capillary vessels, out of which veins pass, and which lies like a sponge in the whitish cells of a fibrous membrane.

2. The fibrous coat, tunica albuginea, forms the frame-work of the organ, since it covers it externally, and sends prolongations into the Parenchyma, like a net, especially at the hilus, where it forms sheaths for the vessels, and accompanies their ramifications, so that the whole acquires a spongy structure.

White splenic corpuscles, corpuscula lienis Malpighi (not to be confounded with the liquefying vesicles of Herbivora), lie, according to J. Müller, inside the red granules of the pulpa, and are seated upon the white sheaths of the arterial branches, of which they are merely sprouts (according to Heusinger blastema, formative matter).

3. The serous tunic (peritoneum) envelopes the whole spleen, even to the Hilus, where the lig. gastro-lienale comes over from the fundus of the stomach. Lig. phrenico-lienale goes from the superior extremity of the spleen to the posterior portion of the inferior surface of the diaphragm. Its internal surface is firmly connected to the external of t. albuginea.
4. Vessels: a. Art. lienalis. branches of cæliaca, divides into four or five 
twigs, each of which supplies one or the other independent parts of the spleen. 
b. Ven. lienalis, the principal branch of the ven. porta, four or five times larger 
than the Art., without valves. c. Lymphatics: they go into the glands along 
the hilus, between the layers of lig. gastro-lienal.

5. Nerves: come immediately from plex. lienalis, as well as from pl. solaris.
Function: The preservation or alteration of the blood or the lymph (?), 
according to Cruveilhier, makes up the chief substance of the spleen, as that 
terminates in cells.

452. The Peritonæum,

is a serous, (in the male) entirely closed sack, (in the female open 
at the extremities of the Fallopian tubes,) which on the one hand 
lines the abdominal walls, on the other partially invests the or-
gans which lie within them. These last are the organs of diges-
tion (below the diaphragm) and the female organs of generation. 
But they do not lie within the cavity of the sac, but in folds on 
the external surface of it. Quite unfolded, the sac would pre-
sent the appearance of a bladder, divided into a larger and smaller 
(by a constriction), but which are connected together by an 
opening at the place of constriction, and of which, the smaller 
(saccus epiploicus, because it forms the omentum, epiploa) is 
inverted into the larger. The place of constriction surrounds a 
semicircular (or triangular) space (foramen Winslowii), one inch 
in size, which is bounded before by the gall-ducts, behind by ven. 
cava infer., below by duodenum, above by the neck of the gall 
bladder, and is situated under the lobulus Spigelii. As the peri-
tonæum passes upon the organs contained in the abdominal cavity 
there become formed: 1. Folds (ligaments), e. g., such as lie 
between two different viscera. 2. Mesenteries; these are inver-
sions from the posterior abdominal walls which always consist of 
two layers. 3. Omenta; these are prolongations of laminae over 
the organs.

As the peritonæum forms a closed sac, the description of it may 
be commenced at any point.

453. A. Peritonæum abdominale.

The walls of the abdominal cavity are lined all round by the 
peritonæum as with a sac, with the exception of those places on 
the dorsal wall, at which inversions take place into the interior of 
this sac, for the purpose of surrounding the viscera with a par-
ticular envelope (compare Pleura), and thus to form the Peri-
tonæum viscerale. The internal surface of this parietal layer 
looks into the cavity of the sac, is smooth and slippery like the 
visceral layer, which is turned to it. The external surface is 
rough, loosely attached by uniting tissue to the internal surface of
the walls of the abdominal cavity. It is, according to the walls, divided into:

1. Anterior wall, formed by the abdominal muscles. It covers the whole posterior surface of the anterior and lateral abdominal muscles, separated from it by *fasciae rectae* and *transversal*. Of it four folds pass off from the umbilicus.

   a. *Ligam. suspensorium hepatis*, the so-called suspensory ligament of the liver, upwards, which surrounds the *lig. teres* (the obliterated *ven. umbilicalis*) at the sides and behind, and goes to the liver.

   b. *Lig. suspensorium vesicae*. *Plica urachi* passes downwards in the middle line from the umbilicus, on the obliterated Urachus to the superior border of the urinary bladder.

   c. *Plica pubo-umbilicales*, two lateral folds from the umbilicus to the *ligg. lateralia vesicae*.

   Between these folds two recesses arise behind and above the femoral arch (Poupart's Ligament) on either side of the middle line, the external of which is again divided by the obliquely ascending but little projecting *vasa epigastria*. On each side we therefore observe:

   a. *Fovea inguinalis interna* between *symphysis pubis* and *ven. iliaca* (in the crural ring) behind *lig. Gimbernati*.

   b. *Fovea inguinalis media* between the sides of the *lig. later. Vesicae* and *v. epigastr.* turned towards one another, above and behind the crural ring (important in *crural* as well as in *direct inguinal hernia*).

   c. *Fovea inguinalis externa*, on the external side of *vasa epigastria* (important in *oblique inguinal hernia*).

**Note.**—b. and c. are together distinguished as *fossa inguinalis externa*.

2. The inferior or pelvic wall descends from the above described folds, and the posterior surface of the *ossa pubis* backwards, into the small pelvis over the superior and posterior surfaces of the urinary bladder, covers, in the female, the *uterus* and the anterior surface of the *rectum*; in the male, immediately, the last. Here it forms between bladder and uterus, which, together with its *tubes, ligg. rotunda* and both the *ovaries*, it receives in a broad fold, a fossa (*excavatio vesico-uterina*), the two broad ligaments (*ligg. latae*), and *ale ruperti*; between *Uterus* and *Rectum* the *excavatio recto-uterina*, between the two *plica Douglassi*, which last, in the male, are situated between the bladder and rectum. Into the fossae the convolutions of the small intestines descend. Hence the *peritonæum* ascends to the dorsal wall, as:

3. The posterior wall, situated before the *nn. quadrati lumborum*, the *Kidneys, Ureters, Aorta* and *ven. cava*, *nn. sympathetici*, *vv. azygos, hemiazygos* and *duct. thoracici*, and forms, hence, the inversions or reflections for the *viscera* (*periton. viscerale*), the access to which is concealed by uniting tissue.

4. The superior wall covers the inferior surface of the diaphragm, passing over behind upon the *Liver, Stomach, and Spleen*, before upon the anterior abdominal walls.

454. **B. Peritonæum viscerale,**

the intestinal layer, consists of two large and several smaller inversions from the posterior walls. The superior larger invests the *Liver, Stomach, Spleen, Colon transversum*, covers the anterior surface of the *Duodenum* and *Pancreas*, and contains the
Omenta; the inferior larger envelopes the Jejunum and Ileum, and forms the mesentery (mesentericum); the smaller contain: Cæcum, Colon ascendens and descendens and rectum, and form their mesenteries.

455. Route, or course, of the Visceral layer.

[Reflections of the Peritonæum Visceral.]

1. From the inferior part of the pars tendinea of the diaphragm, the Peritonæum passes to the obtuse posterior border of the liver, and forms Lig. coronarium hepatis, the right and left extremity of which is considered as Lig. triangulare dextrum and sinistrum; continues to the superior extremity of the spleen, and forms: Lig. phrenico-lienale; lastly, to the cardia of the stomach, forming a right and left lig. phrenico-gastricum on the sides of the cardia.

456. 2. From these places the Peritonæum passes:

a. over the superior surface of the liver to the inferior surface covering it entirely, with the exception of lobulus Spigelii.

b. over the anterior wall of the Stomach as far as the great curvature.

c. over the whole Spleen, except its hilus; forming between its internal surface and the fundus of the Stomach the lig. gastro-lienale, the posterior layer of which passes from sac. epiploicus.

457. 3. The Peritonæum afterwards proceeds:

a. from the right portion of porta hepatis to the right kidney and the angle of the Colon ascendens (forms lig. hepatico-renal s. colicum at the right border of foram. Winslowii).

From the left anterior portion of the Porta (before ven. porta, vasa and duct. hepatic. downwards) to the anterior wall of the duodenum, forming the lig. hepatico-duodenale.

From the fossa ductus venosi towards the left, to the smaller curvature of the stomach, forming the anterior layer of the small omentum, omentum minus s. lig. hepatico-gastricum.

This attaches itself with its inferior concave border to the small curvature of the stomach, with its superior to:—1. The porta hepatis. 2. The esophagus and the diaphragm; bounded on the right by the hepatic vessels and gall ducts (behind them foram. Winslowii), to the left by the esophagus.

b. From the spleen on the right into the great omentum, on the left to the superior angle of the colon descendens.

c. From the stomach (over the anterior surface of the colon transv.) and behind the anterior abdominal walls, before the small intestines, downwards into the pelvis. Here it becomes reflected upon itself, and ascends to the Pancreas (Arnold. According to others it goes immediately upon the superior surface of colon. transv.), [covering the posterior surface of the transverse arch of the colon, and forming the post. layer of mesocolon transv.], and thus forms the first [anterior] and fourth [posterior] layer of the great omentum.

Omentum (s. epiploicum) majus, the great omentum, reaches in adults as low as the femoral arch, is transparent and thin, in fatted persons much beset with
adipose tissue, particularly around the vessels. It consists of four layers, the two internal of which are formed by the _saccus epiploicus_. Its vessels (from _artt._ and _vv. gastro-epiploica dextra_ and _sinistra_) descend between the anterior layers and ascend again between the posterior, anastomosing with those of _colon transv._ Lymphatic glands on the curvature of the stomach and the colon. Nerves from _plex. solaris_, along with the arteries.

_Saccus epiploicus_, the omental sac, is formed as the peritonæum passes through the _foram. Winslowii_ from right to left, above the _lobulus Spigelii_ [to the _transv._ fissure of the liver, hence] to the lesser curvature (as posterior layer of small omentum), on the posterior surface of the stomach, downwards behind the anterior layer of the great omentum, becomes reflected [backwards] upon itself and ascends, before the posterior layer, covering the anterior surface of the Pancreas, and superior third of Duodenum [in front of the anterior surface of the _transv. colon_, and forming the _ant._ layer of trans._mesocolon_], and inclining to the right it passes out at the _foramen of Winslow_, [after ascending upon the _crura_ of the diaphragm, being reflected upon and covering the _lobulus Spigelii_, and entering the transverse fissure of the liver].

458. 4. The Peritonæum forming the fourth layer [posterior] of the great omentum was traced to the dorsal wall below the Pancreas. Hence it again passes downwards and forwards, thus forming the two layers of which _mesocolon transv._ consists, and which lie transversely between _jejenum_ and _ileum_,—liver, stomach, and spleen.

459. 5. Turning back (as inferior [posterior] layer of _mesocolon transv._), it passes again downwards before the second and third abdominal vertebrae [and the transverse third of the _duodenum_] surrounding the numerous convolutions of the _jejenum_ and ileum, and again turning back to the vertebral column (as it forms the root of the _mesenterium_), it thence descends to the inferior (pelvic) wall before the rectum, &c.

_Mesenterium_. The mesentery consists of two curly-folded laminae which lie close to one another, pass down, vertically, on the left side of the vertebral column [obliquely from the left side of the body of second lumbar _vertebra_ to the right sacro-iliac _synchondrosis_], receive between them the branches of _art._ and _ven. mesenterica superior_, Chyle vessels and Lymphatic glands (_gl. mesaraica_), and at the concave surface of the small intestines separate from one another, for the purpose of enclosing these organs.

To the right, left, and below, we find, besides this large inferior inversion, several smaller, which proceed from the dorsal wall and pass into the parts described. They are the incomplete mesenteries for the _colon ascendens_ and _descendens_ for the _cæcum_ and _sigmoid flexure_, and for the _rectum_ (_mesorectum_).

460. The organs of Respiration, _Organa respirationis_, are the lungs, the thorax, the trachea, the larynx and pharynx, and the nasal cavities.
461. 1. The Larynx, larynx s. organon vocis, the most superior portion of the trachea, is a moveable canal formed of seven cartilages, in the centre of the anterior superior region of the neck, under the os hyoides, before the inferior part of the pharynx (between fourth and sixth vert.).

Shape: above, broader and three-cornered; below, narrow and cylindrical.

Elements: cartilage, ligaments, muscles.

a. Cartilages of the Larynx: Thyroid and Cricoid are true, the rest, fibro-cartilages.

462. 1. Thyroid cartilage, cartilago thyreoidea, occupies the greatest part of the anterior and lateral walls, and consists of two oblong four-sided plates, which are united at an acute angle, in the middle line, and the surfaces of which are directed obliquely backwards and outwards. External surface. In the male the angle projects more strongly forwards (Adam's apple) than in the female, and before puberty, when it is more rounded. At the posterior part of the external surface of each lateral plate we find above, a tubercle, and below, a larger; between the two we perceive a linea obliqua, before which m. thyro-hyoides and behind which mm. constrictor infer. and sterno-thyroid, are situated; sometimes a foramen for Art. laryngea super. Internal surface: a. At the angle are attached the vocal cords and mm. thyro-arytenoidei. b. The sides project out over the cricoïd cartilage. The superior border is twisted, in the centre deeply excised, incisura thyreoidea, it looks towards the hyoid bone and terminates at the sides with the great cornua. Here is attached Membr. hyo-thyroid. The inferior border, shorter than the last, inclines towards the cricoïd cartilage, serving for the attachment of m. crico-thyroid, in the centre the lig. crico-thyroid.; is bounded externally by the lesser cornua. The posterior border, slightly twisted, serves for the attachment of mm. stylo-pharyngeus and pharyngo-staphylinus, leans on the vertebral column. The horns, cornua, are oval elongations of the posterior borders, directed inwards and backwards. The larger superior are in connection with the hyoid bone by ligaments, the less inferior with the cricoïd cartilage.

2. The annular cartilage, cartil. cricoidea, thicker and more solid than the other cartilages of the larynx, is circular, narrow before, broad behind (one inch) and like an escutcheon, four-cornered. External surface. In front in the centre under the skin; serves laterally for the attachment of mm. crico-thyreoidei, presents an articular process for the thyroid cartilage; behind, in the centre a projection for muscular fibres of the pharynx; laterally, a depression for m. crico-arytenoidei.posterior.

The internal surface is covered with mucous membrane. The inferior border is completely circular, connected with the trachea by lig. crico-tracheale. The superior border is irregular, before low, with two articular surfaces (for the arytenoid cartilages), behind (on the shield) placed higher. The shield forms the inferior half of the posterior wall of the larynx.

3. The arytenoid cartilages, cartilagines arytenoideae s. pyramidales are two moveable cartilages, standing, close to one another, vertically, upon the shield of the cricoïd, and forming the superior part of the posterior wall of the larynx. Below broad, above pointed, the anterior surface convex, narrow, grooved, with the superior vocal cord; the posterior surface concave and broad (for m.
463. **b. Connections of the Larynx:**

1. With the *os hyoides*, by four ligaments:
   
a. *Lig. thyreo-hyoidenum medium*, yellowish, broad, fills the space between the superior border of the thyroid cartilage and the *os hyoides*; is in the (thick) centre covered by the skin, on the sides by *m. thyreo-hyoid.*, lies before the Epiglottis (separated by fat) and the mucous membrane.
   
b. *Ligg. thyreo-hyoida lateralia*, small and narrow, between the greater (superior) *cornua* of the thyroid cartilage and those of the *os hyoides*. A Synovial capsule lies between the posterior surface of the *corp. oss. hyoid.* and the superior of the thyroid cartilage.
   
c. *Lig. hyo-epiglotticum*, between the anterior surface of the epiglottis and the posterior border of the *os hyoides*.

2. With the Trachea by *lig. crico-tracheale*, that is, a small fibrous band which strengthens the membrane (on the anterior surface) between the cricoid cartilage and the rings of the Trachea.

3. Connection of the Laryngeal cartilages with one another:
   
a. *Lig. crico-thyreoidenum medium* s. *conoideum*, yellow, thick, broad, triangular, the apex at the inferior border of the thyroid, the basis at the superior border of the cricoid cartilage (before).
   
b. *Ligg. crico-thyreidea lateralia*, strong, laterally from the bend of the cricoid [inner lip of upper border] to the inferior *cornua* of the thyroid cartilage [retreating angle of Thyroid cartilage], horizontally below the inferior vocal cord.

[Articulation between the lesser *cornua* of the thyroid cartilage and the
surfaces on the sides of the Cricoid—surfaces plane. Ligament, capsular with shining parallel fibres—synovial capsule. The crico-thyroid articulations are all Arthodial. Trans.

c. Ligg. crico-arytenoidea unite the arytenoid cartilages with the plate of the cricoid, at the posterior internal surface; strong but loose. [Synovial capsule.] The arytenoid cartilages are moveable in all directions, but especially outwards and inwards.

d. Ligg. aryteno-epiglotticum, inside the folds of mucous membrane from the anterior surface of the arytenoid cartilages to the borders of the epiglottis.

4. Vocal cords, ligg. vocalia s. glottidis, s. thyreo-arytenoidea, are four ligaments which extend between the angle of the thyroid (on the posterior surface) and the anterior surface of the arytenoid cartilages, passing from before to behind through the midst of the cavity of the larynx. There are, right and left, a superior and an inferior. The triangular fissure between those on the right and those on the left side is called the glottis s. rima glottidis, is before narrow, behind roundish, at that part formed by cartil. cricoid, and cartil. arytenoid, and is not capable of being completely closed (Mayer).

a. Ligg. vocalia inferiora, are thick roundish cords attached before to the angle of the thyroid, behind to the anterior tubercle of the arytenoid cartilages; covered externally by m. thyro-arytenoideus, internally by closely-applied mucous membrane, they meet below at the ligg. crico-thyroid. lateralia.

b. Ligg. vocalia superiora, less strong than the last, above them in the middle of the larynx, under the Epiglottis, not quite horizontal. Below them the mucous membrane forms a sac, ventriculus Morgagni; above they meet in lig. aryteno-epiglotticum.

464. C. The muscles of the Larynx. The whole larynx is moveable: Mm. sterno-, omo-, thyreo-hyoidei, sterno-thyroidei, &c. (see before); the separate cartilages are moved by the following muscles:

1. Crico-thyroidei, two short, thick, triangular muscles on the anterior surface of the larynx, behind m. sterno-thyroid and thyroid gland, in contact below with the last, above m. crico-arytenoid. later; the internal borders separated by a quadrangular space. Or.: the anterior surface of the cricoid cartilage. Ins.: the inferior border and internal surface, and the anterior border of the inferior Cornua of the thyroid cartilage. Use: to approximate the cricoid and thyroid cartilages, elongating the glottis and stretching the vocal cords.

2. Crico-arytenoidei postici, triangular, on the posterior surface of the cricoid, covered before by this, behind by the mucous membrane of the Pharynx. Or.: from the posterior surface of the cricoid cartil. Ins.: external angle of basis cartil. aryten. Use: to separate the two vocal cords of either side from one another, widening the posterior part of the rima glottidis.

3. Crico-arytenoidei laterales, two flat, rhomboidal-shaped muscles. Situation: on the posterior wall of the Larynx (internal surface), oblique upwards and backwards; closely connected internally with thyreo-aryten. Or.: the lateral part of the superior border of the cricoid cartilage. Ins.: external angle of the arytenoid cartilages. Use.: to draw the external angles of the arytenoid cartilages forwards; the anterior angles with the vocal cords pass inwards, and thus contract the rima glottidis.
4. *Thyro-arytenoidei*, two thin, longish processes of the last muscle. Situation: between *thyroid* cartilage and mucous membrane of the internal surface of the Larynx, chiefly in the fold of the vocal cords. Or.: the angle (inferior two thirds) of the *thyroid* cartilage. Ins.: the anterior angle of the external border of the *arytenoid* cartilages. Use: to draw the cartil. *arytenoid*, forwards, and shorten the *rima glottidis*; extending at the same time the vocal cords.

5. *Arytenoideus*, short, thick, rhomboidal, lying in the concave posterior surfaces of the *arytenoid* cartilages, and in the space which divides them; consists of a deep transverse layer, that is, *aryt. transversus*, and two crossing each other obliquely, *arytenoidei obliqui*. The inferior border touches the *cricoid* cartilage; upon the superior lie glands, and a fold of mucous membrane which separates the *introitus laryng.* from the *Pharynx*. Points of attachment: the external angle and the posterior concave surface of cartil. *arytenoideae*. Use: to approximate the *arytenoid* cartilages, and thus contract the posterior part of the *rima glottidis*.

6. *Reflector epiglottidis* (Theile); in the fold of mucous membrane from the lateral borders of the *epiglottis* to the cartil. *arytenoid*, and *Santorini* of either side. Or.: from three places. 1. Posterior portion from the external angle of cartil. *arytenoid*, of the other side, crosses obliquely. 2. Central portion, from the attachment of the superior vocal cords to the *arytenoid* cartilages. 3. Anterior portion, from the internal surface of the *thyroid* cart. Ins.: lateral border of the *epiglottis*. Use: bends the epiglottis backwards, closing (and contracting) the entrance to the larynx.

c. The mucous membrane of the larynx, a continuation of that of the mouth and nose, passes from the root of the tongue upon the anterior surface of the *Epiglottis*, as it forms three folds (*ligg. glosso-epiglottica*), then covers the posterior surface and passes from its borders upon the cartil. *arytenoid*, and from these upon the posterior surface of the larynx (where this forms a portion of the anterior wall of the Pharynx). At the lateral parts of the entrance to the larynx, above the *rima glottidis*, the mucous membrane forms two folds (*ligg. ary-epiglottica*), covers the superior vocal cords, is loosely suspended in the pocket-like hollows which the *ventriculi Morgagni* form, but firmly and thin to the inferior vocal cords, from which it passes over upon the internal surface of the *cricoid* cartilage, the memb. *crico-arytenoideus* and the *Trachea*.

The mucous membrane is very thin, pale red, very sensitive (particularly over the *rima glottidis*), and contains in the *ligg. ary-epiglottica* much (serous) uniting tissue.

d. Glands: 1. Gland. *epiglottica*, small, numerous, under the mucous membrane, on the posterior surface of the *larynx*; they open towards the sides of the *larynx*.

2. Gl. *arytenoidea* (Morgagni), lie in the *Plica* (ligam.) *ary-epiglottica* in the shape of letter L, opening into the larynx. The vertical portion lies on the anterior surface of the *arytenoid* cartilages, the horizontal on the superior vocal cord.

e. Vessels: *Artt.* and *Ven. laryngea super.* and *infer.* (from *thyroid super.* and *infer.*). Lymphatics pass into the glands above the hyoid bone (in the neck).

f. Nerves: *N. laryngeus superior* and *laryng. inferior* (s. *recurrens*) from *n. vagus*.
465. The Thyroid Gland, *Glandula thyreoidea*,
a blood gland on the anterior part of the neck, between the inferior half of the *thyroid* cartilage and the superior rings of the *trachea*, lying in the shape of a crescent with the horns directed upwards, varying in circumference (in the female larger than in the male), and weight one ounce or more, heavy; of a bluish, in the embryo more of a bright red, colour; consists of two lobes, *lobi, cornua*, and a central, inferior, and flat portion, *isthmus*, from which frequently a third lobe, *cornu medium*, ascends as far as incisura *thyreoidea*. But the *isthmus* is also, frequently, so small, that it appears to be entirely wanting; or it reaches down as far as the *sternum*. The *isthmus* is before convex, and separated from the skin by *mm. sterno-hyoid* and *thyroideus* and *fascia colli*; behind concave, and lying before the rings of the *trachea*. The lateral lobes are before convex and covered by the *m. sterno-thyroid*; internally concave, and surrounding the inferior part of the *thyroid* cartilage, the lateral portion of the *trachea*, the inferior of the *pharynx*, and the superior of the *oesophagus*; they are in relation with, behind, the vertebral column (separated from it by *Art. carotis commun.*, *V. jugular int. n. vagus* and *sympathicus*). The apex of the *cornu* lies on the outer side of *Art. carotis*, on the outer and posterior of the *thyroid* cartilage, and sometimes reaches as far as its superior border. The inferior extremity, thick and round, lies before the fifth and seventh *tracheal* rings, between the *trachea* and the *carotis commun.*; here the *Art. thyreoideal. infer.* enters the inferior convex border of the gland; at the superior concave border the *art. thyreoideal. superior* occurs.

The Parenchyma of the *Thyroid* gland consists of a spongy unifying tissue, the cells of which are connected by openings with each other, without possessing any excretory duct; perforated by many vessels it contains a yellowish white serum, the destination of which is not known. Externally the *thyroid* gland is invested by a dense unifying tissue which is strengthened by *fasc. cervicalis, M. thyroideus* (see before).

Vessels: *Artt. thyreoideal. super.* (from *A. carotis*) and inferior (from *subclavia*), *Vv. thyreoideal sup.* and med. (in *V. jugular intern.*), inferior (in *V. anonyma*).

Nerves: *N. laryngeus super.* and infer. (from *N. Vagus*), and branches of gangl. cervic. med. or *infimum* of *N. sympathetic*.

466. 2. The Windpipe, *Trachea, arteria aspera*,
is a moveable tube composed of cartilages and membranes, four or five inches long, which, close under the *cricoid* cartilage, extends from the fifth cervical as low as the third dorsal vertebra, in which region it divides into its two branches, *bronchi*. In
front and at the sides cylindrical, it is formed of from seventeen

to twenty cartilages placed one above the other, and of the shape

of the letter Ω; behind, flat and membranous.

Cervical portion. 1. Before and above, covered by isthmus

gl. thyreoid., mm. sterno-thyroidei and fasc. cervicalis, below

by much uniting tissue (Art. thyreoida), and a little by Art.

anonyma. 2. At the sides: Gl. thyreoida, A. carotis comm.,

n. vagus, lymphatic glands. 3. On the posterior surface: aeso-

phagus (which projects rather to the left), n. recurrens dexter

and sinister (which passes towards the left side).

Dorsal portion, in the mediastinum posticum. Before it lie,

from above downwards: Sternum and m. sterno-thyroidei, V.

subclavia sinister. and truncus anonymus, the posterior portion of

Arcus Aortæ and Art. pulmonalis (bifurcation); behind it: ΩEsop-

phagus; on the sides: Pleura, Nn. vagus and recurrens (superior

part); a quantity of uniting tissue and lymphatic glands.

The Bronchi are the two branches of the trachea, into which it divides

before the third dorsal vertebra. The obtuse angle of division (bifurcation)

is filled up by a triangular ligament and the blackish bronchial glands. The

bronchus dexter, one inch long, about eight lines thick, consists of five to six

Ω-shaped cartilaginous rings, divides into three branches with which it enters

into the right lung, and lies close under the bend of V. azygos, behind V. cava

superior and Art. pulmonalis dextra. Bronchus sinister,—two inches long, about

five lines thick, consists of from ten to twelve Ω-shaped cartilages, divides

into two branches for the two lobes of the left lung, lies under the arcus

Aortæ and obliquely before the aosophagus, behind Art. pulmonalis sinister and

before aorta descendens. Between each bronchus and Artt. pulmonales we find

the Vv. pulmonales. The branches of the bronchi again ramify and always

dichotomously (bronchia) until at last they terminate in the pulmonary ves-

cules. Vessels: Artt. bronchiae come from the Aorta; Vv. bronch. enter the V.

azygos (upon the right side), the v. intercost. (upon the left).

Structure. 1. The cartilaginous rings are placed at tolerably equal inter-

vals, horizontally above one another, the interspaces filled up with fibrous

rings. Flexible and elastic in the young, they frequently ossify as age ad-

vances. Of unequal vertical diameter (1 ½ to 2 ½ lines), several of them fre-

quently unite together. The vertical diameter of the first is the greatest.

The last, the longest, is turned downwards, has behind an acute angle where

the first Bronchial rings pass off. 2. The fibrous membrane (perichondrium)

commences at the inferior border of the cartilages to which it passes as lig.

crico-tracheale, covers both surfaces of the cartilages, fills the interspaces, and

assists (with the other membranes) to form the posterior flat wall of the

trachea and bronchi, which is attached by uniting tissue to the aosophagus. 3.

Transverse, smooth muscular fasciculi, between the posterior extremities of

the cartilages approximate these to one another. 4. Yellow, elastic bundles

of fibres, pass parallel to the long axis on the internal surface of the muscular

coat. 5. The mucous membrane is thin, paler than in the larynx, firmly

attached (without folds), and perforated by numerous openings, which are the

openings of small, flat, oval glandul. tracheales, which are situated between the

mucous and muscular coats.
Vessels of the Trachea: 1. Artt. tracheales (from thyreoid. infer.) inferiores (from the Aorta). 2. The veins of the spaces between the cartilages open into the great trunks along the trachea (on the internal surface), and these into the Vv. thyreidea infer., mammar., and azygos. 3. The Lymphatics, very numerous, pass into the great lymphatic glands at the bifurcation.

Nerves: Nn. tracheal. superior. (from ram. recurrens Vagi);—inferiores (of the trunk of plexus pulmonalis of N. Vagus).

467. 3. The Lungs, Pulmones,

are two soft bodies, between which lies the heart, and each of which fills up the lateral half of the cavity of the thorax; of an irregular, conical shape, internally deeply excavated, with the base directed downwards. Colour: in the adult and aged, greyish blue, traversed by dark blue vessels and bluish black spots, which form polygons, on which account the surface appears marbled; the posterior surface (generally) a reddish brown. As age advances, the black spots which lie in the interposed uniting tissue, increase. Weight: In the foetus the lungs, in relation to the body, are as 1:60; in the adult, 1:30. Spec. grav. before birth and respiration: heavier than water; afterwards: lighter than water. In the male, the lungs are heavier (3½ pounds) than in the female (2½ pounds).

Each lung is invested by a serous membrane (pleura), and presents: 1. An external, convex surface, which is separated from the ribs by the pleura only, and by a deep fissure, incisura interlobularis, into two and three lobes (lobi). The fissure commences behind and above below the apex, and reaches downwards and forwards to the anterior part of the basis of the lung. On the right lung, a second fissure passes upwards and forwards before the termination of the last.

2. The internal surface, above flat, below excavated, presents, in the centre between basis and apex, and rather towards the posterior border, a surface one inch high, a depression half an inch broad (the root, radix, hilus), at which bronchi, arteries, and nerves enter, and veins and lymphatics pass out. Behind the root the internal surface looks towards the vertebral column; and, on the left side, towards aorta descendens [the lung has a corresponding groove], and the superior part of Ductus thoracicus, on the right side, towards V. azygos, aosophagus, and the inferior part of the duct. thoracicus; before the root on the left lung, the left border, the apex of the heart and Aorta descendens; on the right lung, the right auricle of the heart and V. cava superior.

3. The anterior border is thin, and presents two notches: an inferior (to the left for the apex, to the right for the auricle of the heart); and a superior (to the left for Art. subclavia, the right for V. cava superior).
4. The posterior border is broad, obtuse, and lies at the side of the vertical column.

5. Basis is hollowed out, rests upon the (convex) diaphragm; its posterior border reaches deeper downwards than the anterior, almost as far as the inferior surface of the liver.

6. Apex, is round, and projects (one inch) upwards above the first rib.

The left lung is narrower and lighter, but longer than the right (on account of the heart); has one fissure (incisura) and two lobes, a larger superior, a smaller inferior.

The right lung is less (in the vertical diameter, on account of the liver), but broader; has two incisurae and three lobes; the larger superior, the smaller inferior, and the smallest central lobe.

Parenchyma of the lungs. The spongy and soft tissue of the lung is very strong, elastic, crepitates under the pressure of the finger when respiration has been once performed, and consists of the following parts:

a. Aériserous vessels, vasa aërofera. After the Bronchi have divided many times (always at an acute angle), the small branches (bronchia) lose the regular structure of the larger; the cartilages on the anterior wall are no longer in the shape of the letter C, but irregular, and are finally entirely lost, like the muscular fibres, until at last vesicles with roundish corners, and terminating in a cul-de-sac, vesiculae pulmonales s. cellæ aërae (of one-sixth to one-sixteenth of a line), remain, which consist of mucous membrane and thin longitudinal fasciculi of uniting tissue. The pulmonary vesicles open into a common canal, to which they hang like berries upon their stalks (as in glands), and form a pulmonary lobule (lobulus). The pulmonary lobules are again associated in one great canal into a lobe (lobus), and are, like these, isolated from one another by the serous membrane which forms their envelope.

b. Pulmonary vessels, vasa pulmonalia.—1. Art. pulmonalis ramifies with the branches of the bronchi, and surrounds the lobuli with a large circle of capillary vessels, and the pulmonary vesicles with a smaller and more delicate rete (of 0:02 to 0:06 of a line diam.), between the meshes of which the vesicles lie, so that through the thin wall of both the inspired air (in the vesicles) comes into immediate relation with the venous blood (in the arteries) and changes it into bright red, arterial blood, which through: 2. Vv. pulmonales flows back again into the heart. Two pulmonary venous branches (to each branch of the pulmonary artery) arise from the capillary rete of the art. pulmonal. and bronchiallis.

c. Bronchial vessels, vasa bronchialia.—1. Artt. bronchiales do not pass to the pulmonary vesicles, but to the walls of the bronchia, art. pulmonalis, to the Bronchial glands, to the uniting tissue between the lobules and the pleura; they serve for the nourishment of, and for secretion in, these parts; they arise from the Aorta thoracica and mammoria intera, and frequently anastomose with A. pulmonalis; passing into the commencements of vv. bronchiales, but also the vv. pulmonales.—2. Vv. bronchiales open inside the lung into the Vv. pulmonales; outside, upon the right side into ven. azygos, upon the left side into Ven. intercostal. superior.
d. The lymphatics, superficial, are very numerous; a trunk also passes out from the interior of the lung at the root; however, in their interior the rete is not yet sufficiently demonstrated; they pass into the gl. bronchiales and tracheales, which become black between the tenth and twentieth year.

e. Nerves: branches of \textit{N. vagus} and (a few) of \textit{N. sympathetic} form a \textit{plexus pulmonalis anterior}, which spread upon the bronchia in the interior, and a posterior which go to the larger branches of the Bronchi.

f. Interlobular uniting tissue, consists of fine fibres which surround the vesicles in thin, the lobules in rather thicker laminae, containing no fat, but with time on the surface of the lung the colouring matter which produces the black spotted appearance.

Function of the Lungs. The change of the venous into arterial blood, effected by the inspiration of atmospheric air, and excretion of carbonic acid, resulting from expiration.

468. 4. The \textit{Pleurae, Sacci pleurae},

are two closed serous sacs, one of which covers each lateral half of the thoracic cavity, and then the lung. We distinguish:

a. \textit{Pleura costalis}, that is, the part which loosely attached to the internal surfaces of the ribs and \textit{mm. intercostales}, extends from the border of the \textit{sternum} to the sides of the dorsal vertebra, covering before the \textit{vasa mammaria}, behind (before the heads of the ribs) the \textit{ganglia n. sympathetic}, and projecting above over the first rib and the apex of the lung.

b. \textit{Pleura phrenica} passes off below from the \textit{pl. costalis}, firmly attached to the superior surface of the diaphragm, and by a triangular fold, \textit{lig. pulmonis}, with the posterior border of the inferior lobes of the lungs, and with the pulmonary veins.

c. \textit{Mediastinum}, is that part of the Pleura which is reflected before from the borders of the Sternum, behind from the sides of the dorsal vertebra upon the roots of the lungs, whereby a \textit{mediastinum anticum} and \textit{posticum} arises. The anterior mediastinum is different on both sides; the right, for instance, commences above from the right border of the \textit{manubrium}; below from the centre, indeed from the left border of \textit{corpus sterni}; the left, from the left border of \textit{manubrium sterni}, and below from the external extremity of the sixth and seventh rib cartilages. Between the two anterior and the two posterior mediastina an \textit{X} shaped space remains, \textit{cavum mediastini}, which is divided by the heart (or, as the French describe it with greater accuracy, by the roots of the lungs), into an anterior and posterior.

1. \textit{Cavum mediastini antic}, is bounded before by the \textit{Sternum} and the left rib cartilages, laterally by the two \textit{anterior mediastini}, behind by \textit{pericardium}, the great vessels, and above by the \textit{trachea}. Above narrow and vertical, below sloping and directed towards the left; it contains:

the Thymus gland [or its remains], \textit{nn. phrenici, glandul. mediastini}. 
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antic., adipose and uniting tissue which is connected above with that on the anterior part of the neck, below with that of the anterior abdominal parietes.

2. Cavum mediastini postici, more spacious than the anterior, not oblique, bounded before by the pericardium and roots of the lungs, behind by the bodies of the dorsal vertebra, laterally by the posterior mediastini; contains:

aorta thoracica, aesophagus, nn. vagi, duct. thoracicus, vv. azygos and hemi-azygos, uniting tissue, gland. mediast. post.

d. Pleura pulmonalis is formed by the mediastini of the roots of the lungs, the vessels passing in and out of which they envelope, being reflected upon the internal surface of each lung, and firmly attached covering the external surface; also entering between the lobes, and forming ligg. interlobularia. Thus also there remains between Pleura pulmonalis and the other portions of the Pleura a closed cavity, the smooth moist walls of which frequently secrete a serous fluid, lie close together, and (frequently) are in places united with each other.

Vessels are doubtful. Branches of the neighbouring intercostales, mammae interne, phrenice superius, &c., form a capillary network which manifests itself in inflammation, but only on the external surface of the Pleura.—Lymphatics: numerous, open into plex. mammar. and intercostalis.—Nerves: not yet found out.

469. Thymus Gland, Glandula thymus,

the sweetbread, a so-called blood gland, grows from the third month of foetal life until the termination of the first year after birth, then by degrees diminishes from below upwards, and entirely disappears with the twelfth year. In its complete perfection it consists of two lateral lobes (only associated by uniting tissue) so that properly we must admit two flat, three-cornered thymus glands above and below pointed, which are situated in the superior part of cavum mediastini antici, before the junction of the vv. anonymae, behind the manubrium sterni, reach as far upwards as the thyroid gland, and contain a large cavity filled with white fluid (F. W. Becker), with which the cavities of the lobules, the size of a pea, are connected. The cavity is not bounded by a proper membrane. Astley Cooper maintained that a large lymphatic vessel, which opens into the vena anonyma, served as an excretory duct.

The Parenchyma is, like that of the thyroid gland, pale red. The lateral lobes divide into three or four larger, and these again into a number of smaller lobuli, which are associated together by uniting tissue, in which fat cells are present. The corpuscles which exist in the lobules, resemble the nuclei of the blood discs and the globules of demolished nerve substance (Ehrenberg).

Vessels: Artt. thymicae come from art. mammae interna and subclavia,
sometimes from *thyreoidea, carotis, or arcus aorta*. Veins open into: *v. cava sup., subclavia, thyreoid., mammaria interna.*

Function (see Blood glands).

The Urinary Organs, *Organa uropoëtica*.

**470. 1.** The kidneys, *renes, ρένες*, are two dense glands (gl. *tubulosae*) in the reg. *lumbalis*, close to the sides of the first to third lumbar vertebra, outside the peritoneum, surrounded by uniting tissue with abundance of fat; generally smooth on the surface, sometimes (as in the fetus and several animals) grooved. The right kidney lies rather lower than the left (on account of the liver). Length: three and a half to four inches. Breadth: two inches. Thickness: one inch. Weight: two to four ounces. Colour: reddish brown. Figure: bean-shaped; the fissure [Hilus] directed inwards towards the vertebral column. Position: upright.

a. The anterior surface looks rather outwards, is convex; the left covered by Colon descendens, above by the Spleen and cauda pancreatis; the right by colon ascend., lobus dexter of the liver and pars descend. duodeni.

b. The posterior surface looks inwards, is less convex; behind covered by *m. quadratus lumborum*; separated by the diaphragm from the three last ribs, by *m. psoas* from the vertebral column.

The external, convex semi-elliptical border looks backwards; the internal border forwards, and is deeply notched (*incisura s. hilus renalis*). This *hilus* is fifteen to eighteen lines in length; behind we arrive at the pelvis of the kidney, before *Vena renalis*.

The superior border looks inwards, and is surrounded by the suprarenal capsules; the inferior smaller border outwards, and it projects down below the last rib.

Structure of the kidneys. 1. Between the fatty uniting tissue (*capsula adiposa*) which surrounds the kidney and the Parenchyma we find a firmly adherent fibrous tunic, prolonged over both surfaces (*tunica propria s. albuginea*). 2. The tissue of the gland itself consists of a cortical and a medullary substance.

a. The cortical, vascular substance, *substancia corticalis s. vasculosa*, [secret- ing portion] a thin, soft, red, sometimes yellow layer on the surface of the kidney, which forms columnar processes within the following substance, and thus, septa between the Malpighian pyramids. In it we find numerous fasciuli of very serpentine canaliculi, which terminate in a cul-de-sac, or, more probably, in a convoluted form [loops], *tubuli, uriniferi corticales*, which pass into the tubular substance. Farther, a number of round red granules, *glomeruli s. acini Malpighi*; they are small convolutions of vessels which lie between the windings of the above mentioned canaliculi, which are smaller than they are, and give off *vasa efferentia*, from which the capillary network about the uriniferous tubes and the commencements of the renal veins passes forth.
b. The tubular medullary substance, s. tubulosa, s. medullaris [the excretory portion], paler than the former, striated like muscular fibres, consists of twelve to fourteen (twenty) conical lobes (pyramids Malpighii), which are separated from one another by the cortical substance, and are covered by the same also on the basis which is directed towards the surface of the kidney, whilst the free apex terminates in the hilus like a nipple, as papilla renalis. There are generally only ten to twelve papilla, because some have blended together. Each Malpighian pyramid consists of several fasciculi (these are pyramids Ferreini) of parallel canaliculi, tubuli uriniferi recti s. Bellinianni, which open with fine orifices on the renal papilla, or rather on the walls of a fossa two or three lines deep, inside the papilla; that is, ductus papillar. Ferrein. The uriniferous tubes consist of a clear structureless memb. propria, and have a diameter of 0.009 to 0.016 line.

(Renuli, s. lobi renis, is a name given to the Malpighian pyramids which in early youth, in animals throughout the whole of life, are limited to the surface of the kidney, so that the organ appears to consist of so many small kidneys.)

The vessels for the most part go into the cortical substance. The great art. renalis divides in the hilus into two or three large branches, which again divide at the boundary between the cortical and medullary substance, and form a capillary network, the close meshes of which surround the basis of each Malpighian pyramid, dispatch branches thence into the cortical substance, which divide in a forked manner, and pass along the undulating tubuli into the red granules (acini Malp.). Vena renalis passes out of the hilus before the artery, and sinks into the ven. cava inferior. The vessels of one lobe do not communicate with those of another. Lymphatics: numerons, on the surface. Nerves: numerous, from plexus solaris, N. splanchnicus minor. From plexus renalis, plexus spermaticus passes off.

Function of the kidneys: Secretion of the urine (in the urinary canaliculi).

471. 2. Excretory ducts of the kidneys. These are the renal calyces, the pelvis renalis, and the ureters.

a. The Calyces renales, s. infundibula, are small, membranous, sometimes forked cylinders, which surround the basis of one or more renal papillae. Their mucous membrane terminates blindly upon the papilla, but at the same time blind processes pass into the substance of the latter, where the urinary canaliculi open. (Henle.) They are surrounded by the fat of the hilus, are present in indefinite number (seven to fourteen), and, arranged in rows, they pass into three branches, which form again.

b. The pelvis of the kidney, pelvis renalis. This is funnel-shaped, flat from before backwards, projects out behind art. and ven. renalis from the inferior extremity of the hilus, is very extensible, and contracts as it proceeds into:

c. The ureter, that is the long (ten or twelve inches) membranous tube which descends on either side to the basis of the bladder. Generally of the thickness of a raven’s or goose’s quill; the ureter may be, with its thin whitish wall, considerably distended. We find sometimes two ureters on one side if the renal calyces have not united into a single pelvis. Direction: obliquely downwards and inwards to the sides of the basis oss. sacri, then
downwards, forwards, and lastly inwards, where, arriving at the sides of the fundus vesicae, it passes in this for about ten lines between the muscular and mucous coats, and opens with a narrow mouth into the cavity of the urinary bladder, at the posterior angle of Corp. trigonum. Position: as far as to Basis oss. sacri, along the anterior border of m. psoas; behind the peritoneum and Vasa Spermatica (which cross obliquely with it); the right ureter (externally) close to V. cava inferior. At the basis oss. sacri the ureter crosses the vasa Iliaca (forwards and inwards); in the small pelvis: with Art. umbilicalis, vasa obturatoria, Vas deferens (in the male); the superior and lateral parts of the vagina (in the female). When within the bladder it lies behind Collum uteri (hence retention of urine at child-birth, &c.).

Structure of the excretory ducts. 1. The mucous membrane is white, smooth, and in folds, without valves, covered with pavement epithelium. 2. The middle coat, tunica propria. 3. The external coat is thick, consists of smooth muscular tissue, the circular fibres of which (as in all excretory ducts of glands) form the external, the longitudinal fibres, the internal thicker layer.

472. 3. The urinary bladder, vesica urinaria s. cystis, is a membranous, roundish sac (in the foetus pointed above), which is situated in the cavity of the small pelvis close behind the bones of the pubes, and is for the purpose of holding the urine. It is held in its situation by fascia pelvis, and peritonæum; ligg. vesicalia lateralia (the obliterated artt. umbilicales) and medium (the obliterated urachus); ligg. pubo-vesicalia (3) from the symphysis to the neck of the bladder in the female, or ligg. pubo-prostatica in the male. The capacity of the bladder is different according to the habits of individuals, &c., before birth proportionably larger than afterwards, in the female likewise larger than in the male, where it holds from 7 to 14 ounces of fluid. Direction of the axis: from above and before downwards and backwards.

Divisions: the top, vertex, is the superior, smallest; body, corpus, the central; basis, fundus, is the most inferior and broadest part of the bladder.

The external convex surface presents the following parts:—

1. The anterior wall is situated close behind the symphysis, corp. oss. pubis, and mm. obturat. intern., with loose, uniting tissue only interspersed, and without peritonæum; in the female (because the prostate is wanting), rather under the Symphysis; and above it, close behind the abdominal walls, when the bladder is distended.

2. The posterior wall, quite covered by peritonæum, is situated before the rectum (in the male); before the Uterus (in the female); nevertheless, small intestines generally slip in between.

3. The lateral parietes, covered by peritonæum, close to Art. umbilicales (s. lig. lateralis), and Vasa deferentia (in the male).

4. The inferior wall, basis. a. In the male: above the vesicula seminale and Vasa deferentia, and the triangular piece of the rectum between them,
which, however, when the bladder is empty, is separated from it by the peritoneum. At the sides of the basis are situated: uniting tissue, and Mm. levatores ani. b. In the female: firmly on and above the Vagina, and loosely on the inferior half of collem uteri.

5. The superior wall, vertex, apex, is directed forwards and upwards, and covered by the peritoneum. In an upright position the intestines rest upon it. In front the urachus s. l. suspensorium passes off from it, ascending to the umbilicus. This membranous cord is the remains of a canal which, even in the human embryo (in those of quadrupeds it is certain) up to the fourth month, is said to pass through by the umbilical cord into the allantois. Compare the history of development.

6. The neck of the bladder, collum vesica, in the narrow part of the bladder, at the most inferior region of the anterior vesical wall, which in the male is surrounded by the prostate, and lies close behind the inferior border of the symphys. pubis (in the female above the vagina).

Structure of the urinary bladder: 1. Mucous membrane, whitish and thin, with a few mucous follicles (in the neighbourhood of the neck); strong and sensitive, presents numerous folds, which disappear upon extension of the bladder, and a columnar or network appearance, according as the fibres of the muscular tunic project. Besides, the openings of the two ureters and the urethra, between which arises a smooth triangle, corpus trigonum, bounded by two slight folds, plica ureterica, which are situated behind the neck of the bladder, and before the fundus vesica, frequently forming a pouch on either side (sinus vesical.).

2. The muscular coat invests the mucous membrane, with which it is united by a thin layer of uniting tissue (tunica propria) is externally thin, and consists of—

a. An external layer of longitudinal fibres, which ascend from the neck of the bladder on the anterior and posterior wall to the vertex, and pass as m. detrusor urine.

b. An internal layer, which consists partly of regular or irregular circular fibres crossing each other (the first at the fundus, the last particularly on the posterior wall), partly of fibres passing obliquely.

M. Sphincter Vesica is just such a fasciculus of circular fibres, which closes the orifice of the urethra into the bladder.

3. The peritoneum covers the vertex and the posterior surface of the bladder only; reaches in the male (excavat. recto-vesical) deeper downwards than in the female (excav. vesico-uterina).

Vessels: Artt. vesicales, from the hypogastrica and its branches. Veins form plexus vesical. about the neck of the bladder, and open into V. hypogastric. Lymphatics: they mostly lie between peritoneum and the muscular coat, and pass into plex. hypogastric. Nerves: branches of plexus hypogastricus lateralis and sacralis (voluntary and involuntary).

Function of the bladder: to hold the urine which continually and guttatim flows in through the ureters, and when contained in sufficient quantity, the resistance of the sphincter vesic. is overcome, and it flows out.
473.

4. The Urethra,

is the narrow, cylindrical continuation of the neck of the bladder which passes under the *symphysis pubis* and opens with an external mouth, *osteon cutaneum*, on the external parts of generation.

a. The urethra of the male, *urethra virilis*, from five and a half to nine inches long, four lines broad, passes obliquely forwards and downwards through the *Prostate* (*pars prostat.*) curves, slightly arched downwards, in its course, under the *Symphysis* (*pars membran*.), and lies in a groove between the *corp.* cavern. on the inferior surface of the penis (*pars cavernosa*), whence it passes forwards through the glans to its anterior mouth.

1. *Pars prostatica* perforates the prostate (or lies in a groove uncovered by it above), is wider at its departure from the neck of the bladder than before, and about ten lines to one inch long. On the posterior wall the mucous membrane forms a narrow fold, *caput gallinaginis* (*colliculus seminalis, veru montanum*), upon which are found the two openings of the *ductus ejaculatorii*, and on the sides of which are the excretory ducts of the Prostata, and several radiating bands, *frenula*. Between *Prostata* and mucous membrane there is placed, as in the urinary bladder, a layer of muscular fibres.

2. *Pars membranaceae s. isthmus urethra*, the narrowest part of the urethra (one and a half to two lines diam.) is eight to nine lines long, formed only of the mucous membrane and the *m. constrictor urethrae* [Wilson’s and Guthrie’s], surrounding it like a ring, lies curved under the *Symphysis pubis*, separated from this by veins, above the *rectum* (between the two a triangular space, the apex of which looks backwards and upwards). This portion permits great distension. The muscular layer is surrounded by many veins. [This portion perforates the two layers of the deep perineal fascia about one inch below the angle of the pubes, three-fourths to a half below the subpubic ligament. The bulb of corp. Spongiosum projects backwards upon its under surface, being applied to the anterior surface of the deep fascia.]

3. *Pars cavernosa s. spongiosa*, the longest portion of the urethra, commences with an enlargement, *bulbus*, which has a diameter of about three lines, is placed in the apex of the pubic angle, is surrounded below by the *corp. cavernos.* [*spongiosum*] *urethra*, which likewise forms a bulbus, and laterally by the *mm. bulbo-cavernosi* and Cowper’s glands, and looks forwards and upwards. From the angles in which the roots of the *corpus cavernos.* unite, the urethra passes on the inferior surface of the *penis*, at first above *mm. bulbo-cavernosi*, then close above the skin to the glans; is there enlarged (four lines wide, three-quarters of a line long) into the (*fossa navicularis s. Morgagni*), passes through the middle of the glans [rather, on its under surface], and terminates with a narrow, oval opening (two lines wide) at its point. This portion consists of a fibrous sheath, a spongy body, and the mucous membrane, which here presents particular longitudinal folds, and the oblique mouths of Cowper’s glands directed forwards, and those of mucous glands (gl. Littrii) in larger depressions (*lacuna s. sinus Morgagni*).

Vessels of the urethra are numerous, especially in the *fossa navicularis*.

Nerves also from *pudendo-hæmorroidal*.

b. The urethra of the female, *urethra muliebris*, about an inch and a half long, and wider than that of the male; passes, only
slightly curved, under the *symphysis pubis*, from the neck of the bladder forwards and downwards, contracts by degrees and opens into *vestibulum vaginæ*. Above a *venous plexus* surrounds it and *ligg. pubo vesicalia*; under the symphysis: the angle of the united *crura* of the *Clitoris*; below it rests firmly upon the anterior wall of the *Vagina*. The external mouth, surrounded by a small enlargement, lies about one inch under the *Clitoris* above the entrance to the *Vagina*. Its mucous membrane presents longitudinal folds, and the veins passing longitudinally, also, a few openings of mucous crypts; the external coat consists of a thin layer of erectile tissue (like *corp. cavernosum urethrae virilis*) and a thicker of circular muscular fibres (*pubo-urethralis*).

474. The *glandulæ supra-renales*, *renes succenturati*, are two small (one inch high, two inches broad), flat, semilunar shaped and spongy blood glands, which in the foetus and child are larger than in the adult, and surround the superior extremity of the kidneys like a helmet.

The anterior surface of the right supra-renal capsule looks towards the inferior surface of the liver, to the right of *V. cava inferior*; that of the left touches the *Pancreas* and looks towards the *fundus* of the stomach. The posterior surface is attached to the superior part of the crus of the diaphragm, on a plane with the tenth dorsal vertebra, and has the *Nn. splanchnic. major* and *gland. semilunare* behind and close to it. The superior convex border is thin, and looks upwards and inwards. The inferior concave is thick and lies upon the kidney. The surface is surrounded by a thin layer of adipose tissue (not by peritoneum) and a fibrous coat.

Structure. We distinguish a thick, external cortical substance, of a yellow striped appearance; and a pulvaceous, chestnut brown, medullary substance, in the interior, which is penetrated by numerous vessels (veins). The lobes perceptible upon the surface, only, are formed by the furrows for vessels.

Vessels: very numerous; *suprarenales*, branches of *phrenic. infer.; Aorta; celiac renalis*. Veins: give rise to the idea of a cavity in the supra renal capsules; they pass into *V. cava infer.* (the right) and *renalis* (the left).

Nerves: from *plex. renalis* and *solaris*.

Function of the supra renal capsules unknown.

475. The Genitals, Organs of Generation, *Organa genitalia s. sexualia*.

I. Of the Male, *Genitalia virilia*,

serve for the preparation, preservation, and excretion of the seminal fluid, and are placed for the most part outside the pelvic cavity.
1. The Scrotum, ὀρχεῖον,
is a pouch-like elongation of the external skin which hangs down before the perínæum between the legs, and encloses both the testicles.

This skin is brownish, thin, and without adipose tissue, wrinkled, loose, and large in warmth, dense, strong, and tightly applied in the cold; beset with delicate and curled (it is said obliquely placed) hairs and many sebaceous glands.

In its centre a linear suture-like elevation, raphé, passes from the anus to the root of the penis, which is bounded before by the root of the penis [sometimes extends along it] behind by the anus, and indicates the place where inside the Scrotum a vertical septum passes off from the Dartos between the testicles—tunica dartos, is a red, dense, and very vascular membrane of contractile uniting tissue, which is firmly applied to the internal surface of the scrotum, and only loosely to the tun. vaginalis communis. The uniting tissue between the last continues into the fascia femor. and abdominal. superfic., and becomes changed by pressure into a membrane (e. g., of water). The partition in the central line, septum scroti, consists of fibrous and common uniting tissue. The dartos above, close to the spermatic cords, is supplied with uniting tissue containing much adipose, and it does not pass into the fascia superficialis.

Vessels: Artt. and Vv. scrotales anteriores (branches of pudenda externa and epigastrica); posteriores (branches of pudenda communis).

Lymphatics: numerous; they enter into the inguinal glands.

Nerves: branches of the iléo-inguinal., spermatic. extern. pudendus and cutan. femor. posterior communis.

2. The testicles, testes, testiculi s. didymi, are two oval glands lying under the penis, which until towards the end of embryonic existence lie in the abdomen, but later, enveloped in a peculiar and common vaginal membrane, inside the Scrotum, and the left rather lower than the right. Length: two inches. Breadth: one inch. Thickness: six lines. Weight: one half to one ounce. Each testicle consists of two parts.

a. The proper testicle, testis, ὀρχίς, is egg-shaped, rather flat on the sides, smooth, and yielding (about as much as the eye), of a whiter hue (tunica albuginea). Its superior extremity looks forwards, the inferior backwards; the anterior border downwards, the posterior with the epididymis, upwards.

Structure. The parenchyma (pulpa testis) is soft, doughy, yellowish red; it consists, principally, like that of the kidney, of numerous and many times convoluted tubules, tubuli semiferi, which, surrounded by capillary and nervous rete, are associated by uniting tissue into longitudinal lobules, and are surrounded as a whole by a fibrous capsule (tunica albuginea s. propria), which
last again involves itself in a serous sac (tun. vaginalis propria testis). The
* tubuli semiferi* commence in blind (or looped?) extremities, at the periphery
of the testicle, and form, by means of their many short convolutions, a dense
cortical layer, which consists of from one to two hundred lobules (which un-
folded measure about from one thousand to one thousand two hundred feet
long). The lobules are supported by processes from the *tunica albuginea*,
which at the posterior border of the testicle forms a triangular space, corpus
Highmori, and continues inwards. From this corp. Highmori the *tubuli* pass
almost directly straight, when they have passed away from the lobules, and
then unite at an acute angle into a rete, rete vasculosum Halleri. From these
arise from nine to thirty *vasa efferentia testis*, which perforate the superior
extremity of the *Corpus Highm.*, and pass into the head of the *Epididymis.*
They are many times convoluted, present (each) a conical cord, *conus vascu-
losus Halleri*, the point of which is directed downwards, and they finally unite
to form the Canal of the *epididymis*.

The seminal tubules consist (like the urinary) of a structureless membrane,
have a diameter of 0·11 to 0·24 of a line, and contain the Spermatic filaments
(spermatozoa) and the other elements of the Semen.

b. The *Epididymis s. parastata cirsoideae*, is the vermiciform appendix, two and a half to three inches long, which is placed
along the posterior border of the testicle somewhat externally, of
a brownish red, and flattened from above to below. Its thicker
and broader superior extremity, *caput epididymis*, rests with its
concave surface close upon the superior extremity of the testicle;
the central part, *corpus*, is surrounded all round by *tun. vaginal.*
the inferior thinner and narrower portion, *cauda*, is again situated
close on the inferior extremity of the testicle, and continues,
curved downwards, into the *vas deferens*.

Structure. The *epididymis* consists of a single tube, 0·12 to 0·33 lines in
diameter, and so often convoluted that its length measures thirty-two feet
(Monro), and is a continuation of the *coni vasculos*, which coalesce in the *caput
epididymis.* *Vasculum aberrans Halleri* is a still more minute canal than that
of the *epididymis*, which passes upwards from the tail of the last to the *vas
deferens*, and is then lost; it arises from the departure of a few seminal vessels
in the endeavour to form a second *epididymis*; according to Weber similar
blind canals are sometimes present in the *duct. hepatic.* and *pancreatic.*

Vessels of the testicle: *Art.* and *V. spermatica interna*; the veins arise from
the *plexus pampiniformis*.

Lymphatics: *plexus spermaticus*.
Nerves: *plexus spermaticus* (from *plex. renalis n. sympathetic*).

*Tunica vaginalis propria testis*, the serous envelope (*Perito-
næum*) of the testicle, is a completely closed sac, in which it is
involved (like the lungs in the pleura), so that the one (internal)
layer (*t. serosa testis* or visceral) is connected firmly with the
testicle (*t. adnato*), the other (external) surrounds it loosely [*t.
* vaginalis reflexa* or parietal*], and a cavity is found between the
two, in which a serous fluid is exhaled. The reflection of the
external layer upon the testicle takes place at its posterior border,
at the *corpus Highmori*.* The *epididymis* is separated from the
superior border of the testicle, externally by a kind of mesentery, lig. epididymidis s. mesorchium, and internally it is covered higher up.

The development of the vaginal membrane into a closed sac is closely connected with the descent of the testicle.

Descensus testiculi.—In the tenth to twelfth week of foetal life we see a small elongated testicle, in a mesentery which passes off from the peritoneum of the posterior abdominal wall, below the kidney. In the fissure which leads to it from the posterior abdominal wall, the vasa testiculi are situated, in the centre the vas deferens, below, a fibrous thicker cord projects from it into the short straight inguinal canal.

The leading string, gubernaculum Hunteri, which is widely fixed to the Scrotum. The testicle increases by degrees, not so the gubernaculum, which becomes shortened in proportion to the other parts, and draws down the testicle out of the mesenteric fold, so that the immediately investing and closely attached portion, only (the subsequent tun. serosa testis), of the testicle, accompanies it.

In its passage through the inguinal canal, the testicle draws down with it that portion of the peritoneum which is connected with its covering; a cavity appears therefore inside the scrotum, on the external surface of which the testicle, with its vessels, &c., is situated, and which is separated from the cavity of the peritoneum by a constriction only, the vaginal canal, canalis vaginalis. (Intestines pass through this canal, in hernia congenita; thus they are only separated from the Parenchyma of the testicle [the tunica albuginea] by the serous investment of each other, whilst in hernia acquisita, two folds of peritoneum, namely, the hernial sac and tunica vaginalis testis [reflexa], lie there between them).

So soon as the testicle has arrived at the fundus of the scrotum, the obliteration of the vaginal canal commences, as the tunica becomes converted into a ligamentous band of uniting tissue, habercula, between the internal inguinal ring and the superior extremity of the testicle.

These filaments even sometimes disappear. The obliteration commences above or below, or from both points at the same time, towards the termination of foetal life; at birth the canal is frequently open, and intestines fall into it, forming a hernia (hernia inguinalis congenita). Serum collecting in it forms a Hydrocele.

478. 3. The vas s. ductus deferens,

the continuation of the epididymis, commences at the cauda of the last, ascends through the inguinal canal, together with the remaining parts of the spermatic cord into the abdomen, and terminates before the vesiculae seminales, associated with the excretory duct, of which it forms the duc tus ejaculatorius. In its course we distinguish four parts.

a. Pars testicularis passes in a serpentine form from behind forwards and from below upwards along the inner side of the art. ven. and sperma tica and the epididymis.

b. Pars funicularis, ascends in a proper sheath behind art. and ven. spermatica, directly as far as the inguinal canal, inside of the spermatic cord.
c. *Pars inguinalis*, passes through the inguinal canal, inclining from below, upwards, from within, outwards and from before, backwards, continues over the curvature of the *art. epigastrica* forming a part of the spermatic cord.

d. *Pars vesicalis* sinks downwards, at its exit from the inguinal canal and the cord directly into the pelvis, over *Vasa epigastricae*, at first on the side, then on the posterior surface of the urinary bladder, where it crosses obliquely the *Art. umbilicalis*, and betakes itself inwards and downwards to the *fundus vesicae before the ureter*, then passes transversely inwards to the inner side of the *vesiculae seminales*, where both *vasa deferentia* almost meet together, and join behind the *prostata*, with the anterior extremities of the seminal vesicles at an acute angle. Two inches above the *vesiculae seminales* it is thinner and wider.

Structure. Cylindrical, with thick walls, hard, narrow, and only at its inferior extremity expanded; this canal presents an extremely delicate, white, and folded mucous membrane, surrounded by a compact contractile coat, and an external uniting tissue. Muscular fibres exist in large animals (horses) indubitably. *Arter.: spermatica interna and vesical.;* very numerous inwards towards the seminal vesicles.

The spermatic cord, *funiculus spermaticus*, a looser cord at the posterior part of the testicle, which, passing with and into the testicle, through the inguinal canal as far as the internal ring, is composed of the following parts, viz.:

1. *Vas deferens* (with *Art. and Ven. spermatica deferens* from *vesicalis inferior*; only sometimes); at the internal posterior part.
2. *Art. spermatica interna*, on the anterior and external side of the *vas deferens*.
3. *Ven. spermatic. interna*, with *plexus pampiniformis*.
4. *Plexus spermatic. lymphaticus*.
5. *Nerv. spermaticus extern.* (branches of *genito-cruralis*), *Plex. spermatic. (n. sympatheticus)*.
6. *Habercula* (the obliterated *tunica propria testis*), and sometimes
7. *Vasculum aberrans Halleri*.

The above mentioned parts are united by an adipose uniting tissue (tun. *propria funicii*), and they are held firmly together by the

*Tunica vaginalis communis testiculi et funiculi*. This last is a fibrous membrane, covered by *m. cremaster*, which surrounds the *tunica propria* of the testicle, and is connected through the inguinal canal with the uniting tissue between *fascia transversalis* and peritoneum. (It becomes thicker and stronger from pressure, e. g., of fluid.)

479. 4. *Vesiculae seminales s. spermaticæ*,
two longish, flattened, irregular sacs, between the rectum and bladder, along the external side of the *vasa deferentia*, lying at the anterior extremity close to one another and diverging back-
wards. Length: from two to two inches and a half. Breadth: six lines. Depth: from two to three lines. The internal surface consists of a cavity divided into from ten to fifteen compartments (of about six to eight lines long), is striated and in folds, like the *vas deferens*, the external coat of which, however, is thicker. They contain a yellowish brown viscous fluid. The anterior pointing extremity of each seminal vesicle, which is surrounded by the *Prostata*, forms the excretory duct which, united with the *vas deferens* of each side, passes into the *ductus ejaculatorius*, the ejaculatory duct for the semen, which, likewise, very short, but with thin walls, oblique from above, downwards and inwards through the *basis prostatica*, opens upon the *verum montanum* of the urethra, with a narrow mouth, whilst its posterior extremity is wider.

Function of the testicle. It is to secrete the semen, which, preserved in the seminal vesicles, is carried through the *ductus ejaculatorius* into the urethra, and there mixes with the fluids of the Prostate, and the glands of Cowper.

480. 5. The prostate gland, *glandula prostata*, a whitish conical gland, blunted in front, twelve lines thick, fifteen long and eighteen broad, placed behind and below the *Symphys. pubis*, before the neck of the bladder and the rectum, rather obliquely from above and behind to below and before; and is perforated by the urethra and the *ductus ejaculatorii*. Its inferior surface rests upon the anterior surface of the rectum, attached by uniting tissue, is flat, and in the centre separated by a longitudinal groove into two equal parts.

The superior surface lies under the *ligg. pubo-prostatica*, and some lines below the pubic angle. The sides are surrounded by *M. levator ani*. The *basis*, that is, the posterior extremity, presents two larger lateral lobes and a central, bean-shaped, hidden between the two, surrounding the neck of the bladder, and farther backwards the narrow portion of the seminal vesicles. The blunt apex directed forwards and downwards terminates behind the *pars membran. urethrae*. The canal for the urethra is situated rather above the centre, is often open above, and placed in rare cases on the inferior surface of the *Prostata*.

Structure. The *Parenchyma* of the Prostate, which consists of lobules, forms roundish glandular cells of fibrous tissue, surrounded by vascular rete. The cells, closely compressed together, are connected with one another by small canals, from the junction of which from twelve to fifteen excretory ducts are formed, which pass obliquely from behind forwards in the gland, and open close to the *verum montanum*, with very fine orifices, into the urethra, for the purpose of discharging a whitish viscous fluid, *liquor prostaticus*. The fibrous envelope of the prostate gives to it its external firmness, whilst the
481. 6. Cowper's glands, glandulae Cowperi,
are two irregular glands, the size of a pea and yellowish red, the
lobes of which, consisting of small fossæ, open into two or three
excretory ducts, common to them all, which, after a passage of
one and a half to two inches on the inferior wall of the urethra,
penetrate, obliquely, the mucous membrane at the commencement
of pars cavernosa urethrae. They lie close before the prostate,
under the bulbus urethrae [rather behind it] between the two m.
constict. isthmi urethrae, surrounded by m. bulbo-cavernosi;
and secrete a yellowish mucus.

482. 7. The male organ, membrum virile, penis, virga, coles,
is a cylindrical, spongy body, in a state of erection three-cornered
(and then eight inches long), on the inferior surface of which the
pars cavernosa [spongiosa] urethrae is applied. Its posterior
extremity, radix s. crura penis, is thicker and attached on either
side to the pelvis; its anterior extremity, nut, glans, pointed and
rounded; its superior surface, dorsum, flattened and presenting a
longitudinal sulcus for vasa dorsalia penis; its inferior surface is
convex, and presents the urethrae in a deep groove.

The penis consists of the corp. cavernosum penis, the pars
cavernosa urethrae with its corpus cavernosum [spongiosum],
the glans and muscles (which see).

  a. Corpus cavernosum (s. corpora cavernosa) penis, is a roundish body, spring-
ing with two roots from the internal surfaces of the rami ascend. oss. Ischiæ
(close above the tuber Ischiæ), which passes away from under the symphysis
pubis, where its roots lie close together, as far as the glans, into which its an-
terior rounded and smaller extremity projects, without communicating with
it. On its superior surface the vasa dorsalia penis pass, in its inferior deep
groove, the pars cavernosa of the urethra. A fibrous vertical partition, septum
penis, separates the two halves of the corpus cavernosum (hence the appellation
two corp. cavernosa), which, however, are more or less connected together,
since the veins of the one pass over into those of the other side.

  Structure. The cavernous bodies consist of; 1. a thick, strong, and exten-
sible fibrous envelope, albuginea, from which a septum passes off in the cen-
tre; 2. of an erectile tissue, tela erectilis, which consists of cylindrical fasciculi
of uniting tissue, which cross each other very frequently; contain a blood-
vessel and form, with the processes (bands, trabeculae) passing off from the
albuginea, cellular spaces. The small cells communicate with one another.
In them is placed a very convoluted vascular rete, the principal mass of
which is formed of veins which consist of tunica vasorum communis, only. They
pass very much convolved into their *plexus cavernosus*, and still even present enlargements, *sinus venosi*, although unusually large. A portion of the arteries (*Art. helicina* Müller), which contribute towards erection, are said to open directly into these *sinuses*.

b. *Corpus cavernosum urthra*, the spongy body of the urethra, which it surrounds like a sheath, and extends from the *symphysis*, where it is surrounded by *m. bulbo-cavernosus*, and swells out like a bulb (*bulbus cavernosus*) [*spongiosum*], to the inferior surface of the *penis*, as far as the *glans*, without communicating with the *corpus cavernosum penis*, but with the *glans*. Its structure is just the same as the last, only the *septum* is wanting.

c. The nut, *glans penis*, *Baravos*, the anterior blunted, conical extremity of the member, is perforated by the urethra, the elongated opening of which it presents at its apex. The excavated *basis* of the *glans* projects over the *corp. cavern. penis*, which lies within it, so that an enlarged border, distinctly bet set with nervous papillæ, *corona glandis*, appears. The superior convex surface is smooth, the inferior flat surface smaller, and divided by a longitudinal sulcus into two tubercles, between which, as far inwards as the *corona*, the cord (*frenulum praputii*) is attached, which is a fold of the prepuce. The parenchyma of the *glans* is of the same character as that of the spongy body, only more closely compressed. It is connected with the *corp. cavernos. urthra*.

d. The external coverings of the *penis*.

1. *Fascia penis*, a continuation of *f. perinei*, forms the lig. *pubo-prostaticum*, which extends from the roots of the *corp. cavern. penis* to the lig. *arcuaturn*, and is perforated by the *urethra*; covers upon the *dorsum* of the *penis* the *Vasa dorsaliæ*, and reaches as far as the *glans*.

2. The external skin, attached by loose uniting tissue, destitute of fat, to the fascia, is very thin, brownish, hairless, and moveable, and by these circumstances is distinguished from the skin above and behind the root of the *penis*, on the *pubes, mons veneris*. Behind the *corona glandis* the skin, instead of passing over directly upon it, leaves the *glans*, passes away as far as over the orifice of the urethra, is then reflected, and goes as far back as the posterior border of the *glans*; very delicate, vascular, and firmly attached to the last and to the mucous membrane of the urethra. Thus the foreskin (*praputium*) arises, a free sheath, consisting of two layers, the internal of which is attached as *frenulum praputii* to the inferior surface of the *glans*, and behind *corona glandis* is beset with numerous sebaceous glands, *glandulae praputiales s. odorifera Tyssoniana*, and secretes the *smegma praputii*. The opening of the prepuce is frequently too much contracted, the frenulum too long, as it reaches as far as the orifice of the urethra.

3. *Lig. suspensorium penis*, a triangular, yellow, elastic band in the central line between *Symphisis pubis* and *corp. cavernosum penis*, serving to fasten it, is a continuation of the decussation of lig. *Pouparti*. It does not possess muscular fibres (*m. pubo-cavernosus*, sometimes; it is a portion of *bulbo-cavernosus*).

The vessels of the *Penis*: *Art. profunda penis* goes partly into the veins, partly into the blindly terminating (*Müller*) or looped *Art. helicinae*, projecting into the sinus of the veins; *art. dorsalis penis*. Veins: *dorsalis penis* (*forms a sinus*), only one, between two arteries.

Nerves: *N. pudendus communis; plexus cavernosus N. sympathetic*, most of the branches to the *glans*. After division of the *n. dorsalis penis*, the *corp. cavernosus* collapse, become more vascular, but incapable of erection.
II. The Organs of Generation in the Female,

*Genitalia muliebria.*

They are situated, for the most part, within the pelvic cavity.

483. 1. The ovaries, *ovaria s. testes, muliebres* (Galen), are two semioval whitish glands, flattened from before to behind, transverse at the entrance of the small pelvis, one of which is situated on either side of the *uterus*, behind and below the *Fallo-pian tube*. The convex anterior and posterior surfaces and the superior border are free (enveloped in *peritonæum*); the straight or concave inferior border, where the vessels and nerves pass in (*hilus ovarii*), is connected with the broad ligament of the uterus; the internal extremity by a fibrous cord, *lig. ovarii*, with the superior angle of the *Uterus*; the external extremity with the fringe of the *tuba Fallopìæ*. The surface of the ovaries is not always irregular and uneven.

In the virgin: Length: eighteen to twenty-three lines; breadth: nine to twelve lines; thickness: four and a half to five lines; weight: eighty to a hundred and ten grains.

In women of thirty-five to forty years old: Length: twelve to eighteen lines; breadth: six to seven; thickness: three to four; weight: forty grains.

Position: in the fetus in the *regio lumbalis* (like the testicles); during pregnancy in the abdominal cavity, also after delivery in the *fossæ iliæ*; and very frequently behind the *Uterus*.

Structure. The parenchyma of the ovary is immediately covered by (fibrous) uniting tissue, *tunica propria s. albuginea*, which receives a serious investment from the peritoneum, so that the fossa of the *hilus ovarii* only remains free. The parenchyma itself (*stroma*) consists of a loose, but yet dense uniting tissue, penetrated by numerous blood-vessels, and containing twelve to fifteen roundish, transparent vesicles, of one half to four lines diam.; these are, *foliculi s. vesicule (ovula) Graafii*, the largest of which lie close to the periphery. In impregnation, a Graafian vesicle bursts after it has filled with blood: it is emptied of its contents, the blood changes colour, and is metamorphosed into the cicatrizing matter, which is *corpus luteum*, the yellow body.

484. The Graafian vesicle is to be regarded as a cell of the ovary. It consists of a very vascular, dense *tunica propria (theca, of Baer)* which encloses a clear fluid, mixed with some fat globules and with elementary granules only, and the *ovum*. Each granule forms a connected layer of cells (*membrana granulosa*), which covers the internal surface of the vesicle, and attaches the *ovum* to its wall, since it surrounds it above and below, like Epithelium.

The egg, *ovulum*, appears to the unassisted eye as a white punctule, is still covered on its exit from the Graafian vesicle by a remnant of the granular layer (that is, *discus proligerus* of Baer), which is lost upon the entrance of the egg into the Fallopian tube. It is 0·08 of a line in size, consists of a clear, structureless, firm, and close envelope, *chorion*, and fluid contents, the yolk.
**Chorion**, yolk membrane, is single, indivisible (a **zona pellucida**, that is to say, a space filled with fluid between the yolk and the **membrana granulosa** does not exist). The yolk contains a thick mass of whitish yellow, brilliant granules and globules, the size of which equals the fat globules. Surrounded by, and close beneath the **Chorion**, lies the

**Germinal, or vesicle of Purkinje, vesicula germinativa.** It is round, clear as water, and so much the larger the smaller the egg, consists of a smooth, structureless membrane, and contains, besides, a very clear albuminous fluid, a dark granule, the germinal spot (**macula germinativa**).

**Vessels of the Ovary.** Arter.; **ovaria** branches of the **uterina**. Veins and lymphatics like the arteries.

**Nerves:** **plex. spermatis intern.** from sympathetic.

**485. 2.** The Fallopian tubes, **tubæ Fallopiz**, two membranous tubes, four inches long, lying transversely between the **Uterus** and the external wall of the pelvic entrance (one upon either side), before and above the ovary, behind the round ligament. The external extremity, **extremitas abdominalis**, consists of thin, extensible walls, curves backwards and inwards towards the external extremity of the ovary, and opens with an orifice a line wide into the abdominal cavity, surrounded by fringed lobules, **fimbriae laciniae s. morsus diaboli**. One of these lobules (the innermost) is connected by means of a ligament with the **Ovarium**, which it surrounds like a funnel, in consequence of the flow of blood to it after conception. The inner extremity, **extrem. uterina**, is firm, and not extensible, and opens into the cavity of the **Uterus** at the superior angle with a very narrow orifice (one fourth of a line) obliquely inwards and downwards. A (narrow) canal consequently leads from the cavity of the **Uterus** directly into the cavity of the abdomen.

**Structure.** The tube consists of three coats: a. The serous coat (peritoneum); a continuation of the **lig. uteri latum** passes to the external orifice, where it also passes on to the fringe and over into the mucous membrane (the only instance of such a transition); the peritoneum is likewise open at this point.

b. The central, very vascular coat, a continuation of the tissue of the **Uterus**, contains, in the larger animals at least, muscular fibres; the internal fibres pass longitudinally; the external transversely.

c. The innermost coat, mucous membrane, presents, especially at the external extremity, many longitudinal folds, **rugæ longitudinalis**, and passes into the **tunica serosa**. Arteries; from the **uterina** and **spermatis interna**. Veins: in the **plex. pampiniform.** and **v. uterina**.

**Function:** a. The conveyance of the male semen to the ovary (?). b. The reception and conveyance of the **ovum** from the ovary into the **Uterus**.

**486. 3.** The Womb, **Uterus**, a pear-shaped bag, flattened from before to behind; its broadest closed extremity directed upwards, its narrow open extremity
downwards; it lies in the centre of the small pelvis, between the urinary bladder and rectum, above the Vagina, in a fold of the peritoneum; very moveable. Direction: oblique from above downwards, and from before backwards; sometimes, but generally in pregnancy, from above downwards, and from right to left. Dimensions: in the mature virgin two and a half to three inches deep, six lines thick, above sixteen to eighteen broad; at the neck six lines broad; weight: six to ten drachms.

We distinguish the following parts: the base, fundus, the most superior, broadest, and convex; corpus, the central, longer; collum, the most inferior and narrowest portion, which passes obliquely downwards and backwards, and projects with its rounded extremity freely into the Vagina. This vaginal portion, portio vaginalis, in front six, behind five lines long, presents upon its inferior uneven surface, the so-called os tincæ, a transverse fissure, that is, the external opening of the Uterus, orificium uteri externum, which is bounded before by a thick and long lip (labium anter(us), behind by a thinner and shorter lip (labium posterius), which are smooth in the virgin, but otherwise indented. The anterior surface a little convex, covered as far as the neck by peritoneum, is attached from the neck downwards by loose uniting tissue to the fundus of the urinary bladder. The posterior surface convex, entirely covered by the peritoneum, lies on the anterior wall of the rectum. The superior border convex, does not reach as high as the pelvic inlet. The lateral borders form, with the superior of either side, an angle, where the tuba opens; and under that the lig. rotundum is attached. Ligg. lata adhere to them.

The cavity, cavum uteri, is narrow; and in the fundus and corpus triangular; the apex leads into the cylindrical canal of the neck through the internal mouth of the Uterus, orific. uteri internum. The walls are four to six lines thick, the thinnest (two lines) at the place where the tubæ are affixed.

Structure of the Uterus. The parenchyma is grayish-brown, very dense and firm, and consists of several layers of a very thick fibrous tissue, which in the gravid state and in animals is regarded as muscular substance. It is penetrated by numerous vessels (veins). At the collum we see only circular fibres crossing at acute angles; on the body and fundus a superficial layer of longitudinal and oblique fibres, which converge to the lateral borders, and a deep layer of circular fibres. In the unimpregnated uterus the fibres are similar to the undeveloped of the Embryo.

2. The mucous membrane, which lines the cavity of the uterus, is a continuation of that of the Vagina, but very thin, and firmly attached, beset with numerous mucous follicles, which, when filled, resemble vesicles (vesiculae s. ovula Nabothi), and, in consequence of their capillary vascular rete, have a red appearance. In the neck it is whiter, thicker, and presents on the anterior and posterior wall longitudinal folds, which, from their conjoined trans-
verse folds, look like a palm leaf (*plicae palmatae, arbor vitæ uteri*), and after one pregnancy (not always) disappear.

3. The serous coat. The external surface of the *uterus* is covered by peritoneum, in front as far as the commencement, behind deeper downwards, to the middle of the *collum*, which, from the urinary bladder to the *uterus*, forms *ligg. vesico-uterina*, and, passing from this over upon the rectum, it forms *ligg. recto-uterina*. On the sides of the *Uterus* the peritoneum forms two folds: The broad ligaments of the *uterus, ligg. uteri lata*, which pass transversely from the internal surface of the external pelvic wall (at the pelvic inlet) to the *Uterus*, and each (of the two) consists of two layers, between which are situated at the superior free border the *tuba*; under that the *lig. ovarii*; and behind that the *ovarium* itself, whereby an expansion like a bat's wing arises, *ala vespertilionis*. Before the broad ligaments an actual fibrous band lies on either lateral border of the *uterus*:

*Lig. uteri rotundum s. crus uteri*, round ligament of the uterus, which goes off from the *uterus* close under the *tuba*, consists, like this, of muscular tissue, and is placed in a particular fold of the anterior layer of *lig. uteri latum*; ascends externally to the internal inguinal ring, then passes forwards and downwards through the inguinal canal, covered by a serous sheath and muscular fibres (like *m. cremaster*), to the *mons veneris*. It serves for the fixation of the uterus (and, from its large supply of blood, to conduct it to this organ).

Vessels: *Art. uterinae* are branches of *hypogastr. or umbilicalis*; pass in a very serpentine course, and often Anastomose with *spermatica interna*. Veins: *plex. uterini* open into the *vv. uterinae* and *spermatica*; they form *sinuses* in the substance of the mucous membrane. Lymphatics: very numerous and strong, especially upon the surface; passing between the *lig. lata*, they open into the *plex. hypogastric*.

Nerves: branches of *plex. hypogastricus superior* (of sympathetic), and *lateralis* (of *sympath. and sacral nerves*); they enter the substance of the *Uterus*.

Function of the *Uterus*: 1. Formation of the embryo. 2. Separation of the menstrual blood [probably from veins].

487. 4. The *Vagina*,
a membranous cylinder from three to seven inches long, one inch wide, flattened and curved from behind forwards, is situated between the *bladder* and *rectum, vulva* and *uterus*, and forms with the last a concave angle forwards.

The superior, widest portion, *fundus s. fornicis vaginae*, surrounds, intimately united to it, the vaginal portion of the neck of the *Uterus*. The inferior, narrow extremity, surrounded by *m. constrictor vaginae*, forms the entrance to the *Vagina, introitus vaginae*, which is partly closed by a crescentic fold of mucous membrane lying at the inferior border (the membrane of the virgin, *Hymen*). (As the remains of the *Hymen*, torn during copulation, we observe two to five small lobules, the so-called, *carunculae myrtiformes*; according to Lauth they are, however, present close to the *Hymen*. The *Hymen* is sometimes found, notwithstanding the performance of coitus; but it is sometimes wanting even in the newly-born). The anterior wall rather concave, shorter than
the posterior, is placed behind the urethra and the base of the bladder, which are firmly united with it. The posterior wall, above convex, below concave, about half an inch longer, abuts upon the rectum. At the sides, the ligg. lata are attached above, the fasc. pelvis and m. levator, below.

Structure. The vagina consists of a spongy, erectile, very vascular tissue (like corpp. cavernosae), which is enclosed by an external very dense and strong, and an internal less thick fibrous coat. The internal surface is lined by a firmly attached reddish mucous membrane, through the thick Epithelium of which numerous mucous follicles and villi are distinguishable. Transverse columnar folds are placed on both sides of the middle line on the anterior and posterior wall, these are columna rugarum, anterior and posterior. They disappear at the superior part after delivery.—The serous membrane (peri toneum) at the posterior uppermost part.

Vessels: Artt. vaginales, branches of the hypogastrice, the uterinae, vesicales. Veins: plexus vaginalis upon the anterior and posterior wall (containing frequently phlebolithes).


488. 5. The Vulva,

lies in the regio pubis under the mons Veneris, about an inch before the orificium ani, and consists of the large and small pudendal lips, the clitoris and the vestibule.

a. The great or external lips, labia pudendi majora, the parallel folds of skin, passing from above downwards and behind forwards, which are beset with hair and cushioned with fat (like mons Veneris), which cover the rest of the pudendal parts, have a longitudinal fissure, "rimae vulvae," between them. The superior angle is designated commissura anterior, the inferior c. posterior. At the inferior commissura a thin membranous fold, frenulum labiorum, which in delivery is generally torn; and the space between the frenulum and the Hymen, the fossa navicularis. The internal surface is smooth, like mucous membrane, and passes into the internal lips.

Arter.: labiales post. (of pudenda intern.); labial. anterr. (of pudenda extern.)
Nerves: from deo-hypogastric, spermatic. from the inguinal canal.

b. The internal or small pudendal lips, l. p. minora s. nymphæ, the narrow folds of mucous membrane on the internal surface of the great lips, having the vestibule between them. Above they become broader and divide into two rami, the superior of which blends, above the clitoris, with the preputium clitoridis, the inferior, losing itself in the clitoris, forms the frenulum clitoridis. Between the layers of the fold an erectile tissue is found [which presents an enlargement below; in fact corresponds to, and is of the same structure as the bulb of the Corp. Spongiosum of the
male. Trans.] At birth the internal lips are larger than the external; in women who have frequently given birth to children, and are thin [even during pregnancy], they project out beyond the great lips; in the Hottentot women they form the so-called “aprons.”

c. The Clitoris—an erectile organ, like the corpus cavernosum penis—lying close under the anterior commissure between the great lips, surrounded by fat and a fibrous sheath. Commonly one inch long, three lines thick, it often becomes much larger, and then might be taken for a penis, (but it is not perforated by the urethra, and the corp. spongiosum urethrae is wanting in it). It arises with two roots, from the ram. ascendent. oss. ischii, which are united below the symphysis pubes, and thus terminated, a few lines before the symphysis, with a roundish extremity, glans clitoridis; prepuce and frenulum exist. Lig. suspensorium and Mm. ischio-cavernosi, as in the penis. M. constrictor vaginae (this corresponds with m. bulbo-cavernosus penis). Arter.: profunda and dorsal. clitorid. from pudenda interna.

d. The vestibule, vestibulum Vaginae, that is, the floor of the pudendal fissure, between the clitoris and the inferior commissure; bounded laterally by the nymphae. A superior opening is found therein, the orificium urethrae, one inch [less] under the clitoris, surrounded by a slight elevation and radiating folds; and lower down the entrance to the Vagina. Mucous follicles are found, particularly in the region of the orifice of the urethra; sebaceous glands, which secrete a caseous substance of a peculiar smell upon the nymphae.

e. Glandulae Bartholinianae, (again made known by Tiedemann in 1840) s. Duverneianae s. Cowperi, two flat, almost bean shaped, reddish white, hardish glands; of five to ten lines long, lie in a considerable quantity of fat, at the sides of introitus vaginae (one on either side) beneath the external skin of the inferior part of labia majora and fill up the space, between the extremity of the vagina, ram. ascend. ischii and crura and erector clitoridis, before the m. transvers. perinæi.

Structure. The glands consist of small, flat rounded, and conglomerate lobules, in which arises a membranous excretory duct, from caecal vesicles, eight lines long, which passes out at the anterior border of the superior part of the glands, before m. constrictor vaginae, passes behind the labia majora horizontally, inwards and forwards, and opens with a wider orifice at the sides of the vestibulum Vaginae.

Arteries: these are branches of pudenda interna and vaginales.
Nerves: delicate twigs of n. pudendus.

489. 6. The breasts, mammary glands, mammae, are two semi-globular or conical (in Spanish women) glands on
the anterior surface of the Thorax (before the third to the sixth ribs) covered with fat and a delicate smooth skin, in the centre of which rises the conical teat, or nipple, papilla mamma, surrounded by a rosy or brownish halo, areola. The bosom, sinus, is the space between the two mammæ.

Structure. The gland, freed from fat, is flattish, round, and rests upon the m. pectoral maj., with its flat base, separated by fasc. superficialis. The surface is irregular, because the gland chiefly consists of irregular lobules, which are associated together by uniting and adipose tissue, but do not communicate with one another. [They are placed in a fibrous tissue, a kind of proper fascia, pointed out by Sir Astley Cooper, in his work on the Breast. Trans.] The lobules again consist of roundish vesicles arranged together, like a bunch of grapes (acini, cellula, vesicule), the white excretory ducts of which unite together to form a large milk duct, ductus lactiferi, of which twelve to twenty finally remain passing inwards towards the central point of the gland, and open in the nipple, between the wrinkles of the skin, either singly, or two or three united together.

The vesicles consist of fibrous tissue, which also unites the lobules and gives to the gland its firmness. The milk ducts are surrounded by erectile tissue both in the areola, where they form enlargements, and in the nipple itself, in consequence of which the nipple in suckling, or from physical causes, becomes erect.

In the male breast the vesicles and ducts are wanting.

Vessels: Branches of artt. mammæ externæ, very strong during suckling; Veins: circulus venosus areola; they open into Vv. mammæ externæ. Lymphatics: they enter the axillary glands and plex. mammarius.

Nerves: Branches of nn. supraventriculares from the fourth cervical nerve to the skin; very delicate twigs probably enter the gland with the arteries. [Filaments of nervi intercostales.]
OF THE SENSES.

ORGANA SENSORIA.

"We observe in the eye many exquisite refinements of construction, by which various defects, unavoidable in all optical instruments of human workmanship, are remedied. Of this nature are those which render the organ achromatic, which correct the spherical aberration, and which provide for the adjustment of its refracting powers to the different distances of the objects viewed; not to speak of all the external apparatus for the protection, the preservation, and the movements of the eyeball, and for contributing in every way to the proper performance of its office. Are not all these irrefragable proofs of the continuity of the same design; and are they not calculated still farther to exalt our ideas of the Divine Intelligence, of the elaborate perfection impressed upon His works, and of the comprehensive views of His providence?"—Roget. Bridgewater Treatise, vol. i. p. 32.
OF THE SENSES.

Literature.

Organs of the Senses:—


Ear:—


Nose:—

OF THE SENSES, ORGANA SENSORIA.

490. 1. The organ of Sight, the Eye, Organon visus, oculus.

The eye is placed in the orbit (see Osteology), and is moved, for the complete performance of its functions, by six proper muscles, (see Myology), protected by certain contrivances, and by others maintained in a lubricated state.

A. Accessory Organs, Tutamina oculi.

491. 1. The eyebrows, supercilia,

two arched enlargements of the skin along the superior border of the basis of the orbits, are beset with short, stiff hairs, directed towards the temples, which are arranged more closely, inwards towards the nose, and are, rarely only, continued over the root of the nose (by intercilia). The skin is thick, lies firmly upon a muscular layer of m. frontalis, orbicular, and superciliaris; is provided with numerous nerves from n. facialis and trigeminus, and with vessels from ophthalmicus and temporalis. Uses: The eyebrows protect the eyes against too strong light, and from the perspiration flowing down from the forehead; they serve, besides, for the expression of the face.

492. 2. The eyelids, palpebrae,

two movable cutaneous curtains, which, passing off from the superior and inferior border of the base of the orbits completely shut up the eye when they are approximated. They consist of skin, muscular fibres, cartilage and mucous membrane. The anterior or cutaneous surface is convex, and folded across; the posterior surface turned towards the globe of the eye, concave and beset with yellowish, vertical lines (glandul. Meibom.). The free borders are in the open eye curvilinear, and they bound an elliptical space, in the closed eye rectilinear, and only leave a narrow fissure, rima palpebrar., but not a triangular canal between them. The anterior edge of the free borders is beset with, three rows of short, stiff and curved hairs, cilia, eyelashes, the points of which diverge from one another; the posterior edge presents a regular row of (twenty-five to thirty) small openings (see Meibomian Glands, § 493.) At the last [internal] one-sixth of the free border, it presents a tubercle provided with an opening, the lacrymal punctum. From this point inwards there are neither cilia nor openings any longer
present. The free borders unite together, and form towards the temples the external acute angle, commissura externa s. canthus minor, which leads into a depression (of the conjunctiva); towards the nose (at the posterior border of proc. ascendens maxill. super.), the internal rounded and wider angle, commissura interna s. canthus major. The superior eyelid is deeper than the inferior.

a. The cartilages of the eyelids, tarsi, tarsal cartilages, are thin fibro-cartilaginous plates, which are placed towards the free border of the eyelids; the superior four, the inferior two lines, deep. Their anterior convex surface is covered by m. orbicularis; the posterior is firmly united with the conjunctiva; the free border is thick, the attached thin, in the superior eyelid convex (here is affixed the m. levator palpebr. super.), and it continues into a fibrous membrane, which externally, very strong at the basis orbiculæ, internally loses itself in uniting tissue.

The two tarsi do not reach to the angles of the eye, but become united to them by the tarsal ligaments:

Lig. palpebræ internum, a flat ligament, with its surfaces directed upwards and downwards, its borders forwards and backwards, which passes away transversely inwards, before the lacrimal sac, to the place where the frontal and superior maxillary bones (proc. frontalis) unite together; and

Lig. palpebræ externum, which passes off from the external extremity of the tarsi (in a forked manner) protected by fibrous tissue, passes to the proc. frontal of the malar bone inside the orbit, and is attached to its external angle.

b. The external skin of the eyelids is thin, rather transparent, attached by loose but fatless uniting tissue to the pale internal portion of m. orbicularis, connected firmly with the tarsi, and passes over on the free border of the eyelids into.

c. The uniting membrane of the eyelids, conjunctiva palpebrarum. It is a soft, mucous membrane, covered with epithelium, provided with nerves and vessels, which covers the free border and the posterior surface of the eyelids, is reflected at the margins of the orbits from the lids upon the globe, forms at the external angle of the eye a depression, at the internal (where is the so-called lacus lacrymalis) a semilunar fold, concave towards the temples; this is, plica semilunaris (memb. nictitans, of animals). On the globe of the eye, the anterior third of which it covers, the conjunctiva is only loosely connected with the sclerotica, but the more intimately with the cornea. It enters into the lacrimal canals at the puncta, and lines them.

Vessels and nerves of the eyelids. Artt. palpebrales (interna et externa) are branches of art. ophthalmica, temporalis, infraorbitalis and facialis; they form an arcus palpebralis (s. tarseus) superior and inferior. The veins of the same name open into Vv. angularis and temporalis (facial. anter. and posterior). Conjunct. palpebrar. is plentifully supplied with blood vessels, less so the conj. scleroticae, not at all the conj. cornea, in which Arnold has found Lymphatics.
Nerves: they are branches of trigeminus (frontal., lacrymal., infraorbital., infratrochlearis); facialis (to m. orbicular.); oculomotorius (to levat. palpebrar.)

493. The glands of the eyelids.

a. The glands of Meibomius, gl. Meibomiana, lie in the substance of the tarsal cartilages (twenty to twenty-five in the inferior, thirty in the superior), are rather lower than the last, and open on the posterior edge of the free border of the lid, in a row. Each gland consists of a convoluted tube, the walls of which are cellular all round, so that it looks like a bunch composed of berries united together without stalks, is formed of uniting tissue, filled with flat cells and fat vesicles, and pours out a viscous fluid which prevents the overflow of the tears (laima). The short excretory duct of one gland sometimes unites with that of another, or is fissured.

b. Caruncula lacrymalis, is a flesh-like corpuscle, the size of a grain of rye at the internal canthus, internal to plica semilunaris, covered by the conjunctiva; it consists of an assemblage of glands of the same kind as the Meibomian, from which (seven or eight) minute openings proceed, and upon which light, short, small hairs are seen.

494. 4. The lacrymal organs, organa lacrymalia.

a. The lacrymal gland, glandula lacrymalis (innominata), consists of two parts, both of which are situated above the external canthus.

The superior or orbital portion, of the size of an oat grain, lies transversely with the superior convex surface attached to the fovea lacrymal. of the frontal bone, with the inferior concave surface upon m. rectus externus; its anterior border close behind the superior external border of the orbit, and the upper lid; on its posterior border nerves and vessels enter.

The inferior or palpebral portion is smaller, thinner, situated, covered by a fibrous membrane, upon the external side of the upper lid, and reaches downwards almost to the superior border of the tarsus superior. The ten or twelve excretory ducts of both parts open (almost invisibly) on the posterior surface of the upper lid, one line above the cartilage, from the external angle as far as the centre of the lid, in a row, and perforate the conjunctiva. Arter.: art. lacrymalis. Nerves: a branch of sympathetic; n. lacrymal. (trigem.) passes, nominally only, through it to the conjunctiva, like n. facialis in the Parotis.

b. The puncta and lacrymal canals. The circular, constantly open punctum lacrymalis, is found at the apex of a small tubercle (papilla lacrymalis) on the internal part of the free border of the eyelid. The superior looks downwards and backwards, the inferior upwards and backwards towards the globe. Both lead into the lacrymal canaliculi, canaliculi lacrymales s. cornua limacum. They pass at the commencement vertically, immediately bend at a right angle, inside the free border of the eyelids, inwards and open, inde-
pendently, in the anterior external part of the lacrimal sac, behind lig. palpebræ internum. The commencement is somewhat wider than the remaining part, in the whole a capillary tubule; the walls thick and elastic, covered before by fibres of m. orbicularis, behind by fibres of m. Horneri, consist of mucous membrane.

Musc. Horneri [tensor tarsi] arises from the crista lacrymalis, passes transversely outwards, is divided by lig. palpebr. intern., and attaches itself to the internal angle of the eye, drawing the lids inwards, and making the puncta deeper in the lacus lacrymalis, where they take up the lacrimal moisture and carry it into

c. The lacrimal sac and duct. These two form one canal (canalis lacrymalis oss. unguis), which extends from the eye as far as the nose; secretes a mucous fluid, and carries this, together with the tears, into the nose. The lacrimal sac, saccus lacrymalis, an oblong but closed sac, formed of soft, reddish mucous membrane, united by areolar tissue on the inner side with the fossa lacrymalis. (os unguis and proc. nasalis of the upper jaw) on the external with a fibrinous continuation of m. orbicularis; it lies, close behind the internal inferior angle of basis orbitæ, behind and under the lig. palpebræ intern., above which the cæcal extremity of the sac, only, projects a little upwards. On the external surface is placed m. Horneri. The lacrimal canaliculi open close behind lig. palpebr. Below it continues into the

Lacrimal duct, ductus (naso-) lacrymalis a membranous canal flattened on the sides, somewhat contracted in the centre, which, slightly curved forwards and outwards, descends in the osseous canalis lacrymalis to the nasal cavity, and opens into the inferior nasal chamber below the anterior part of the inferior turbinate bone (sometimes in a fold of mucous membrane which elongates the ducts a few lines). Internally it lies on the meatus narium and concha inferior; externally on the thin wall of the antrum Highmori.


495. 5. The muscles of the eyes.

These are placed together inside the orbits, in the depth of which they arise and form a circle around the N. opticus and the nerves of motion.

a. M. lev. palpebr. superioris (see Myologia).

b. Mm. recti bulbi oculi, the four straight muscles of the eye.

Origins: round about the foramen opticum. Insertions: with a broader aponeurosis to the Sclerotica, convex towards the Cornea and in its proximity. Position: one surface turned towards the walls of the orbit, the other towards the optic nerve and the globe of the eye; separated from these by adipose tissue and vessels; in a straight direction from behind forwards, curved on the globe. The opening in the capsule for rect. intern. is rather higher than the internal, for rect. extern. on the same plane with the external angle of the
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eye, for rect. super. and infer. rather inwards of the vertical diameter (Wilbrand). Use: each draws the globe towards its own side; associated they draw it inwards, with the exception of the rect. extern. [The rect. externus has two origins, one as stated, the second from the margin of the spheroidal fissure.]

Rectus superior s. superbus is the weakest; rect. inferior s. humiliis: rect. internus s. amatorius s. bibitorius, the shortest and thickest; rectus externus s. indignatorius, antagonist of the two obliqui, the longest, is alone provided by nerv. abducens, the others by N. oculo-motorius.

c. M. obliquus superior s. trochlearis s. patheticus.

Or.: between m. rectus sup. and intern. before the foram. opticum, from the body of the Sphenoid bone. Ins.: at the superior part of the Sclerotica; four lines broad, behind musc. rect. super. Figure: elongated, fusiform; the tendon curves backwards, downwards, and outwards. Position: at the superior, internal angle of the orbits; the tendon passes in the trochlea [a small cartilage, five-sixths of a small ring] through a tendinous sheath. It is alone provided by nerv. trochlearis. Use: to roll the globe inwards and downwards.

d. M. obliquus inferior s. minor.

Or.: os maxilar super., between margo infer. orbitæ [sometimes from it] and canal. lacrimal.; often from the lacrimal sac. Ins.: the posterior external part of Sclerotica, six lines distant from the cornea, three from the optic nerve, behind the attachment of rectus externus. Pos.: flat under the globe of the eye (externally, above and behind) between the floor of the orbit and m. rectus inferior, enveloped in fat. Use: to roll the bulbus outwards and upwards. Both musc. obliqui draw the globe forwards [1].

496. B. The Globe of the Eye, Bulbus oculi,
an oblong globe formed of three circular membranous layers lying over one another, which are filled with a transparent refracting apparatus, being surrounded by the capsule of the eye and an elastic cushion of adipose tissue in the anterior parts of the orbits, and projecting outwards at the external border of the basis beyond it. Its longitudinal diameter is about one line longer (eleven lines) than the transverse, as the anterior segment of the globe formed by the cornea projects before that composed of the Sclerotica.

Capsula bulbi oculi (Bonnet and Ferrall),
a strong, fibrous membrane, firmly applied behind to the globe, and passing, becoming thinner in its course, into the fibrous sheath of the Optic nerve, before into the Perichondrium of the tarsi of both eyelids. All the muscles of the globe lie behind and perforate it
with their anterior extremities, in order to attach themselves to the Sclerotica; so that, in consequence of the thickness and strength of the capsule, each passes away, as it were, over a trochlea.

a. The most external of the coats of the eye. They determine the shape of the organ. They are the stiff Sclerotica and the transparent cornea.

497. 1. Sclerotica (s. tunica albuginea s. cornea opaca),
the white coat.

a strong, opaque membrane, forms a segment of a sphere, the anterior sixth of which is represented by the transparent cornea. It consists of short fibrous fasciculi interlacing with each other in every direction, is bluish, brilliant (inwardly brown), provided with few vessels, and not at all with nerves. [?] Rigid, and not extensible, it is thinnest anteriorly in the neighbourhood of the Connea, behind, where a foramen for the Optic nerve perforates it, thickest. The foramen for the optic nerve lies rather internally to the axis of the globe. The external surface of the Sclerotica is covered before by the conjunctiva connected with it by loose uniting tissue, and by the tendons of the muscles of the globe. The internal surface is wrinkled, brown, and connected by delicate uniting tissue and the obliquely passing ciliary vessels with the tun. Choroidea. The ciliary nerves pass from behind forwards between the two coats.

The anterior border is circular, bevelled off on the internal surface obliquely backwards (sulcus Sclerotica), for the reception of the corresponding bevelled border of the Cornea. Both are firmly united together. Between them and the ligam. ciliare, which is here, also, attached, we find (in animals) sinus circularis venosus iridis s. canalis Fontana, a very narrow circular canal which receives the veins and the blood of the iris, which is driven out from these during enlargement of the pupil, and is said to give off vv. ciliares anticae; but in Man it is placed in the substance of the Cornea (as canalis Schlemmi).

The Sclerotica is to be considered as a continuation of the dura Mater upon the Optic nerve; [?] the pia mater and arachnoidea do not pass into the eye. At the foramen for n. opticus a lamina cribrosa was formerly described, that is, a perforated plate which apparently arises from the manner in which the neurilemma leaves the fasciculi of the n. Opticus at this place.

Vessels: a few arteries from artt. ciliares; Veins more numerous, in connexion with the canals of the Cornea; Lymphatics are probably present. Nerves not yet demonstrated.

498. 2. (Tunica) Cornea, the transparent Cornea,
is a thick, transparent, strong, but elastic membrane, forming the segment of a smaller (also more convex) sphere than the Sclerotic, and the anterior part of the bulbus. Its anterior convex surface is covered by Epithelium, a conti-
uation of that of the *conjunctiva* (this is the firmly applied *conjunctiva cornea*); the posterior concave surface forms the anterior wall of the anterior chamber of the eye; its posterior border, bevelled obliquely on the external surface, is extremely firmly united with the *Sclerotica*. (According to Valentin, both membranes grasp one another by indentations of looped and reflected fibres.)

The *cornea* consists of four layers:

a. *Epithelium* on the anterior surface, forms after death a slimy covering, which makes the cornea appear opaque (*conjunctiva cornea*).

b. The proper *cornea* is laminated, and consists of flat cell fibres which interlace in all directions, becoming in boiling water a white jelly and dissolved.

c. The membrana *Demoursii s. Descemetii*, a firm cartilaginous, colourless, and transparent thin membrane, which remains unchanged in boiling water; does not pass over upon the *Iris*, but passes over to its external border and terminates between *sclerotica* and *lig. ciliare* with a sharp border.

d. The pavement Epithelium on the posterior surface of the Demoursian membrane reaches only as far as the external border of the Iris, and looks into the anterior chamber of the eye (this is the so-called, *membr. humoris aquei*). The cornea is nourished mediately only, by the aqueous humour with which it is saturated. In the fætus a capillary rete is found under the anterior epithelium, the branches of which come from the vessels of the *conjunctiva sclerotica*; in the adult the

*Canalis Schlemmii* (see before, § 497), near to the border of the cornea, is said to be a venous sinus, but it receives no branches from the cornea.

The layers, a, c, and d, possess no vessels; in the inflammatory condition of the eye such may be regarded as but only newly formed. Nerves: (discovered by Schlemm in the eyes of animals) arise from the ciliary nerves on the *sclerotica*, and are lost at the border of the *cornea*;—Pappenheim has followed them between the lamellæ.

The *cornea* is more convex and thicker in the embryo and the newly born than in the adult. Impinging rays of light passing through it become refracted in a converging direction.

Weber has classed the cornea with the Epidermic formations. According to Arnold its substance passes immediately into that of the (fibrous) *Sclerotica*, and it bears all the characters of a serous membrane, as: transparency, secretion of serum, vascular canals, formation of bloodvessels, regeneration; the laminated structure is only an artificial production.

Arnold admits of a second layer between *sclerotica* and *choroidea*; this is the

*Arachnoidea oculi*, which is said to form a closed serous sac, and has been already observed by Zinn, Wardrop, and others, the external portion of which has been designated *lamina fusca sclerotica*, the internal *membr. suprachoroidea*. Cases of a morbid collection of fluid (by Riolan, Weller, Scarpa) are said to support this acceptation. According to
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Henle it does not exist; but there is only to be found in this situation a loose, delicate, uniting tissue with pigment cells.

b. The central, vascular, and coloured layer of the coats of the eye.

499. 3. Choroidea s. tunica vasculosa,
a thin, very vascular tunic of the same extent as the sclerotica, to the internal surface of which it is attached by a delicate, brown, uniting tissue (see Arach. oculi). Both surfaces, but especially the internal, on which the Retina lies, are covered by a deposit of black pigment which consists of mosaic-like, angular, or roundish cells, and is provided with innumerable convoluted longitudinal striae which correspond to vessels. What has been described as lamina fusca sclerotica, is probably identical with the pigment deposit on the external surface of the choroid. Behind, this membrane is perforated by a circular foramen for the passage of the optic nerve. The choroid has been artificially divided into an external (venous) layer, and an internal (arterial, membran. Ruyschiana); of which we may assume the former to form the ligam. ciliare, the latter the corpus ciliare. Vessels: artt. ciliares post. upon the internal surface; vasa vorticosa (veins) upon the external surface, pass into vv. ciliar. postt. Nerves; a few ramify in it, most pass through it. (Pappenheim.)

a. Ligamentum ciliare s. orbicularis ciliaris, the ciliary ligament, a flat, gray and delicate circle, from a line to a line and a half broad, the anterior, smaller and thicker border of which abuts on the point of junction of the cornea and sclerotica and unites with the external border of the iris, whilst the posterior, thinner, and larger border meets the corpus ciliare, and receives the ciliary nerves which divide in the ciliary ligament, going through it (Arnold) or ramifying in it (Pappenheim). Its external surface lies loosely on the anterior part of the interior of the sclerotica. A vascular rete with large meshes in it, is connected behind with that of the choroid, and passes anteriorly into the iris.

b. Corpus ciliare, the ciliary body, the internal lamina of the anterior border of the choroid, reaches farther backwards than a, is sharply bounded by a toothed edge from the proper choroid, but which belongs to the zonula Zinnii, turns up from the posterior body of the lig. ciliare inwards to the border of the lens, and forms a flat circle which consists of the

Processus ciliares,—seventy to eighty short folds. These become larger from behind forwards, and they converge; in the intervals between them corresponding folds of the zonula Zinnii are placed, whereby both are firmly united with one another, and the ciliary body with the capsule of the lens; deprived of the pigment layer in their depressions, they appear white. It is said that a circle of (muscular) fibres extends from their free circumference as far as the capsule of the lens; this is

Ammon’s orbiculus capsulo-ciliaris, but which belongs to the zonula Zinnii. A proper membrana pigmenti is even admitted by some, which separates the pigment layer on the posterior surface of the choroid from the Retina, is re-
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reflected at the capsule of the lens over and upon the posterior surface of the
iris, to terminate at the margin of the pupil.

The pigment is so much the darker, the farther it lies internally; it is some-
times entirely wanting (in Albinos); it sometimes presents deposits of salts
(the so-called ossifications). In ruminants, also the dog and cat, remarkably
brilliant, it is called tapetum.

500. 4. The Iris,
a thin disc-shaped membrane, becoming thicker from without inwards, con-
sisting of contractile tissue, forms a vertical septum, perforated by a foramen,
between the anterior and posterior chambers of the eye. The foramen (pupilla)
is not placed quite in the centre, but rather to the inner side, is bounded by
the internal or free border of the Iris, is dilated or contracted according as the
last contracts or relaxes, and is closed in the foetus by the membrana pupillaris.
The external, larger (ciliary) border of the Iris is loosely attached to the lig.
ciliare which on the anterior surface, and to the proc. ciliares, which on the
posterior surface project rather over it. The anterior surface of the Iris is
flat, speckled (blue, brown, &c.), striated, and forms the posterior wall of the
anterior chamber of the eye. Towards the pupillary margin the colour is
deeper than in the remaining two-thirds; we therefore distinguish a zona
iridis minor and major. The striæ pass from the external towards the inner
margin, converge and cross each other; they are in the contracted pupil
straight, in the dilated wavy, like the vessels through which they arise.

The posterior surface is covered with a thick layer of black pigment, on the
ciliary border by the proc. ciliares, and folded; denuded of pigment, it is white
and smooth, like the Choroid, which, besides, is far thinner than the Iris.

Structure. The Iris probably consists of contractile uniting tissue, accord-
ing to the older, now also the opinion supported by Valentin, of simple mus-
cular fibres, which pass like a sphincter on the pupillary margin. (In the ox
there are distinct circular fibres.)

Vessels and Nerves: Art. ciliares antice and postice longæ (see art. ophthal.)
form a circulus arteriosus iridis major on the ciliary border, from which arises
a circ. art. irid. minor. on the pupillary margin.

Veins: like the arteries; some open into the canalis Fontanae.

Nerves: N. ciliares, from ganglion ciliare, very numerous, pass through
lig. ciliare into the Iris.

There was formerly distinguished an anterior lamina, the proper Iris, and
a posterior, uvea.

c. The third layer of the coats of the globe of the eye.

501. The Retina s. tunica nervea the nervous coat,
a soft, yellowish white membrane, which is placed concentrically on the
internal surface of the Choroidea, covered with pigment, consists of several
layers, the most essential of which is a smooth expansion of the Optic nerve.
Its internal surface is applied loosely to the vitreous body; its anterior extremity reaches as far as the posterior border of *corpus ciliare* (according to the older view as far as the lens, before or behind the *zonula Zinnii*). At the posterior extremity, where the rather projecting optic nerve enters (medullary elevation), it presents in the axis of the eye, that is to say, on the external circumference of the optic nerve, a transparent spot (probably not perforated), the so-called

*Foramen centrale retina*, hidden behind a yellow transverse fold, *macula lutea*. This last is found in man (and apes) only, and even here but for a time after birth. Its object is unknown.

**Structure:**

1. The external layer of the Retina, which is connected with Choroid, and is described as *Tunica Jacobi*, consists of the so-called rod-shaped corpuscles, that is to say, closed cylinders, which are soft, flexible, easily torn, filled with an oily material, and only loosely joined with one another.

2. The proper nervous layer arises from the manner in which the optic nerve sends out nerve tubules in bundles from its place of entrance in all directions, and forms long meshed plexus. Whether the nerve fibres terminate freely, or are reflected in loops (Valentin), is yet uncertain. Likewise, whether a proper (ganglion) globular layer exists on the internal nervous layer.

3. This lies immediately within a dark granular layer, in which the vessels pass, and which towards the vitreous body is bounded by a kind of large-celled epithelium (vascular layer of the Retina). This last passes over the *processus ciliares*, and extends over the *zonula Zinnii* as far as the capsule of the lens (whilst the nervous and cylindrical layers do not reach the *corp. ciliare*), and forms the so-called ciliary portion of the Retina (Henle). According to Bidder, the layer of cylindrical cells does not reach to the *zonula ciliaris*. His layer of ganglion globules (continuations of the gray substance) and the *stratum nervosum* (continuation of the white substance) reaches as far as the capsule of the lens. According to Langenbeck, jun., and Pappenheim, a sinus passes on the internal surface in the anterior border of the retina, *sinus s. circulus venosus retina*.

[Art.: See Angiology, *Art. ophthal.*]

Function of the Retina: it presents a susceptible nervous surface towards the light, the sensation of which is transmitted by the optic nerve to the cerebrum.

d. The transparent nucleus of the eye.

502. 1. *Humor aqueus*, the aqueous humour,

a transparent fluid, as clear as water, of spec. grav. 1·005, contains most water and only a little common salt and albumen, fills
up the anterior and posterior chambers of the eye, and is probably secreted by the Iris and the corpus ciliare (according to others by the vitreous body, &c.).

a. Camera oculi anterior is the space between cornea and Iris, measures in the longest diameter from before backwards about one line, is at its circumference encompassed by the anterior extremity of the lig. ciliare, and stands, through the pupillary aperture, in connexion with:

b. Camera oculi posterior, that is, the small (one-third of a line) space between the posterior wall of the Iris and the anterior surface of the capsule of the lens. The two chambers contain about five grains of fluid. The anterior chamber is, in the fætus, shut out from the posterior by the pupillary membrane. An aqueous membrane which lines the two chambers as a closed sac, for which the membr. Descemetii is said to pass, is not to be found.

503. 2. Lens crystallina, the crystalline lens,
a round, biconvex, colourless, transparent body, is situated, narrowly enclosed by its capsule, behind the pupilla, at the boundary of the anterior fourth of the globe, and its axis in the axis of the pupil.

Its anterior surface is flatter, one line and a half distant from the cornea; the posterior more convex, four lines distant from the fundus of the eye. Its margin is encompassed by the folds of the zonula Zinnii, and encircled by canalis Petiti.

Structure. The substance of the lens contained in the capsule becomes thicker from without inwards. The anterior portion, almost a thin fluid, the so-called liquor Morgagni, contains cells, like the gelatinous portion found behind it, with a very delicate membrane, which, when their water evaporates, become dark and granular. Upon the cellular layer narrow, straight fibres follow, which form layers, and lie close upon one another, like the scales of an onion, inwards towards the middle thickened into a nucleus (of a gummy consistency). Each lamina consists on the anterior surface of the lens of three, on the posterior of four triangles, between which a space in the form of a Δ or ((remains, to which the fibres converge inwards, so that the lens breaks up into three to four (or more) wedge-shaped pieces by the action of an acid, boiling water, or even merely by heat.

The substance of the lens contains, more than the half, water, and much albumen, (Globulin according to Berzelius; Casein, Fr. Simon.); it becomes cloudy after death (whether by coagulation?), and coagulates in sulphuric and phosphoric acids, which last does not make it opaque.

The capsule of the lens, capsula lentis, a simple membrane, clear as water (under the microscope a faint yellow), in adults non-vascular, is smooth, strong, stiff, and distinctly thicker on the anterior wall than on the posterior. Its anterior wall looks freely into the posterior chamber of the eye, lies quite open when the pupil is widely dilated, and is firmly connected at the margin with zonula Zinnii; its posterior wall lies in the fossa-hyaloidae of the vitreous body.
It is rendered neither cloudy nor soluble either by boiling water, or by alcohol and acids. Of nerves it also possesses, like the lens, a few; and the vessels which it shows in a morbid condition are only developed in an abnormal manner. However, Walter has injected vessels on the posterior wall of the capsule.

The very vascular capsule of the lens in the Embryo (membrana pupillaris, and capsulo-pupillaris) is a closed, delicate membrane, formed of a capillary rete, which at the commencement closely surrounds the lens and its non-vascular capsule; but later, when the eye grows, it becomes smaller in proportion to the lens, and is applied to the Iris with its internal border; the anterior portion of the sac is removed from the lens and capsule, and now consists of two halves, namely, the piece which reaches from the border of the lens to the pupillary border of the Iris (membr. capsulo-pupillaris, J. Müller), and the piece which closes the pupil vertically (membr. pupillaris, Wachendorf). From the seventh month the vessels are obliterated (on the pupillary membrane from the centre towards the circumference), the membranes themselves disappear, and the humor aqueus is produced; in the fossa hyaloidea a few vessels appear to continue in existence.

504. 3. Corpus vitreum, the vitreous humour,
a globular, completely transparent body, which consists of a viscous fluid and a membrane (not anatomically demonstrable), filling up the posterior three-fourths of the globe of the eye, is surrounded by the Retina, and receives on its anterior surface, in a depression (fossa hyaloidea), the posterior surface of the lens. At the posterior boundary we find in the fætus an infundibular-shaped fossa, area Martegiaui, which arises from the Art. capsularis, passing in its canal, drawing upwards the vitreous body during the obliteration of its branches (or only arises after death, Arnold).

Humor vitreus, the vitreous humour, is colourless, and behaves, chemically, exactly like the humor aqueus. It is (probably) placed in cells of the vitreous membrane, which, by punctures, are individually emptied, but nevertheless, perhaps, communicate with each other. In the Embryo it is nourished by numerous vessels, of which, at a later period, the principal trunk only, passing to the fossa hyaloidea, art. capsularis, remains behind.

Membrana hyaloidea, the vitreous [or hyaloid] membrane, is only visible under the microscope; it is said to form the cells and the envelope of the whole vitreous body. This envelope is said to divide at the anterior boundary of the vitreous body into two laminae, one of which passes behind the lens, and the other on its anterior surface, so that between the two the Canalis Petiti, a triangular, circular, and closed canal, is formed, which surrounds the border of the capsule of the lens like a projecting fold, and probably contains fluid.

The anterior lamina, strengthened by a fibrous layer of corpus ciliare (on its posterior surface), forms the

Zonula Zinnii s. corona ciliaris (whether an independent structure or not is
still doubtful). It lies like a circlet of folds before the vitreous body, around the border of the lens, behind the corpus ciliare, and presents alternating black and clear rays. The rays are longer than the proc. ciliares of the choroid, and form depressions and folds which correspond to those of the last. Its posterior border is undulating and indented (ora serrata), and impinges upon the anterior boundary of the Retina; its anterior border is firmly connected to the border of the capsule of the lens (upon the anterior surface). The corona ciliaris in the foetus is supplied plentifully with blood-vessels, which anastomose with those of the very vascular capsule and Choroidea; but in the adult, like the hyaloid membrane, it is non-vascular.

505. II. The organ of Hearing. Organon auditus.

The ear, auris, consists of three parts. These are: The external, that is, the auricular cartilage and the external auditory meatus. The central, that is, the tympanic cavity and the Eustachian tube. The internal, that is, the Labyrinth.

A. The external part.

506. 1. The external ear, auriculus, the ear, an oval, elastic, cartilaginous plate, many times curved, situated on, and firmly attached by ligaments to, the lateral parietes of the head at an angle of from 25° to 30°; covered by the external integument. On its outer surface the following parts may be observed:

   a. Concha auris, a hollow, the shape of a muscle shell, at the anterior and inferior part of which the external auditory canal commences, is bounded anteriorly by

   1. Tragus, the anterior auricular valve, that is, a rounded, four-sided plate, internally beset with hairs, which can close the external auditory meatus in front.

   2. Antitragus, a small triangular projection at the termination of the anthelix. It lies rather deeper, opposite to the tragus, and between the two we find:

   incisura intertragica, a deeper and rounded excavation, above the lobule of the auricle. Above and behind, the concha is bounded by:

   3. Anthelix, that is, a curvilinear elevation, which commences above the antitragus, passes upwards and forwards, and terminates with two crura (a sharp inferior and a blunt superior), between which is situated a shallow, triangular fossa, fossa innominata.

   b. Helix, that is, the elevation which commences in the auditory concha, separates it into a superior and inferior portion, then, parallel with the anthelix, forms the external anterior reflected border of the auricle, and ceases at the auricular lobule.

   Between helix and anthelix an oblong fossa, fossa navicularis s. scapha is
situated, extending from the superior extremity of the auricle, almost as far as the lobule.

The cartilage of the ear is elastic and flexible, covered with Perichondrium. The external integument which, particularly on the concha, is applied closely to it, is delicate and transparent, beset with folliculi sebacei, particularly in the concha and fossa innominata, with little hairs (tragi) upon the tragus. On the border of the helix it is applied more loosely, and forms at the inferior extremity a fold, the lobule of the auricle (lobulus auriculi,) between the layers of which we find a deposit of adipose tissue.

Ligaments:

a. Lig. auriculae posterius is thick, and extends from the posterior parts of the concha to the superior of proc. mastoideus.
b. Lig. anterius s. Valsalvae, triangular, broad, and strong, arises from a nodule on the helix, close above tragus, and even from this, and attaches itself to the root of proc. zygomat. (oss. tempor.)

Muscles. (For those moving the whole auricle, see Myology.) They should move the separate parts of the ear, but they are rudimentary; in savages, besides, not more strongly developed. The four first lie on the external surface of the auricle.

a. M. helicis major, narrow, about half an inch long, thin, at the arched superior and anterior part of the Helix, fibres vertical.
b. M. helicis minor, very small, at the arched inferior and posterior part.
c. Tragicus, three-cornered, tolerably thick, with vertical fibres; upon the tragus.
d. Antitragicus, narrow, short; passes from the antitragus to the anthelix.
e. Transversus auriculae, transverse on the posterior surface of the ear, from the convexity of the concha to the external part of the anthelix.
f. Dilatator conchae (Theile), from the anterior surface of the cartilaginous meatus audit, on the anterior inferior part of the tragus. Use: to draw the tragus forwards, and thus dilate the concha.
g. Obliquus auriculae (Arnold), upon the internal surface of the ear, between the elevations of fossa innominata and the concha.

Vessels and nerves. Arteries: art. auricularis posterior; a branch perforates the helix, and enters into the concha; the rest curve round the edge of the former. Art. auriculares anter. from temporalis. Veins: they open into V. facialis posterior.

Nerves: nn. auriculares anterior, superior, magnus [to the skin (sensitive)]; posterior [to the muscles]; and a ramus nerv. vagi.

507. 2. The external auditory canal, meatus auditorius externus,
a semi-cartilaginous, semi-osseous canal, one inch long, is elliptical
in the transverse section, and passes from the base of the auditory concha horizontally to the membrana tympani, that is, from without inwards and from behind forwards. Close to the entrance it makes a bend, the curve upwards (whenever we wish to see to the end of the auditory passage, the centre of the auricle must be drawn upwards and backwards). The entrance is oval beset with hairs, bounded before by tragus, behind by the crescentic crista of the concha. The internal opening circular, directed obliquely from above downwards and from without inwards, and closed by the tympanic membrane. The narrowest place is found at the bend, the widest at the junction of the cartilaginous and osseous parts. Superior wall, ten lines, inferior, thirteen, posterior, ten and a half, anterior, twelve and one third long.

a. The osseous portion (seven to eight lines long) lies on the basis oss. petrosi, is in children made up by the annulus tympani, of which a groove remains behind (sulcus tympani), and which is interrupted at the superior boundary.

b. The cartilaginous portion (five lines long) is attached by fibrous uniting tissue with the toothed border of the osseous portion, forming, besides, the superior wall which is attached to the proc. zygomaticus. Its inferior longer wall is properly a continuation of the tragus, from which, by incomplete fissures (incisurae Santorini), two C-shaped pieces are separated (like the trachea), which are approximated by interposed muscular fibres. The posterior wall is connected with the Concha.

The external integument, which is continued from the external ear upon the interior of the auditory passage, is always more delicate, proceeding inwards, is from the commencement beset with stiff, then with fine hairs and ceruminous glands (gl. ceruminosae), and forms internally a closed cylinder, since it terminates upon the tympanic membrane. The glandules are numerous, especially in the centre (some thousands upon a square line.)

The cerumen is very bitter, partly soluble in water, containing a yellow oil, albumen, and salts of lactic acid. It becomes thickened by the evaporation of its watery elements.

Vessels: branches of Art. auricular. poster. and profunda.
Nerves: branches of auricul. anter. from ram. 3 trigeminii and auricul. n. vagi.

508. 3. The drum of the ear, membrana tympani,
a thin, elliptical, semi-transparent and elastic membrane, four and a half lines in its vertical diameter, forming a partition between the cavity of the tympanum and the external auditory meatus, with the inferior wall of which it describes an angle of about 45°. Its external surface looks also obliquely outwards and downwards into the
auditory passage; its internal surface upwards and inwards into the cavity of the tympanum, and presents in the centre an elevation where the handle of the *Malleus* draws it inwards (on the external surface a funnel-shaped excavation). Its margin lies in the *sulcus tympani*; close to that, at the superior posterior part of the *membrana tympani*, the short process of the *malleus* presses the last outwards (*umbo*); at the posterior extremity of the horizontal diameter it is perforated by the *Chorda tympani*.

The *membrana tympani* consists of three laminae; the external is the sack-like extremity of the skin (*cutis* or *epidermis*) of the auditory passage; the internal is a prolongation of the thin mucous membrane of the tympanic cavity; the central the proper tympanic membrane, is very strong, fibrous (according to Ev. Home muscular), its fibres converge from the circumference towards the centre. The vessels appear to belong exclusively to the internal lamina. They form a close rete, *circul. vasor. major* and *minor* (as in the *Iris*).

*Art. tympanica superior* (from *stylomastoid, s. auricular. poster.*) and *inferior* (from *maxill. interna* or *externa*).

*Nerves: auricul. anterior* (trigemini.)

The *membrana tympani* is strained and vibrates feebly under strong, but is relaxed and vibrates strongly under feeble impressions produced by the undulations of sound.

**B. The central part of the Ear.**

509. 1. The cavity of the tympanum, *tympanum, cavitatis tympani*,

an irregular, oblong, (four and a half lines) narrow (two lines) cavity, situated at the anterior part of the *basis oss. petrosi*, between the external auditory canal and the labyrinth. Anteriorly it is in connexion by the *tuba Eustachii* with the *Pharynx*, behind and above, where it is more spacious, with the cells of *proc. Mastoideus*.

Its external wall is formed by the osseous plate in which the *memb. tympani* is strained as well as by this itself; it is bounded before by *fissura Glaseri* (for *chorda tympani, art. tympan. infer.* and *lig. mallei anterius*). The internal wall [*fundus*] lies opposite to the *memb. tympani*, and presents:

a. *Fenestra ovalis s. vestibuli*, an oblong opening, directed obliquely downwards and forwards (1½ line long), at the superior part of the internal wall, lying in a depression, bounded above by *canal. Fallopia*, below by *promontorium*, is closed by the footpiece of the *Stapes* and a thin membrane.—Under it,

b. *Promontorium s. tuber cochleae*, an elevation which corresponds to one
turn of the *cochlea*, is covered with three grooves opening below into the *canal. tympanicus*, and diverging upwards (for the anastomosis of Jacobson).

c. *Eminencia papillaris*, the pyramid, a small conical projection behind the *fenestra ovalis*; a fine orifice in its apex leads to a canal which passes away under *canal. Fallopii*, and is connected with it; this is *canalis stapedi.".

d. *Fenestra rotunda*, s. *cochlea*, behind the promontory in a depression (which leads to the *vestibule*) is closed by a fibrous *membrana tympani secundaria*, and leads into the *Scala tympani* of the Cochlea.

At the anterior boundary the tympanic cavity contracts and runs out into two canals, the superior of which, *canalis tensoris tympani* (for *m. mallei internus*) is separated by a thin osseous lamella from the inferior canal, that is, the osseous *tuba Eustachii*, and is said to commence as a semi-canal (semicanal) with a wide open-mouthed lamina, *proc. cochlearis*. Above and behind the great opening of the *sinus mastoideus* leads into the cells of *proc. mastoideus*. These cells are filled with air and covered with Epithelium. The superior boundary is vaulted, and the head of the *malleus* and of *incus* are situated in it.

510. 2. The Bones (ossicles) of the Ear, *Ossicula auditis*.

These are (three to four) movable osseous pieces, associated at angles into a chain, which are situated from without inwards between the *memb. tympani* and the *fenestra ovalis*.

a. The *malleus* lies immediately upon the *memb. tympani*. We observe on it, Head, neck, handle, and two processes.

1. *Head*, an oval, smooth enlargement, situated in the superior part of the tympanic cavity, above the *memb. tympani*, unites on its posterior concave surface with the *incus*, and is placed upon

2. The *neck*, a narrow piece inclined from before outwards, which passes into

3. The *handle* (*manubrium*). This passes off from the neck at an obtuse angle, downwards and forwards, and terminates with a roundish point in the centre of the *memb. tympani* between the internal and central lamina.

4. *Processus brevis* s. *obtusus* arises at the commencement of the *manubrium*, on the outer side, and presses the superior part of the *memb. tympani* (*umbo*) rather outwards in the ext. auditory meatus.

5. *Processus longus* (s. *folianus*) arises from the anterior part of the neck, long and thin, and enters into the *fissura Glaseri*, where *lig. mallei anterius* is applied.

b. The *incus*, the anvil, like a molar tooth, is situated behind and below the *malleus*. Its body, that is, the most superior thick piece, has a concave articular surface directed forwards for *caput mallei*. Its shorter, superior process passes backwards, and attaches itself to the cells of the *proc. mastoideus*. 
Its longer, thinner process, passes parallel with manubrium mallei internal to and behind it (chorda tympani between the two). On its hooked apex, which is bent backwards, we find the ossiculum lenticulare Sylvii, a tubercle, which is almost always united with the incus. It is situated freely in the tympanic cavity. From its apex passes inwards to the fenestra ovalis.

c. The Stirrup, stapes, horizontally, at a right angle. Its capitulum unites with the ossicul. lenticulare; from it passes off inwards an anterior and a posterior crus (on the concave surfaces of which, turned to one another, we find a groove, sulcus stapedis), which become associated by a thin plate, the foot piece (basis stapedis). This basis passes directly into the fenestra ovalis, in which it moves.

Muscles of the ossicula. Sömmering admits four muscles, three of which belong to the malleus, one to the stapes; distinct muscular tissue is, however, only found in the

_M. tensor tympani s. mallei internus._ Or.: from the superior wall of the cartilaginous tuba Eustachii and from the Sphenoid bone (behind foram. spinosum). Course: backwards in the osseous canal above the tuba, enters into the cavity of the tympanum, where the tendon is reflected at, almost, a right angle. Ins.: the anterior superior part of manubr. mallei. 

Use: to draw the malleus inwards, and stretch the memb. tympani.

To the ligaments of the ossicula belong therefore, besides the capsular ligaments between malleus and incus, and between os lenticulare and stapes:

1. **Lig. mallei capituli s. superius** passing from the superior wall of the tympanum to the head of the malleus.

2. **Lig. mallei manubrii s. posterius (laxator tympani minor);** passing from the internal extremity of the auditory meatus, upwards and backwards, to the manubrium.

3. **Ligg. processus longi anterius s. mallei (laxator tympani major s. malleus externus),** passes from proc. spinos. (of the sphenoid bone) through fissura Glaseri to the apex of proc. folianus.

4. **Lig. processus longi et brevis incudis** come from the posterior and external wall of the cavity of the tympanum.

5. **Lig. stapedis (musc. stapedius);** very thin; arises inside the eminentia papillaris, passes out of it into the tympanum, passes forwards and downwards, and is attached behind to the capitulum of the stapes; it is said to draw the stapes backwards, and thereby to press the posterior part of its basis deeper into the fenestra ovalis, whilst the anterior part is raised.

The same thing happens when the tensor tympani draws the head of the malleus backwards, and imparts the movement to the remaining ossicula.

511. 3. The Trumpet of the Ear, _Tuba Eustachii_,

a straight canal, about two inches long, flattened at the sides, between the inferior anterior part of the tympanum and superior lateral part of the pharynx, passing in an oblique direction from
without inwards, from above downwards, and from behind forwards. It consists of an osseous and a cartilaginous portion, both of which are covered with mucous membrane, which at the orificium pharyngeum is thicker than in the remaining parts, and at the orificium tympanicum passes over into that of the tympanum. Both openings (about two lines broad) are wider than the rest of the canal (about one line broad).

a. The osseous tuba, seven to eight lines long, is situated in the angle between pars mastoidea and petrosa of the Temporal bone external to canal caroticus, vestibule and cochlea, below the canalis tensoris tympani. To its rough border is attached:—

b. The cartilagino-membranous tuba, the internal half of which consists of cartilage, whilst the external wall is formed of a fibrous coat which is attached to the Sphenoid bone. It lies above the fossa pterygoidea at the inferior border of the ala magna of the Sphenoid bone. Its oval opening (four lines high, two broad) is tumesced, sloped, situated close behind and rather above the inferior nasal concha, at the superior part of the pharynx. The mucous membrane covering it is looser, very vascular, and beset with numerous mucous glands which are wanting in the osseous tuba. Through the tuba the external air obtains admission to the tympanum.

Vessels and nerves for the central part of the organ of hearing. Arteries: Art. tympanica, stylomastoidea, farther branches from Art. meningea media, pharyngea ascendens and carotis interna (for tuba Eustach.)

Veins: they open into the plexus pharyngeus and meningea media.

Nerves: they come from the fifth, seventh, and ninth cerebral nerves; they are: Chorda tympani; passes from Canalis Fallopiae in a canal peculiar to itself, then into the tympanum (between manubr. mallei and proc. long. incudis), and out through the fissura Glaseri to ram. lingualis of the nerv. trigeminus; it gives off no branches in the tympanum. Anastomosis Jacobsonii—gives two filaments to the membrane in the region of the fenestra, and one filament to the tuba (where by pressure of the vessels in sanguineous congestion violent pain arises).

C. The internal part, the Labyrinth.

512. 1. The osseous labyrinth, labirinthus osceus.

1. The vestibule, vestibulum, a small oval cavity (three lines high, two broad, and one and a half deep) in the centre of the labyrinth, behind the Cochlea, before the semicircular canals, situated in the direction of the long axis of meatus auditorius internus, abutting externally on the tympanum, above, on the Canal Fallopiae, below, on the foramen jugulare. We see in it—

a. Seven larger openings:
1. *Fenestra ovalis* on the external wall; it is tightly closed by the *basis stapedis*.

2. The five openings of the three semicircular canals.

3. *Aditus ad cochleam*, before and below the *fenestra ovalis*.

b. Four smaller openings:

1. *Ostium aquaeductus vestibuli*, on the posterior wall, internal to the common opening of the superior and inferior semicircular canals (leads to the posterior, the cerebral surface of the petrous bone).

2. *Macula cribrosa*, three of many small holes on the perforated part of the posterior wall, at the base of *meatus auditorius internus*, through which vessels and nervous twigs enter; there is a superior, for *n. semicircularis major*; an inferior for *n. ampullaris inferior*; and a *hemisphaericus* for *nerv. semicircularis minor*.

c. Depressions, on the floor of the Vestibule, nearer to the inner wall:

1. *Recessus hemisphaericus*, anterior, smaller fossa, situated inwards towards the *cochlea*, opposite to *fenestra ovalis*.

2. *Recessus hemiellipticus*, oval, larger fossa, rather behind and above, at the openings of the semicircular canals. Through the foramina on their base the nerves pass. The two are separated from one another by a *crista pyramidalis*.

513. 2. The semicircular canals, *canales semicirculares*,

three curved, rather elliptical cylinders, of half a line in diameter, lying behind the vestibule, two vertically and one horizontally between them. They open with the two extremities, which are rather wider than the rest of the canals, into the *vestibule*, as one extremity is expanded like a flask (ampulla), but with only five orifices.

a. The superior (vertical) semicircular canal, about six lines long, at the most superior part of the labyrinth, in the transverse diameter of *oss. petrosi*; is convex above, and projects rather below the superior surface of the petrous bone. Its anterior crus expands and opens alone, on the superior wall of the vestibule; its posterior crus in common with the superior of the inferior semicircular canal, and without expanding on the superior and internal wall of the vestibule.

b. The inferior (vertical) semicircular canal, seven lines long, narrower than the other two, describes almost a complete circle, is situated parallel with the posterior surface of the petrous bone, with its convexity directed backwards and outwards towards *proc. mastoideus*. Its superior crus opens in common with *a*; its inferior expanded crus, one line distant from that on the inferior wall of the vestibule.

c. The external (horizontal) semicircular canal, four lines long, but wider than the other two, also lies in the long diameter of the petrous bone, with the convexity directed outwards. Its anterior expanded crus commences close above the *fenestra ovalis*, below the crus of the superior semicircular canal; its pos-
terior crus opens between the common orifice of the two vertical canals and the inferior (ampulla) of the inferior semicircular canal.

514. 3. The Cochlea, a twisted canal, like a snail-shell, of four lines axial diameter, occupies the most anterior space of the internal ear, is situated internally and before the tympanum with its basis turned to the base of meatus auditoris internus, the apex towards tuba Eustachii. The canal, canalis spiralis, consists of two and a half spiral turns, the length of which together measures one inch, commences with its wide basis behind the promontorium, and contracts inwards towards the apex (cupola), under which it terminates in a funnel-shaped cavity (scyphus). The spirals pass in the right ear to the right, in the left towards the left. The cavity of the canal is divided by a thin septum, spiral plate, from the basis to the apex into a superior ladder (scala vestibuli), and into an inferior (scala tympani).

The spiral plate (lamina spiralis) follows the windings about the axis of the Cochlea, to which it is attached by its internal border, whilst the external border is attached to the circumference of the Cochlea. It consists of an osseous portion zonula ossea, which occupies the internal half attached to the axis and predominates in the first turn, and of a membranous, external half, zona Valsalvae. The osseous lamina terminates in the third turn with a kind of hook, hamulus s. rostrum [where the scalæ communicate, canalis scalaris communis, Cassebohm; Helicotrema, Breschet], and itself consists of two plates, between which many canaliculi for the nerves of the Cochlea are found.

The axis, spindle, modiolus s. columella, is the porous mass of bone which fills up the space in the axis of the Cochlea, bounded by the concavity of the spirals. Its basis, perforated by many spirally arranged foramina (tractus foraminulentus, for the nerv. Cochleae), rests upon the base of the meatus auditor. internus; above the first turn the mass is rather thickened, and is then called columella, and terminates as lamina terminalis, of a funnel shape in the half turn. The external surface of the modiolus is provided with two screw-like grooves which communicate through their numerous foramina with the same number of canaliculi in the interior of the modiolus, the largest of which in the centre, canalis centralis modioli, passes from the basis to the lamina terminalis.

The Scalæ:

a. Scala vestibuli, is wider than b, lies more anteriorly and above and opens into the vestibule (aditus ad cochleam.)

b. Scala tympani, lies more towards the basis and opens through the fenestra rotunda (clausa) into the tympanum. Both scalæ
communicate in the lamina terminalis through an opening in the membrane which separates them (see before).

Aquæductus cochleæ (Cotugno) opens into the scala tympani close before fenestra rotunda, and opens on the other side on the inferior border of the petrous bone close to fossa jugularis.

Both the aqueduct of the cochlea and vestibule are at last regarded as canals for small veins. Arnold, however, thinks still that they serve as vent canals. The delicate membrane with which they are lined passes over into the dura mater and the periosteum of the petrous bone.

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3. The membranous labyrinth.

In the interior of the labyrinth, which is covered with a delicate vascular membrane (choroidea labyrinthi, Arnold), we find a watery fluid (aqua Cotunnii, Perilymphæ), in which—but only in the vestibule and the semicircular canals—a whitish, transparent nervous membrane is suspended (labyrinthus membranaceus). The last forms in the vestibule two, in the semicircular canals three sacs filled with the aquula vitrea. Zona Valsalvae (see before) separates the two scala, the humor aquæus of which flows through the opening at the lamina terminalis [helicotrema] from the one into the other.

a. Canales semicirculares membranacei, far more narrow, but otherwise similar to the osseous semicircular canals, in which they lie, they are expanded in the internal crura (ampullæ) and open with five orifices into the

b. Vestibulum membranaceum. This consists of two portions.

1. Sacculus oblongus (s. utriculus ventricularis) receives alone the five semicircular canals, is larger than 2., lies in the recessus hemiellipticus, separated from the Stapes only by the aq. Cotunnii.

2. Sacculus rotundus is much smaller, lies in the recessus hemisphericus under the former without communicating with it, and the n. saccularis minor spreads out in it.

c. Aquula vitrea (Scarpe) s. Endolympæ; rather a thicker fluid than the aq. Cotunnii, fills up the membranous tubes and sacs of the labyrinth and contains a fine crystalline deposit.

Otoconia, sand of the ear, otolithi, stones of the ear; these are smaller or larger accumulations of six-sided columns consisting of carbonate of lime, and an organic material (Huschke) which in the vestibule adhere opposite to the expansion of the nerves, and serve for the strengthening of the sounds. Larger and more distinct in the lower classes of animals (and in the embryo) their structure, in man, in spite of the researches of Breschet, Krieger, and others, is not yet determined.

Vessels and nerves of the labyrinth. Artt. cochleæ and vestibuli are branches of art. auditoria interna, and correspond to the
Nerves: *N. cochlea*, the anterior stronger branch of *n. acusticus* enters through the inferior anterior fossa of *meat. auditor. internus* at the basis of the *modiolus* in its canals, and thence between the layers of the *lamina spiralis*, where the most delicate fasciculi (in loops) spread out as far as the external border. *N. vestibuli*, the posterior branch of the *acusticus*, divides at the basis of *meatus auditorius internus* into three fasciculi, the strongest of which goes to the *sacculus oblongus* and the *Ampulla* of the vertical superior and horizontal semicircular canal; the central to the *sacculus rotundus*, and the inferior smallest to the *ampulla* of the vertical inferior semicircular canal.

516. III. The Organ of Smell, *Organon olfactus*.

The nose, *nasus*, consists of an external portion projecting upon the face and an internal covered with mucous membrane.

517. A. The external Nose, *Nasus externus*,

consists, above, of an osseous (*ossa nasi* and *process. nasales*) below, of a cartilaginous skeleton, which are immediately covered with *periosteum* and *perichondrium*, nearer the surface with muscles (see *Myology*), and *cutis*, on the internal surface with mucous membrane. Portions: The root of the nose, close under the forehead,—the back or dorsum of the nose,—the point or tip of the nose,—the lateral parietes, *ala s. pinnae nasi*,—openings of the nose, *nares*, the partition, *septum narium*.

518. 1. The Nasal cartilages, five, *Cartilagines nasi*.

a. *Cartilago lateralis*, the lateral cartilages, are situated (one on either side) at the most superior part of the cartilaginous nose; triangular, attached above and behind by fibrous uniting tissue with *ossa nasi*. The internal borders of the two meet upon the *dorsum nasi*, where they are also firmly attached to the cartilage of the *septum*. The inferior border is convex, and meets anteriorly with *b*, behind with the fibrous membrane of the *ala nasi*.

b. *Cartilago narium* (*s. spinalis*), one on either side, is a more irregular semi-elliptical cartilage, the external thinner arch is situated in the groove above the *ala nasi* and *point*, whilst the internal reaches below the *septum mobile* as far as the *spina nasalis*. A fibrous plate between the pinnal cartilages and the inferior border of the lateral nasal cartilages forms the skeleton of the *ala nasi*, in which (generally) small flat cartilaginous nuclei (*cart. sesamoideas*) exist.

c. *Cartilago septi narium*, the septal cartilage, thick, flat, and triangular, meets with its superior posterior border, the *lamina perpendicularis* of the *Ethmoid* bone; its inferior border is placed between the two plates of the *Vomer*; its anterior border unites upon the back of the nose with the *cartt. laterales*, and below with the *cartt. narium*. Behind a pro-
cess projects from it into the angle between lamina perpendicularis oss-ethmoid. and Vomer. It separates the two halves of the nasal cavity.

2. The muscles of the nose: levator labii alæq. nasi, compressor and dilata. tores narium, depressor alæ nasi, pyramidalis and depressor septi mobilis (see Myology).

3. The skin of the nose is very thick and strong on the alæ nasi and below the septum, and passes at the nares into the mucous membrane, the commencement of which is beset with stiff hairs (vibrissæ). It is also furnished with many folliculi sebacei, which frequently appear as black punctules.


519. B. The Cavity of the Nose, Nasus internus.

The cavities of the nose, fossæ nasales, are covered with the nasal mucous membrane, membrana pituitaria s. Schneideriana, the proper seat of the sense of smell. This membrane is thick, soft, rosy red, very vascular and largely supplied with nerves (in the neighbouring cavities, sinus frontales, ethmoidal., sphenoidal., and antra Highmori, we find instead of it a delicate, fine periosteum covered with ciliated epithelium.) Numerous mucous follicles cover the free surface, whilst the external is firmly attached to the periostium and perichondrium. It continues upon the palate and pharynx, the lacrimal canal, and Eustachian tube, the openings of which, as well as those of the sinus, it generally covers like a veil. [There is ciliated epithelium on the mucous membrane lining the nose.]

We observe in it the meatus narium:

1. The superior nasal chamber, below the superior turbinate bones, with the openings of the posterior ethmoidal and the sphenoidal cells.
2. The central nasal chamber, below the middle turbinate bones, with the openings of the anterior ethmoidal cells, the sinus frontalis, and antra Highmori.
3. The inferior nasal chamber, below the inferior turbinate bones, with the openings of the canal. lacrimal.


Nerves: Nn. olfactorii, ethmoidales, naso-palatini Scarpaë, and nasales. (Branches of Nerv. trigeminus).
"In the history of Physiology, I have shown that those who studied the structure of animals were irresistibly led to the conviction that the parts of this structure have each its end or purpose; that each member and organ not merely produces a certain effect or answers a certain use, but is so framed as to impress us with the persuasion that it was constructed for that use; that it was intended to produce the effect. It was there seen that this persuasion was repeatedly expressed in the most emphatic manner by Galen; that it directed the researches and led to the discoveries of Harvey; that it has always been dwelt upon as a favourite contemplation, and followed as a certain guide by the best anatomists; and that it is inculcated by the physiologists of the profoundest views and most extensive knowledge of our own time. All these persons have deemed it a most certain and important principle of physiology, that in every organized structure, plant, or animal, each intelligible part has its allotted office; each organ is designed for its appropriate function; that nature, in these cases, produces nothing in vain; that, in short, each portion of the whole arrangement has its final cause; an end to which it is adapted, and in this end the reason that it is where and what it is."—Whewell. *Indications of the Creator*, p. 75.
ANGIOLOGIA.

LITERATURE.

Blood Vessels:—

Lymphatics:—
Cruikshank. Anat. of the Absorbent Vessels. 4to. 1790.
Lane, S. Art. "Lymphatic System," in the same.
520. THE VASCULAR SYSTEM.

The nutritious fluid moves in closed flexible tubes, which traverse the body in all directions. That division of these tubes, through which the blood moves, has a contractile organ as the central point, from which blood is impelled into the tubes, and to which it returns from the tubes.

The other division, in which the Chyle and Lymph move, does not possess in itself such a central point, but in the blood system, to which it carries its contents, without being immediately distributed from its orifice.

521. The System of Vessels carrying Blood.

Central organ—the heart. From it vessels go off—the arteries (pulsating vessels). To it vessels lead back—the veins (blood vessels). Very delicate ramifications and transitions between the two kinds of vessels. Capillary vessels.

522. Course. The vessels, vasa, are cylindrical tubes, the largest trunks of which lie in the neighbourhood of the central organs, and the branches of which, going off at an acute angle, diminish in circumference towards the periphery. The effect of this continued division however is, that the calibre of the branches taken together is wider than that of the trunk from which they came off.

Many branches divide from one trunk, and pass to another, without diminishing in circumference, that is, they anastomose. Their course is curved or in the form of an acute angle. If they are numerous, and the interspace between them only small in proportion to the organ, they are called Plexuses, which is particularly remarkable in the venous trunks. When larger branches suddenly divide into a number of smaller vessels united together, without previous arborescent separation, the so-called rete mirabile is formed, for example, in the lungs. The capillary vessels also form a network, but which by gradual, always more delicate, division, arises from large vessels. The more narrow and complicated the course through which the blood has to circulate, so much the longer it is delayed therein.

Structure of the vessels. The parietes of the vessels consist of six membranous layers, which are not, however, always present at the same time in every vessel.

a. The innermost layer, which lies next to the cavity of the vessel, is a thin,
granular membrane of pavement epithelium, which is also seen in the most delicate capillaries.

b. The striated or fenestrated membrane is delicate, clear, fragile, and rolls up at the corners.

c. The longitudinal, fibrous membrane is distinctly seen in large vessels. It is, like a. and b., formed of oval cell nuclei or fibres, which are placed longitudinally, in which direction the membrane may be torn off; and it was formerly considered, with a. and b. as the most internal layer of the vessels.

d. The circular, fibrous coat (so-called tunica media) is thick, contracting upon certain stimuli (falsely, tun. elastica); consists of short parallel fibres, which are soluble in acetic acid, and of dark striæ, which are only rendered transparent by the acid; it is fragile, and tears off transversely.

e. The elastic coat is only present in the larger arteries and veins; is white, thinner than d.; is neither soluble in, nor rendered transparent by acetic acid; tears off neither in the longitudinal nor transverse direction, and consists of very branched, often reteform, fibres.

f. The external tunica (tun. adventitia) forms with e. the hitherto so-called tunica externa; it consists of fibro-cellular tissue, with oval nuclei in a longitudinal direction, and passes from the larger vessels into the surrounding amorphous, fibro-cellular, or uniting tissue.

The nutrition of the larger vessels (above half a line diam.) is supplied by small arterial twigs (vasa vasorum), which do not come immediately from the cavity of the vessel for which they are destined, whilst the venous ramusculi open into those veins, from the coats of which the blood collects. The vasa vasorum themselves, as well as the capillary vessels, are nourished by the blood circulating in them.

Nerves: (nervi vasorum) the vessels obtain their supply from the N. Sym patheticus.

523. I. Capillary vessels, vasa capillaria,

are the blood-vessels intermediate between the arteries and veins, the branches of which form a net-work with each other, and tolerably equalized meshes. In these meshes is placed the peculiar substance of the tissue, and it receives its nutrition from the blood of the vessels (metamorphosis of matter). The blood circulating in them is neither arterial nor venous; in the finest vessels it appears colourless; it generally flows in a direction from the arteries, which here terminate, to the veins, which commence at this point. It is impossible to draw a definite limit between the terminations of the arteries and the commencement of the veins. Structure. In the parietes of the capillary vessels (which are not merely canals in the parenchyma of organs), pavement epithelium, and, most externally, a tunic of areolar tissue, has been found.

The forms of their network vary according to the diameters of the vessels (the finest in the brain = 0.008 of a line; the largest in the medulla of the bones = 0.010 of a line); according to the breadth of the meshes, which is so
much the more minute, the larger the consumption of blood (the narrowest network is in the lungs, the glands of the skin, the mucous membranes, &c.) According to the shape of the space bounded by them, we may distinguish roundish or oval (*e.g.* in the lungs, the corium, the glands), and longitudinal or elongated meshes (in the nerves and muscles). Ball-shaped, convoluted meshes are only found in the cortical substance of the kidneys (*e.g.* glomeruli Malpighi).

Function. The capillary vessels impart, through their thin (not porous) walls, the nutritious material of their blood to the organs, in which they spread out and ramify, and on the other side they take up, likewise (in the lungs), the inspired oxygen. *Vasa exhalantia*, exhaling vessels.

524. II. Pulsating vessels, *arteriae*,

are the vessels, the trunks of which arise from the ventricles of the heart, and which distribute the blood throughout the body. Their walls are thicker, and more elastic than the rest of the vessels. The smaller arteries possess, relatively, the strongest parietes; the thinnest arteries are those of the cranial cavity. They pulsate, that is, they extend in length and breadth, when the ventricles of the heart contract (*systole*), and thereby force their blood into the arteries, and they again become narrower and shorter, when the ventricles of the heart dilate (*diastole*). The arteries are further distinguished by their great elasticity and contractility. The first produces retraction when the arteries are divided across; the last a narrowing, but not collapse, as happens in the veins. Of the coats, before all, we remark:

That consisting of circular fibres (the so-called middle, elastic coat). It is thick, yellowish white, dry, and fragile, and the medium of contraction. It is distinguished from the muscular tissue by its easy solubility in nitric, insolubility in acetic acid, and by yielding gelatine on boiling; from the fibro-cellar or uniting tissue, by insolubility in boiling acetic acid, difficult solution in mineral acids, caustic potash, and gastric juice.

The external, proper elastic coat of arteries, is firm, and stronger than in the veins, and is remarkable for not dividing when an artery is included in a ligature, which the internal coat does.

The inner coat, *tun. vasorum comm.*, that is, the striated tunic (for the tunic of longitudinal fibres is usually wanting), is only in a diseased condition as thick as we are accustomed to find it, especially in old people, when it is so much the more fragile.

The arteries take a serpentine course, generally deeper than the veins and lymphatics, the larger on the flexion side of the joints, and convey (the pulmonary excepted) bright red blood.

525. III. Blood-vessels, *venae*, veins,

originate from the capillaries, and open into the auricles of the heart. Their walls are thinner, and more lax, and when the vessel is empty, they fall together, as the elastic coat is entirely wanting in them; the contractile, circular,
fibrous coat, much thinner, or only consisting of bundles of fibro-cellular tissue, in place of which, on the superior and inferior cavae, and on the pulmonary veins, muscular tissue is found. The tunica of longitudinal fibres (here tunica interna) is always present in the larger veins; it does not easily lacerate. The striated tunica and epithelium line them inside, in thinner or thicker layers.

Peculiar to the veins are their valves, valvulae, which are semilunar flaps of fibrous tissue, the free concave border of which is directed towards the heart, and which closes up the calibre of the vessel against the retrograde course of the blood. In small vessels (of one line diam.), single, in larger, two or three placed opposite each other, the valves are wanting in the abdominal, and chiefly in those veins which are protected against the pressure of the column of blood or the pressure of muscles on hard parts; they are, on the contrary, especially numerous in the inferior extremities. In the larger valves we find two layers, and fat. Moreover they are not duplicatures of the internal coat (see Lymphatics).

The veins generally take a straight course, are wider, and form more frequent anastomoses than the arteries, and carry (the pulmonary veins excepted) dark red blood, rich in carbon.

526. IV. Lymphatics, vasa lymphatica s. resorbentia,

form a system of vessels which must be considered as an appendage to the venous system. The tubes are narrow, thin-walled, flat, and provided with numerous valves. The commencements of the lymphatics probably form a rete, the tubes of which, like those of the capillaries, are of pretty equal size, and which are to be sought upon the surface and in the parenchyma of all organs. From the reteth minute tubules coalesce, generally pass in a straight course with the blood-vessels, form Plexuses, here and there convoluted, complicated ganglia, lymphatic glands, and lastly, one large trunk (or several), which opens into a great vein.

Those lymphatics are called chyle vessels, which arise inside the intestinal villi beneath the mucous membrane (of the small intestines), not with reteform, but with fine, club-shaped, closed tubes.

Structure. The walls of the lymphatics are transparent, more delicate, but more extensible, and stronger than those of the blood-vessels. In the larger trunks we also distinguish in them: a. an innermost layer of pavement epithelium; b. a coat of longitudinal fibres; c. a coat of circular fibres, with fasciculi of areolar tissue, which blends with the surrounding uniting and adipose tissues.

The numerous valves, generally arranged in pairs, consist of fibro-cellular tissue, with fibrous unyielding rings attached to the walls of the lymphatics, which produce contractions in the distended vessels, and therefore a knotted appearance.

The function of the lymphatics consists in the reception of the Plasma (Lymph) passing out of the blood-vessels, and of the nutritious fluid (Chyle) formed in the intestinal canal.
THE VESSELS.

They are, therefore, wanting in non-vascular parts, e. g. in the teeth, the crystalline lens, &c. They are probably not wanting in the substance of the brain, spinal cord, eye, internal ear, placenta, the membranes of the egg, and the umbilical cord, although they have not been yet found in them.

Lymphatic glands, glandulae lymphaticae s. conglobatae, are oval, generally flattened and reddish bodies, with a smooth, even surface, and one line to an inch in diam., lying generally dispersed in groups, especially in the popliteal and inguinal regions, the axillary fossa in the neck, at the roots of the lungs (black), in the mesentery, and in the liver (yellow), but never in the substance of organs. The larger are invested by a fibrous tunic, and contain (besides the numerous convolutions and ramifications of the lymphatics, besides the amorphous areolar tissue, blood-vessels and nerves) small cellular spaces, with granules (acini), and thus form, perhaps, actual glands, like the spleen, in which the lymph obtains a particular substance, which it prepares for the change into blood. Almost every lymphatic vessel passes into one of these glands and out again (vasa in- and efferentia).

A delicate capillary rote, investing the lymphatic glands and vessels very abundantly, serves to nourish them. Nerve filaments have been at least found in the lymphatic glands.

527. The heart, Cor, χαρδία,

A hollow conical muscle, lies, surrounded by a serous envelope (pericardium), in the centre of the thorax, between the lungs, above the diaphragm, behind the sternum and before the vertebral column, in rather an oblique direction from above downwards, from right to left, and from behind forwards.

It is composed of two halves, a right venous and a left arterial, each of which is again separated by a septum into two communicating portions. The heart contains four cavities, viz.:

the auricle (atrium) and the ventricle (ventriculus) of the right, and

the auricle and ventricle of the left side of the heart.

The cavities are lined by tunica vasorum communis [endocardium], the outer surfaces receive a continuation from one of the layers of the pericardium.

We have to observe of the Heart: a. the basis, that is, the superior and posterior part, at which point the vessels enter and from which they pass out, which lies behind the right border of the Sternum, before the eighth to the sixth dorsal vertebra, and is bounded by sulci circularis. b. The apex, apez s. micro, obtuse and slightly curved backwards towards the space between the sixth and seventh left ribs, presents a depression, vallecula, with two elevations. c. The superior, convex surface looks towards the sternum, the inferior flat rests upon the diaphragm. d. The
rounded lateral edges point out the direction of the heart from right to left. e. *Sulcus longitudinalis*, that is, a shallow groove which passes downwards from the basis as far as the apex in a curved course and indicates the septum between the right and left half of the heart. f. *Sulcus circularis*, a deep transverse groove which marks out the boundary between the auricles and ventricles.

**Measurements.**
- Length = 4½ inches,
- Breadth = 3½ inches,
- Thickness = 2½ inches,
- Capacity = 32 cub. inches.

**Weight.**
- In male = 9 ounces,
- In female = 8 ounces, 5 drachms.

After the thirtieth year it always rather increases.

1. The auricles, *atria*, are to be regarded as dilatations of the large veins, the blood from which they receive, and pour it (through *ostia venosa*) into the ventricles. They are situated at the most external portion of the *basis cordis*, are nearly quadrangular, two inches high and broad, provided with thin walls, and a blind, pocket-like appendage, auricle, *auricula cordis*, and separated from one another by a partition (*septum atriorum*).

The anterior surface is concave, without a longitudinal groove, covered by *Aorta* and *Art. pulmonalis*.

The posterior surface is convex, presents a longitudinal groove (near it, to the right, the opening of the *ven. cava infer.*, underneath, that of the *ven. magn. cordis* [coronary vein], and is separated by the aorta and œsophagus only from the vertebral column.

The superior extremity looks backwards and to the right, lies under the *bifurcatio tracheae*, presents a longitudinal groove, to the right side of which lies the opening of *Ven. cava superior*, to the left are seen the four openings of the *four pulmonary veins*.

2. The ventricles, *ventriculi cordis*, give origin to their arteries, and force the blood which they have received from the auricles into them. They are situated below the *sulcus transversus*, form the middle and the apex of the heart, and are provided with thick external walls, and a partition (*septum cordis*), which separates the one from the other. Their anterior surface, particularly the part which lies to the right of the longitudinal groove, looks towards the sternum, and lies, in large hearts, immediately behind it.

**528.**

The Cavities.

1. *Atrium dextrum*, right auricle, caval dilatation, lies behind the third to the sixth costal cartilage and the body of the sternum, rather covered by the anterior border of the right lung. From its superior angle the right appendix passes inwards and upwards, covering the commencement of the aorta. Its
cavity is formed by three walls, an anterior convex, an internal (the septum), and a larger posterior, concave. It presents in the adult three, in the foetus four openings.

a. The crescentic opening of the superior cava, separated by a fasciculus of muscle from the appendix on the left, from the inferior cava on the right, without valves, looks downwards and rather backwards.

b. The crescentic opening of the inferior cava, larger than the former, close to the septum, not vertical from below upwards, but directed obliquely (at a right angle to the vein), with the half-moon-shaped valvula Eustachii on the anterior border, which completely closes the opening in the embryo only. The free concave border of the Eustachian valve looks upwards, the attached convex downwards.

c. The opening of vena magna cordis [coronary vein] lies before the last described, separated from it by the Eustachian valve; is closed by a thin, crescentic valve, valvula Thebesii, the superior extremity of which continues into the inferior of the valv. Eustach.

Several small foramina Thebesii are found below the opening of the superior cava, but they are not to be considered as the openings of smaller cardiac veins.

d. Foramen ovale, in the embryo, is a longitudinal opening in the posterior inferior part of the septum between the auricles. At birth is already found in its place a smooth or wrinkled, but thin layer, fossa ovalis, bordered above and before by a crescentic, fleshy protuberance, isthmus Vieussens, the inferior extremity of which passes into the Valv. Eustachii. A depression with a small foramen is frequently found in the oval fossa behind the isthmus, as the remains of the oval foramen.

Valvula foramin. ovalis (of the foetus) is the membranous portion spread out in the circle of Vieussens, the continuation of the inner coat of the left circumference of ven. cava super., whilst the valvula Eustachii proceeds from the right circumference.

Tuberculun Loweri, the elevation at the upper part of septum atriorum, between the mouth of v. cava sup. and fossa ovalis, which directs the stream of blood from v. cava sup. upon the posterior inferior circumference of the right auricle, and that of v. cava infer. forwards, and to the right towards the right appendix.

2. Right ventricle, ventriculus dexter., pulmonary ventricle, at the anterior inferior part of the heart, directed obliquely to the left and downwards from its auricle, does not reach the extreme apex. Its internal wall (septum ventricularis,) is convex, and on its lower half like trellis-work. The anterior and inferior walls are concave, thin and loose, and beset with an interlacement of fleshy fasciculi (mm. papillares), as they are found, also, particularly developed in the cavities of the auricles. At its base the two following openings are found:

a. Right auricular-ventricular opening, ostium venosum, at the posterior, right part of the base of the ventricle, is elliptical (from before to behind), six-
teen to eighteen lines long, twelve lines broad, and connects the auricle with the ventricle. From a fibro-cartilaginous ring, which encircles it, the inner membrane (endocardium) forms a three-curtained, annular valve, valvula tricuspidalis, τρικυπτήριον, which projects with its smooth surface into the auricle, with an uneven surface, produced by small tendinous cords, into the ventricle. The cords are partly attached to the free border, partly to the surface of the valve, and they are so arranged that the latter becomes stretched when their muscular fasciculi contract.

b. Arterial opening, ostium arteriosum, is situated at the anterior, left part of the base of the ventricle, is separated from the auricular opening by a projecting edge of muscle; it is circular, and surrounded by three semilunar valves, valva semilunares, sigmoideae, which above form open pouches, and close the ventricle against the pulmonary artery, as they lie close to one another, and nodulus Arantii (a thickening in the centre of the free C-shaped margin of each pouch), also shutting the triangular space yet remaining open.

3. Left auricle, dilatation of the pulmonary veins, atrium sinistrum, is placed higher than the right, concealed behind Art. pulmonalis, Aorta, and left lung. The left appendix, longer and smaller than the right, is placed on the anterior surface, close to Art. pulmonalis, and its conical cavity opens with a circular mouth into the auricle. The cavity of the left auricle is narrower than the right, and presents, (besides the foramen ovale and the ostium venosum) at its upper part the four mouths of the pulmonary veins, two on either side.

4. Left ventricle, Aortic ventricle, ventriculus sinister, is situated further behind than the right, towards the left and above, is conical (the right being pyramidal), convex, its cavity oval; the apex reaches farther down; the walls are three to four times thicker; two openings.

a. Ostium venosum, between auricle and ventricle; elliptical, large (quite close to the following opening, external to it, so that the valves of the two meet together), is closed by a two-curtained valve, διπλόκυπτος, valvula Mitralis. The tendinous cords (chordæ tendineae) are attached to the borders of the valve, and are stronger than in the right ventricle.

b. Ostium aorticum is of the same character as the arterial opening in the right ventricle, closed by valv. semilunares [more developed].

Situation. The heart lies for the most part in the left half of the chest, one inch to an inch and a half to the right, and three to three inches and a half to the left of the central line (in the Embryo up to the third month vertical); its highest point (the left auricle) corresponds to the fifth dorsal vertebra; its deepest part (the inferior border of the right heart) to the ninth to tenth dorsal vertebra; the apex to the space between the fifth and sixth rib cartilage; the mouth of the pulmonary artery to the third, that of the Aorta to the space between the third and fourth left rib cartilage, close to the border of the Sternum. Behind the Sternum and the pericardium we meet in the following order from before backwards with: 1. the right ventricle; 2. the pulmonary artery; 3. the right auricle; 4. the left ventricle; 5. the aorta;
6. the left appendix; 7. the right auricle; 8. the superior cava; 9. the left auricle; 10. the pulmonary veins (Blandin).

Structure. The chief mass of the heart consists of round and flat muscular bands (transversely striated fibres), which are throughout separated into two halves, lying evenly close to one another on the outer surface, projecting irregularly on the inside of the cavity, as they are either firmly attached at both extremities (fleshy bands, trabeculae carnea [musculi pectinati]), or the free pointed extremity is turned to the basis of the heart (mm. papillares [car- nae columna]). In the ventricles the muscular layer is as thick as eight lines; at places in the ventricles extremely thin. Fibro-cartilaginous filaments separate the auricles as well as the ventricles (in the septa) from one another, and the auricles from the ventricles (in the circular groove). The outer covering is formed from the internal layer of the pericardium, and attached by fibro-cellular, containing adipose tissue. Fat is found, particularly in aged (also in lean) individuals on both sides of the transverse groove, and along the coronary vessels as far as the apex, especially on the right half of the heart. The internal membrane, endocardium, the immediate continuation of the internal coat of the large venous trunks, lines the cavities of the auricles and ventricles, forms folds at the passage into the latter and in the great arterial trunks, between which two layers, areolar tissue, and fibro-cartilaginous filaments, are found.

These folds projecting into the cavities are the Valves, which are free in the mouths of the arteries (as valv. semilunares), in the mouths of the ventricles (as valv. bi- and tricuspidates), are connected by tendinous filaments with the musc. pectin. and column. carnea.

The internal membrane of the heart is thickest in the auricles.

Thickness of the walls:

- Left ventricle, in male, \(5\frac{1}{4}\) Par. lin.; female, \(4\frac{1}{4}\)
- Septum of ventricles — 5 — — 4\(\frac{1}{4}\)
- Of right ventricle — 2 — — 1\(\frac{3}{4}\)

The cavities and openings of the right half of the heart are wider than those of the left.

529. Vessels and nerves of the Heart.

Arteries: coronaria cordis dextra and sinistra from aorta ascendens.
Veins: coronaria cordis magna and media.
Lymphatics: accompany the arteries and pass into the lymphatic glands above and behind the arcus aorta.
Nerves: plexus coronarii accompany the arteries and are then lost in the tissue of the heart, arising from plex. cardiacus magnus, and these from Nn. cardiaci of N. Vagus and sympathetic.

530. The Pericardium,

is a fibro-serous, perfectly closed sac, in which the heart has been so inverted that it is wrapped round as far as its base, and is covered with a serous mem-
brane firmly attached to it. The heart lies also on the surface, not in the cavity of the sac, and is loosely surrounded by the non-inverted portion of the pericardium, so that it can move freely therein. The inverted, internal layer of the pericardium passes over the base of the heart, since it leaves uncovered a narrow stripe only of the left auricle, on the great vessels (ven. cava super., aorta and Art. pulmonal.) into the free, external layer, and surrounds the vessels like a sheath. To the external surface of the free layer we find a thin fibrous lamina firmly attached, which at the anterior inferior part is united with the tendon of the diaphragm (three and a half inches transversely, one to two inches from before to behind, close to the Sternum) and also passes over upon the vascular trunks. The cavity of the pericardium secretes a humid vapour, which in disease, or after death, becomes fluid, as lig. Pericardii; its walls are smooth.

The shape of the pericardium is a cone, the base of which lies upon the speculum Helmontii, of the diaphragm, the apex looking upwards (to the great vessels). Its anterior surface is covered by pleura, and touches the sternum with only a small rhomboidal piece covered by areolar tissue (corresponding to the right half of the heart). The posterior surface is separated from the vertebral column by the mediastin. post. with esophagus, Aorta, duct. thoracici, &c. At the sides the Nn. phrenici and Artt. phrenic. sup. pass between pericardium and pleura.

Vessels: Artt. pericardiacæ, or branches of aorta descend., mammar. intern., phrenicae super., bronchiales, thymica and esophagæa.

Veins: pass with the arteries, and open partly into Ven. azygos.

Lymphatics: go to the glands on the V. cava superior, and into the ductus thoracici.

Nerves: have not hitherto been found.

531. Circulation, course of the blood, Circulatio sanguinis, differs according as to whether the lungs (after birth) effect the change of the dark red blood into the bright red, or the placenta (before birth) is the medium for the exchange of the consumed, for a blood containing nutritious substances.

532. I. Circulation after birth.

It is divided into two sections:

1. Smaller circulation, course of the pulmonary blood.—The venous blood collects from the vv. cave and coronaria cordis in the right auricle of the heart, passes into the right ventricle, thence into the pulmonary artery and lungs. From the capillary rete of the lungs it comes forth as arterial blood, and returns through the pulmonary veins to the heart, but to the left auricle.

2. Greater circulation, course of the blood through the body.—Pressed by the left auricle into the left ventricle, thence into the aorta, the bright red blood streams through all arteries (with the exception of the pulmonary),
becomes changed into the dark red blood in the capillary rete of the body (in opposition to the lungs), passes through the veins (with the exception of the pulmonary) and returns through the vv. cavae and coronariae cordis (see before) to the right auricle.

533. II. Circulation of the mature foetus.

1. From the right auricle the blood passes out, a. of v. cava inf. through the foram. ovale (partly) into the left auricle (partly into the right ventricle), hence into the left ventricle, aorta ascendens, truncus anonymus, carotis and subclavia; b. the blood of v. cava superior into the right ventricle, art. pulmonalis and through the ductus arteriosus Botalli into the aorta descend. (in great part) into two artt. umbilicales and in these through the umbilical cord into the placenta.

2. From the Placenta the blood passes back through the vena umbilicalis into the belly of the foetus; goes along through a branch of v. umbilicalis to the ven. porta, through another, ductus venosus Arantii, to the v. cava infer. into which also the blood of the liver and of the inferior half of the body empties itself.

534. A. The vessels of the small circulation,

namely, Art. pulmonalis, which carries the blood from the right half of the heart (venous blood) into the lungs; and

Vvæ pulmonales, which carry back into the left half of the heart the blood which having passed through the Art. pulmonalis to the lungs has been changed into arterial blood by the influence of the inspired air.

535. 1. The pulmonary artery, artelia pulmonalis s. venosa, arises above and before from the right ventricle (thirty-one and a half to twenty-nine and one third lines wide), is situated at the commencement before, then to the left of the aorta, since it inclines to the posterior and right concave side of this, between the auricles of the heart, afterwards before the left auricle, it finally divides after a course of one and a half to two inches into two branches which embrace the arch of the aorta, enter into the lungs, and after fine ramifications, anastomosing with the Artt. bronchiales, they form a capillary rete round about the vesicles of the lungs, from which the pulmonary veins arise.

a. The right branch, sixteen to eighteen lines long, and larger than the left, passes away towards the right and behind aorta ascendens and V. cava superior, before the bronchus dexter, above the superior right pulmonary vein, and enters with three branches into the three lobes of the right lung.

b. The left branch, one inch long and narrower, passes away to the left and backwards, before the aorta descendens and bronchus sinister (separated from the last, sometimes by art. bronch.); above the left superior pulmonary vein and enters with two branches into the two lobes of the left lung, where the pulmonary veins are situated before it.
In the embryo, a canal, ductus arteriosus Botalii passes upwards obliquely to the left from the place where the pulmonary artery divides into its two branches, to the concavity of arcus aortae, opposite to the art. subclavia sinistra, which at a later period changes into the ligam. arteriosum (one to two lines thick, four long).

536. II. Pulmonary veins, four, Vene pulmonales s. arteriosae, arise from the capillary vessels of Art. pulmonalis and Artt. bronchiales, pass out at the roots of the lungs before the arterial and bronchial branches, two, as well as from the right (at the commencement three), as from the left lung, and sink inside the pericardium behind V. cava super. on the right side and Art. pulmonalis on the left, into the superior part of the left auricle. They possess no valves. The capacity of all four together, is inferior to that of the pulmonary arteries.

Vessels of the large circulation, Arteries.

537. Arteria Aorta, the great artery of the body, arises above and before from the left ventricle (between septum ventricul. and valv. mitralis), where its root (bulbus aortae) corresponds to the three semilunar valves, presents internally three pouch-shaped expansions (sinus Valsalvae), and externally three elevations (tubera). At the origin circular (in the male thirty-one, in the female twenty-eight Paris lines wide), farther on elliptical, anteriorly convex.

538. Course. It ascends from left to right (aorta ascendens), at the same time a little curved, between Art. pulmon. and V. cava superior. It now bends suddenly backwards, and passes almost horizontally (above the ramus dext. art. pulmonal.) from right to left, and from before backwards, to the left side of the third dorsal vertebra (arcus aortae); whence it descends, after another curvature, vertically on the left side of the vertebral column, through the thorax (aorta descendens thoracica), and in the abdomen before the centre of the bodies of the vertebrae, as far as the fourth lumbar vertebra (as aorta desc. abdominalis). Here it divides into its two terminating branches, arteriae iliacae.

539. Aorta ascendens, the ascending Aorta, two to two and a half inches long. Position: surrounded by the pericardium; below, behind Art. pulmonalis, which winds like a screw from before to the left; behind: ramus dexter art. pulmonalis; to the right above: V. cava superior; to the right below: the right auricle.
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Branches:

1. Small twigs for Art. pulmonalis and V. cava superior.

2. Art. coronaria cordis dextra cardiaca, the coronary artery, arises from the anterior surface, close above the tuber anterius bulbus aortae; is thicker, passes away behind Art. pulmonal., in the sulcus transversus, on the right half of the heart towards the right and behind, and then in the longitudinal groove as far as the apex of the heart. Branches: for the right half of the heart, bulbus aortae and Art. pulmonal.

3. Art. coronaria cordis sinistra, arises above tuber posterius; passes off into two branches.
   a. ramus anterior s. descendens on the anterior surface of the heart in the longitudinal sulcus, reaching downwards as far as the apex, and sending branches to the right and left ventricles.
   b. Ramus posterior s. circumflexus passes on the left to the posterior surface of the heart in the sulcus transversus, and sends branches to the left half of the heart.

540. Arcus Aortae, the arch of the Aorta.

Situation: oblique from before, backwards, and from right to left (one and a half to one inch long).


2. Behind and to the right: the trachea, the commencement of bronchus sinister, the æsophagus, ductus thoracicus N. recurrents, vertebral column and lymphatic glands.

3. The highest point of the convexity directed upwards is situated about ten to twelve lines below manubrium sterni.


   Branches: from the concavity only very small branches to the bronchi (bronch. superr.), pericardium, thymus; from the convexity: Art. anonyma [brachio-cephalica], art. carotis and subclavia sinistra.

1. Anonyma s. truncus anonymus [s. brachio-ceph.], the common trunk of Art. carotis and subclavia dextra, is thick and one inch (to two) long; arises the farthest upwards, to the right and before from the aortic arch; is situated behind the manubrium sterni and vv. jugulares communes, a little before, then to the right of the trachea; it describes with the Carotis sinistra an acute angle. Sometimes also the Carotis and subclavia sinistra, or even both carotides and subclavia arise from a common trunk.

2. Carotis communis sinistra, arises from the centre of arcus aortae to the
left and behind the *anomyma*, is longer than the *Carotis communis dextra*, and passes obliquely before the *trachea* and to the left of it and the thyroid gland.

3. *Subclavia sinistra*, arises the farthest backwards and to the left, from the *arcus aorta*, is longer, rather thicker, and ascends in a rather straighter direction than the *subclavia dextra*, to the left and externally.

541. A. *Carotis communis*, the common carotid artery.

Origin: the right arises from the *A. anonyma*, the left close to *A. subclav. dextra*; on the right close to the *trachea*. The left from the centre of *arcus aorta* itself. Course: both carotids ascend obliquely upwards and outwards, from the chest into the neck, and terminate at the superior border of the *larynx* with an enlargement, so that they diverge from below (where *trachea* and *oesophagus*) upwards (where *larynx* and *pharynx* lie between them).

Situation: 1. In the chest.

a. The right Carotis commences only very shortly before the superior border of the *Manubrium sterni*, from which it is separated by *ven. jugular. comm. sinistra*.

b. The left, about one inch before its exit, lies behind *V. subclavia sinistr.* *mm. sterno-hyoidi* and *thyreoidei* and *sternum*; before *trachea* and *oesophagus*, *Artt. subclavia* and *vertebr. sinist.*

2. In the neck: in a sheath of *fasc. cervicalis*; the inferior half of the anterior surface covered by *mm. sterno-thyroidei, sterno-mastoidei*; the centre by the tendons and the superior belly of *m. omo-hyoides*; the superior half in the *trigonum cervicale superior* only by *platysma-myoides*. The posterior surface is separated from the vertebral column by *mm. rectus capitis* and *long. colli*, and (below) *Ven. thyreoidea inferior*. Internally are situated: *trachea, oesophagus, larynx*, and *thyroid* gland. Externally: *V. jugularis interna*. Between these and the *Carotis: ram. descend. N. hypoglossi* (the farthest forwards), *N. vagus* (inwards), *N. Sympathicus* (externally and behind). The first passes downwards only to the centre, the two last vertically along the entire cervical portion of the carotis.

Branches pass off from the *Carotis communis* as exceptions only, as: *Art. thyroidei inf.* (and *media*); but it divides into two terminal branches, into *Carotis externa* and *interna*.

542. I. *Carotis externa s. facialis*.

Origin: on an elevation with the superior border of the *larynx*, internal to and before *Carotis interna*. Termination: at the neck of *Condylus mandibulae*. Course: in adult slightly undulating;
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in the *trigonum cervicale superius* vertically as high as the *m. digastricus*: then backwards and outwards as far as the angle of the inferior jaw; then again vertically along the posterior border of *ramus mandibulae*. Circumference: inferior to that of the *carotis interna* (in children); length, two and a half to three and a half inches. Situation: at the commencement covered by *V. facialis commun.*, and *platysmam.*, only; then behind *mm. digastricus* (the posterior belly), and *stylo-hyoideus* (before *m. styloglossus*), and *n. hypoglossus*; lastly, within the *Parotis* (and quite above between Parotis and lower jaw).

Collateral branches; three anterior: *A. thyreoidea super.*, *lingualis maxillar. extern.* s. *facialis.*
2 Posterior: *Aa. occipitalis* and *auricularis.*
1 Internal: *A. pharyngea.*
2 Terminal branches: *Artt. temporalis* and *maxillar. interna.* The three anterior and the internal arise below the *m. digastricus*; the two posterior before the entrance into *Parotis.*

543. The anterior branches of the *Carotis externa.*

1. *Thyreoida superior*, the superior thyroideal artery supplies the Larynx and thyroid gland with blood.

Or.: close above (sometimes at) the point of division of the *carot. commun.*

Course: at first upwards, directly afterwards downwards, several times curved to the superior cornu of the thyroid gland. Position: at first only behind the skin, then behind *mm. omo-, sterno-, hyoideus*, and *sterno-thyroideus.*

Branches:

a. *Art. laryngea superior*, the superior laryngeal artery, arises, sometimes, from the *carotis externa.* Course: transverse between *m. hyo-thyroideid* and *memb. hyo-thyroideid*, perforates the last (with *N. laryng. sup.*) gives a superior branch to the *Epiglottis* and a descending for *m. thyreo-arytenoid*, and the mucous membrane.

b. *Art. laryngea inf. s. ram. cricothyreoideus* (Cruveilhier), arises from the internal terminal branch, passes transversely on the inferior border of the thyroid cartilage, anastomoses with that of the other side, and ramifies on the mucous membrane and the muscles of the *larynx.*

c. *Ram. sterno-mastoides*, arises under a, and passes away downwards over *carotis communis* on the posterior surface of *m. sterno-cleido-mastoideus.*

d. *Rami thyreoidi*, three terminal branches. The first passes between thyroid gland and trachea, the second along the external border, the third in the central line before the thyroid gland.

2. *Lingualis*, the lingual artery. Origin: on a plane with the great cornu
of the os hyoides. Course: obliquely upwards, then along the superior border of the hyoid bone, forwards and inwards, and thence into muscles of the tongue from behind forwards. Termination: at the tip of the tongue as Art. ranina. Position: commences below m. digastricus, stylo-hyoid, and n. hypoglossus; on the os hyoides between m. hyogloss, and constrictor pharyng. medius; in the tongue between m. genioglossus and lingualis (close to n. lingualis.)

Branches:

a. Ram. hyoideus, passes away transversely above the hyoid bone, anastomoses with that of the other side, between m. genio-glossus and genio-hyoideus.

b. Art. dorsalis linguae, small, arises on a plane with the cornu majus oss. hyoid, passes upwards to the border of the tongue and to arcus glosso-palatinus, forwards and inwards, always close under the mucous membrane, gives branches to the epiglottis, mm. hyo-, and stylo-glossus; lastly, the skin in the region of papillae calyciformes.

c. Art. sublingualis, stronger than the former, passes between m. mylohyoideus and the mucous membrane, upon the floor of the mouth forwards, along the inferior border of glandul. sublingual., external to the duct. Whartonianus, supplies these parts, and terminates with a branch above the frenulum and a branch for the foramina incisiva at the chin.

d. Art. ranina s. profunda, the terminal branch, penetrates above into the thickness of the tongue, between m. geniogloss. and lingualis (half an inch distant from the back of the tongue), and runs along to the tip, as it gives off internal, external, and superior branches for the muscles and papillae.

3. Maxillaris externa, s. facialis.—large. Or.: rather higher than lingualis, covered by m. digastric. and stylohyoideus. Course: very serpentine; at first upwards to the angle of the lower jaw, then horizontally forwards in the fossa on the outer surface of gland. submaxillaris; towards the middle of the horizontal ramus of the lower jaw it turns over it into the face, passes obliquely upwards to the mouth, nose, and internal angle of the eye, and anastomoses with Artt. ophthal. and infraorbitalis. Position: at first between gland. submaxill. and parotis, along the basis of the lower jaw: externally the skin and lymphatic glands, internally the gland. submaxillaris; in the face on the anterior border of m. masseter, below covered by the skin (with m. risorius), above the angle of the mouth by the zygomatici and levatores labii, lastly, by much fat and skin.

544. Branches of the horizontal portion.

a. Art. Palatina ascendens (arises sometimes from Corot. externa or pharyngea ascendens), ascends behind mm. styloidei, to the side of the pharynx, ramifies in the Tonsils (Art. tonsillaris), the soft palate and its arches, anastomoses with A. pharyngea ascendens.
b. *Art. submentalis* passes directly forwards, along the (internal) inferior border of the lower jaw, between *mm. mylohyoid.* and *digastricus,* inclines on the external border of the last (*vent. anter.*) upwards, supplies the skin and muscles of the chin, and anastomoses with branches of *A. dentalis inferior* and *sublingualis.*

c. *Rami glandulares,* 3. and 4. small, supplies *gl. submaxillar.*

d. *Ramus pterygoideus,* small, for *m. pteryg. internus.*

Branches in the face. a. External, supplying the muscles and skin of the cheek; the most distinct are, *ram. massetericus* and *buccinatorius.*

b. Internal.

1. *Art. coronaria s. labialis inferior,* arises close under the angle of the mouth, passes between the muscular and glandular layer, not far from the free edge of the under lip, and anastomoses with that of the other side.

2. *Art. coronaria s. labialis superior,* arises at the angle of the mouth, under *m. levator labii supe.*, passes to the upper lip like 1., and gives off from the middle line:

   a. *Art. septi mobilis nasi,* which passes to the cartilaginous nasal septum, vertically upwards, and then horizontally under the *sept. mobile.*

   b. *Art. pinnalis s. alaris nasi,* at the posterior border of the nasal openings, anastomoses with:

3. *Art. angularis s. nasalis lateralis,* passes upwards from the angle of the nose to the internal angle of the eye, and there unites with *art. ophthalmica* in the *art. frontalis.* It gives the following branches:

   a. *Rami pinnales,* 1. at the superior, concave border of the nasal pinna;

   2. enters into the nose.

   b. *Rami dorsales,* on the back of the nose.

   c. *Rami palpebrales,* on the inferior eyelid.

The most remarkable anastomoses of *Art. maxillaris externa* are: a. with *A. dentalis inferior;* b. with *A. maxillar. intern.;* c. with *A. ophthalmica.*

**545.** The posterior branches of *Carotis externa.*

4. *Occipitalis,* the occipital artery,—smaller than 1. and 3. Origin: *Art. maxillar. extern.* or *lingualis,* opposite, sometimes close under, the *Parotis,* covered by *m. digastricus* and *N. hypoglossus.* Course: oblique upwards and backwards, above *proc. transv. atlantis,* under *incisura mastoid.* horizontally backwards, very tortuous. Position: deep, separated in front by *m. stylohyoid.* from *art. auricular. post.* and *carot. externa.* The horizontal portion between *m. rectus lateral.* and *complexus,* then between *obliquus super.* and *splenius.* Divided under *m. splenius* into an external and an internal ascending branch.

Collateral branches: a. *rami cervicales* consist of: 1. for *m. sterno-cleidom.;* enters at the internal surface into the superior part of the muscle, turns round the loop of the *n. hypoglossus.* 2. *Ram. descendens,* between *m. splenius* and *complexus,* divides among the superior layers of the cervical muscles (*m. splen.*
trachelomast., complex., biventer cervicis, cucullaris), and in the deeper (mm. recti and obliqui).

b. Art. stylomastoidea (s. Art. auricular. post.)
c. Art. meningea posterior s. mastoidea, enters through foram. mastoideum (or f. occipitale) for the posterior part of the dura mater.
d. Ram. parietalis—frequently, enters through for. parietales to sin. longit. superior. The two ascending terminal branches reach as far forward as the vertex, and are situated between galea aponeurotica and the skin.

5. Auricularis posterior, the posterior auricular artery, supplies the external and internal ear, the Parotis, narrower than four, arises sometimes in common with it or from it, generally one inch high above it. Course: upwards, in the direction of and external to proc. styloïd. at first behind and between m. digastric. and parotis; then covered by retrahentes auricular., and divides at the anterior border of proc. mastoideus into two branches, ram. mastoideus and auricularis.


b. R. glandulares for the Parotis.
c. Art. stylo-mastoidea, enters into the stylo-mastoid foramen, traverses the canalis Fallopia, meets with a branch of Art. meningea media anastomosing at hiatus can. Fallop., gives branches to: cellulae mastoid., Tympanum (Art. tympanica superior), Memb. tympani (forming on this with a branch of Art. temporalis the plexus tympanicus), and to the cochlea (through fenestra rotunda).

Terminal branches.

d. Ramus occipitalis s. mastoideus ascends backwards beneath the skin, passes with a horizontal branch inwards along the superior border of m. sterno-cleidom. and splenius; with an ascending to the external border of m. occipitalis as far as the vertex; supplies mm. retrahentes and skin; anastomoses with art. temporal. and occipitalis.

e. Ram. auricularis s. anterior, passes upon the posterior surface of the external ear, with a superior and an inferior branch; the last supplies the lobule of the ear, passes in the groove between helix and anthelix, as it perforates the concha.

6. Pharyngea ascendentens, the ascending pharyngeal artery—the smallest branch of carotis externa. Or: from the posterior side of the carot. externa, close above the place of division of carot. communis; or, on a plane with A. lingual. Course and position: vertically upwards, at first between carotis externa and interna, then behind the last in the triangular space between pharynx and m. pterygoideus internus; divides into two branches, art. meningea post. and ram. pharyngeus. Collateral branches: ram. pharyngeus inferior, which passes transversely inwards, in ascending and descending branches, and anastomoses with a. thyreoid inferior.
Terminal branches.

a. *Art. meningea posterior*, ramify in the *gangl. suprem. N. sympathici*, *Nn. vagus*, *glossopharyng.*, *hypoglossus*, and enters through *foram. jugulare* to the *dura mater* in the *fossa occipital. inferior*; gives a branch which anastomoses with *Art. cervical. ascend*.

b. *Ram. pharyngeus*, continuation of *pharyng. ascend*. Course: before the *carotis interna*, and divides at the *basis cranii*, behind the *pharynx* into several branches, which are reflected and terminate on the *tuba Eustachii*, and in the muscles of the *pharynx*.

546. Terminal branches of the *Carotis externa*.

7. *Temporalis (superficialis)*, the temporal artery. Origin: behind *collum condyli* of the lower jaw and before the *external auditory meatus*. Course: directly upwards, before the ear, over the root of the *process. zygomatic* of the temporal bone, then in a serpentine direction as far as the centre of the temporal region (or one inch above the *zygoma*) where it divides. Position: at first upon the maxillary articulation covered by *Parotis*, then by the skin and *fasc. parotidea*, only, above *fascia temporalis*.

Anterior collateral branches.

a. *Transversa facei*, arises (frequently from *carotis externa*) immediately at the *collum condyli*, passes transversely over this and *m. masseter*, covered by *Parotis*, underneath the *zygoma* (inch and a half) and above *ductus Stenonius* (parallel with it) on to the face; sends a branch for the maxillary articulation, for the *duct. Stenon.*, several *r. masseterici* and ramifies on the anterior border of *m. masseter* into cutaneous branches for the cheeks into muscular branches for *mm. zygomaticus major, orbicular. palebr.*, *levat. labii super*.; anastomoses between *artt. temporal. and buccalis, infraorbital. and maxillaris externa*.

b. *Ram. orbicularis*, not always present, arises above the *zygoma*, placed behind *m. orbicularis*, supplies these and anastomoses with *art. palpebral. super.* (see *Art. ophthalm.*)

Posterior branch.

c. *Auriculares anteriores*; the inferior for the lobule of the ear; the central for the auditory meatus; the superior for *helix, m. attrahens* and *attollens auriculæ*.

Internal branch.

d. *Art. temporalis media (s. profunda)*, arises close above the *zygoma*, enters into the *m. temporal*. through the deep layer of *fasc. temporal*. and anastomoses with the temporal artery of *Art. maxillaris interna*.

Terminal branches.

e. *Ram. frontalis s. anterior* passes in a curve towards the forehead, and anastomoses with *art. frontalis, supraorbital. and ram. frontal. of the other side.*
f. Ram. occipitalis s. parietalis, larger, passes upwards to the vertex and anastomoses with Artt. auricular., occipitalis and ram. frontalis.

8. Maxillaris interna (s. facialis profunda). Origin: behind the collum condyli of the lower jaw. Course: horizontally forwards, inwards and rather upwards to the tuber. maxill. super., curves forwards and sinks into fossa sphenomaxillaris, where it terminates as sphenopalatina. Position: at first close behind the condylus and before proc. styloideus; between mm. pterygoid. extern. and internus (external to n. dentalis and lingualis), then between pterygoid. extern. and temporalis.

547. Collateral branches: A. Arising in the neighbourhood of the Collum condyli.

a. Auricularis profunda ascends directly, divides into branches for the maxillary articulation, the external auditory meatus (through some foramina in the bones) and the inferior border of the memb. tympani.

b. Tympanica (inferior), the tympanic artery, frequently from Art. temporalis, small; supplies the external auditory meatus, the maxill. articulation, and enters through fissura Glaseri into the tympanum, on the anterior wall of which and the memb. tympani it anastomoses with tympanica superior (s. stylo-mastoid).

c. Meningea media s. spinosa, ascends vertically behind collum condyli and m. pterygoid. extern. through foram. spinosum into the cranium, becomes horizontal and is placed, divided into an anterior and posterior branch, between dura mater and the bones of the skull; the anterior ramus ascends from the inferior angle towards the external angle of the fiss. orbital. super., and thence as far upwards as the sagittal suture; the posterior ramus ascends on the pars mastoide. of the temporal bone as far as the posterior inferior angle of the parietal bone, and as high as the sagittal suture. Small ramuli pass out of the skull.

1. Ramul. petrosus, through hiatus into canal. Fallopii to the nerv. facialis and Art. stylomastoid.

2. Ramuli for nerv. trigeminus.

3. Ramul. for m. mallei intern. through the semi-canal for this.

4. Rami temporales for the great wing of the sphenoid bone, anastomoses with the Artt. temporales profunda.

d. Dentalis s. alveolaris inferior, arises close to the last artery, passes downwards and between m. pterygoid. intern. (or rather lig. maxillare intern.) and the ramus of the lower jaw through foram. maxillar. posterius, and passes through the canal. alveolar. infer. as it gives off a twig in the interior of this to each tooth, and many small ones for the diploe of each alveolus. Art. mylohyoidea passes from foram. max. post. to the inner surface of ramus maxillar. in a groove with nerv. mylohyoid downwards to m. mylohyoide. Through foram. mentale a larger branch passes out as art. mentalis from the canal, and anastomoses with art. submentalis and coronar. inferior.

e. Temporalis profunda posterior passes between m. pterygoid. extern. and
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temporal. upwards, to the posterior border of the last, and ramifies in these and the periosteum; anastomosing with Artt. temporal. profund. anter. and media, and gives, sometimes, Artt. masseterica and buccinatoria.

f. Masseterica, small, passes over incisura semilunar. outwards to the masseter m.

g. Pterygoideæ for mm. pterygoidei; some from the Art. c. and e.; pterygoïd. extern. gives off, sometimes, a meningea parva through foram. ovale.

548. B. Arising in the neighbourhood of the tuber

Maxillae superioris.

h. Buccinatoria, small, passes in a serpentine course from behind forwards, between the ramus of the lower jaw and m. pterygoïd. intern., and is lost in m. buccinatorius.

i. Temporalis profunda anterior, passes to the anterior border of m. temporalis (behind the malar-sphenoidal suture) upwards, is lost in the last, and sends branches into the fat of the orbit.

k. Dentalis superior (posterior) passes downwards in a very serpentine manner to the posterior surface of the upper jaw, below proc. zygomatic. upon the anterior surface of the former, gives branches to the gums, periosteum, and the superior alveolus, and enters, divided into several branches, through foramn. alveolaria post. into the upper jaw for the (superior) molar teeth. Separate branches pass to the mucous membrane of the antrum.

l. Infraorbitalis, arises behind fissura orbital. infer., and enters immediately into the canal. infraorbitalis, passes through it, and appears at its anterior opening on the face, where the artery ramifies in branches for the exterior and mucous membrane of the cheeks, gums, the corner and incisor teeth, and for the nose, and anastomose with Artt. maxillaris externa and facialis transversi.

Branches out of canalis infraorbitalis.

1. Ram. orbitalis, passes with a branch forwards to the inferior eyelid; with another inwards for ram. palpebral. infer. of art. ophthalmo.

2. Ram. dentalis anterior, passes downwards between the plates of the upper jaw (anterior wall) to the roots of the cuspids and incisor teeth.

549. C. Arising in the fossa sphen-o-maxillaris.

m. Vidiana, passes backwards through canal Vidianus to the superior wall of the pharynx and to the tuba Eustachii; arises also from the following (as pharyngea suprema).

n. Pterygo-palatina s. palatina superior, internal and below the former, descends through can. pterygo-palatinus behind the upper jaw, through and out of foram. palati. anterius [posterius] and passes in a serpentine course close to the alveolus forwards on the inferior surface of the palatine vault, until, forming a curve, it meets with the one of the other side at the canal. incisivus. Quite above it gives off

1. Ramuli palatini; going through canales palatini post. to the soft palate.

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2. Branches for the glands and mucous membrane of the palatine vault.
3. Ram. nasalis enters through can. palatinus anter.; into the nasal cavity.
   o. Art. sphenopalatina s. nasalis posterior, the terminal branch of Art. maxill. intern., passes, curved, transversely inwards through foram. sphenopalatinum into the nasal cavity, and divides behind the superior nasal chamber into:
   1. Art. septi narium s. nasopalatina, which passing obliquely inwards, downwards, and forwards, between the nasal septum and mucous membrane, it divides into a superior and inferior branch, and anastomoses with art. palat. super. in the canalis incisivus.
2. Art. nasalis posterior, enters behind the middle concha into the nose, descends upon the internal surface of the palate bone forwards, perforates the inferior concha, and enters the inferior nasal chamber.
3. Art. pharyngea descendens passes in a canal (internal to vidian) at the base of proc. pterygoid. backwards to the superior part of the nasal cavity and the pharynx.

Art. maxillaris interna, thus sends branches:

1. To the organs of mastication, as: Artt. dentales, infraorbitalis; masseterica, temporal. profunda ant. and post. pterygoidea.
2. To the organs of deglutition: Artt. palatina super., vidiana, pharyngea.
3. To the cavities of the nose: Artt. infraorbitalis, sphenopalatina.
4. To the organs of audition: Art. tympanica, auricularis prof., rami art. meningee media.
5. To the face: Artt. buccinatoria, infraorbitalis, mentalis.
6. To the cranial cavity: Art. meningea media.

550. II. Carotis interna s. Cerebralis, the internal Cranial Artery.

It supplies the anterior portion of the brain and the eye. Course: from the point of separation of the carotis communis as high as the m. digastricus (posterior belly), almost parallel with carotis externa and a little curved; thence to the entrance into the canal. caroticus deeper backwards and inwards, in a triangular space between pharynx and ram. maxill. infer.; before the entrance horizontal. In the canal. caroticus it makes four curvatures, as at first it ascends vertically, then passes (first curve) horizontally forwards and inwards as far as sinus cavernosus to the apex of the temporal bone, comes forth and (second curve) ascends at a right angle by the side of sella turcica, passes again horizontally (third curve) as far as proc. clinoid. anter., and (fourth curve) perforates the dura Mater obliquely upwards, backwards, and somewhat inwards, on the outer side of the optic nerves. Situation: in the
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neck, behind mm. stylo-glossus and pharyngeus, separated by these from carotis externa; before m. longus colli and the vertebral column; internally, bounded by the lateral wall of the pharynx, art. pharyngea ascend. and gangl. I. N. sympathici, externally by the ramus of the lower jaw, V. jugularis interna and Nn. vagus, glosso-pharyng., hypo-glossus (which lie behind it above); in the canal. caroticus: surrounded by filaments from ganglion cervicale supremum and by a thin sheath; in the sinus cavernosus: on the inner side of nerv. abducens, oculo-mot., pathetic., and ram. ophthalm. of the fifth nerve.

Branches: As an exception, the Artt. pharyngea ascendens and temporalis pass off from the cervical portion, otherwise none; inside the canal. caroticus a small branch for the tympanum; in the sinus cavernosus several small branches for the basilar portion of the dura mater, the walls of sinus petrosus infer., for the hypophysis cerebri, N. trigeminus, and a connecting branch to the Art. mening. media. Besides, anteriorly: Art. ophthalmica, and the terminal branch of carotis interna; these are, artt. communicans, choroida, corporis callosi, fossae Sylvii.

551. 1. Ophthalmica.—Origin: close behind proc. clinoid. anter. from the convex anterior surface of the fourth curve of the carotis. Course: enters immediately below the optic nerve, through the foram. opticum into the orbit, passes at first on the outer and lower side of the optic nerve, between musc. rectus super. and externus, then inwards above n. opticus as far as the internal wall of the orbita; lastly, directly forwards along the inferior border of obl. superior, and under the trochlea, and divides at the place of junction of the upper jaw and frontal bone, into Art. nasalis and frontalis.

Collateral branches: Arising on the outer side of the Nervus Opticus.

a. Lacrymalis, the lacrimal artery, large, arises immediately as the Art. ophthalm. enter the orbita (or as it crosses the optic nerve), passes on the external wall between periorbita and m. rect. extern., as far as the lacrimal gland, ramifies here and gives off branches to the superior eyelid, m. rect. extern., super., to Art. mening. med. (backwards), to the temporal (through for. zygomatic.)

b. Centralis retinae, thin; penetrates into the centre at the inferior side of the optic nerve, passes in its axis directly forwards, spreads out with three diverging branches on the internal surface of the retina. A branch passes from it in the axis of the eye; this is,

Capsularis, through the vitreous body as far as the posterior wall of the capsule of the lens, giving off on the way minute ramusculi.
Arising above the Optic Nerve.

c. Supraorbitalis, arises where the ophthalmic artery crosses the optic nerve, passes between the roof of the orbita and m. levator palpebr. sup., passes through foram. supraorbital., upwards, and divides into an external and internal branch, ascending upon the frontal bone, for corrugat. orbicular. and frontalis and skin of the forehead.

d. Ciliares (for. choroidea, corp. ciliare and iris).

1. Postica s. breves, arise, often from a superior and inferior common trunk, pass along the optic nerve in a tortuous manner, surrounding it in clusters, perforate the sclerotica with it, and spread out in the choroidea and proc. ciliares, with ten to twenty branches.

2. Medica s. longe, an external and an internal; they perforate the sclerotica rather farther from N. opticus, pass between sclerotica and choroidea as far as lig. ciliare, where they divide, unite to form circulus iridis major, out of which also the circulus iridis minor arises.

3. Antica (six to twelve branches of the Artt. musculares, or lacrymalis and supra-orbitalis), give some branches to the fascia, perforate the sclerotica not far from the cornea, and open into the circulus iridis major. Their number is indefinite.

e. Rami musculares, a superior smaller (sometimes wanting), supplies mm. levator palpebr., rectus and obliquus superior; an inferior passes between n. opticus, and m. rectus inferior supplies this, and rect. externus and obliq. inferior; gives off ciliar. antica.

Arising on the inner side of the Optic Nerve.

f. Ethmoidales, a posterior and an anterior (larger), pass under m. obliq., through the foram. ethmoidalia out of the orbit into the cranial cavity, divide (each) upon the superior surface of the cribiform plate into two branches for the dura mater and nasal cavities. The anterior gives:

1. Meningea antica, for the falx cerebri, along the coronal suture.

2. Nasalis anterior, passes through an anterior foramen to the anterior part of the labyrinth and the septum and anastomoses with branches of the Spheno-palatina.

g. Palpebrales s. tarsea, arise close before the trochlea. The inferior passes behind lig. palpebr. intern. downwards and outwards, and passes close to the free border of the lid, between the cartilage and muscle of the inferior eyelid as far as the outer angle, forming an arch (arcus tarsus infer.) and anastomosing with the lacrymalis and infraorbitalis, where a branch for the mucus membrane of the nasal canal then passes off. The artery of the superior eyelid descends to the superior lacrymal punctum, then passes outwards, like the inferior (arcus tarseus superior), and anastomoses with the lacrymal, frontalis, temporal. superfic.

h. Nasalis (s. dorsalis nas.), terminal branch of ophthalmica, on the internal superior angle of the orbita, passes out of these over lig. palpebr. intern into the face, and divides after it has once given off:
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1. Art. sacci lacrymalis to the mucous membrane of the lacrymal sac, into
2. Angularis, which passes between m. pyramidalis nasi and levat. labii
   sup., and anastomoses with the maxill. externa. (See that artery.)
3. Dorsalis nasi, passes upon the back of the nose under the skin trans-
   versely below the forehead, extends downwards, often to the middle of
   the nose, and anastomoses on the nasal pinna with Art. alaris nasi.
   i. Frontalis, the terminal branch of ophthalmica, smaller than h, passes
      parallel with A. supraorbitalis upwards to the forehead, where it divides into
      branches for the skin, the muscles, and the periosteum, and anastomoses with
      art. temporalis.

552. 2. Art. cerebri anterior s. corporis callosi, passes away above n.
   opticus, behind the root of olfactorius, (forwards) and inwards towards the
   middle line, and in the fissure between the two anterior cerebral lobes on the
   inferior surface of the brain; here, a stronger, short (two lines) transverse
   branch unites the two anterior cerebral arteries, ram. communicans anterior.
   Each artery then turns round the anterior border of corp. callosum, passes upon
   its superior surface to the posterior border, and terminates with a small branch
   curved upwards in the neighbouring convolutions. Branches: to nn. opticus,
   olfactorius, to ventriculus tertius, to the inferior and internal surface of the an-
   terior cerebral lobes, to corp. callosum.
3. Art. cerebri media s. fossa Sylvii passes externally and internally into
   fossa Sylvii, divides into three branches for the anterior and middle cerebral
   lobes, and anastomoses with Art. cerebri anterior and posterior. Small
   branches pass directly from below upwards to the corp. striatum. Is larger
   than 2. and 4.
4. Art. s. ramus communicans (posterior), arises from the posterior part of
   carotis intern.; passes under tractus n. optic. backwards (one half to three
   quarters of an inch long), and forms with art. cerebri posterior (s. Art. verte-
   bralis) the circulus arteriosus Willisii.
5. Art. choroidea arises above the former, passes outwards and backwards
   with the tractus n. opticor. below the crus cerebri, enters into the lateral ven-
   tricle, on the cornu ammonis around the thalamus, and ramifies in the vascular
   plexus, plexus choroideus of the third [lateral] ventricle.
   All the arteries of the brain take a very tortuous course.

553. B. Subclavia, the subclavian artery.
   Origin: the right from the truncus anonymus; the left from the
   arcus aortae. (The right frequently arises below the left, at
   the posterior inferior part of the arcus aortae, and betakes itself to
   the right behind trachea and esophagus, sometimes between the
   two). Course: ascends as high as the apex of the lungs, curves
   over the first rib, and passes between scalenus anticus and medius,
   outwards and downwards to the axillary cavity. The right i
   shorter, thicker, and inclines less upwards than outwards. Situa-
   tion: first portion, from the origin to m. scalenus anticus.
The right is covered before by \textit{m. sterno-thyreoid.}, \textit{ven. anonyma}, \textit{n. vagus} and \textit{phrenicus}, \textit{m. cleido-mastoid}, behind, separated by \textit{n. recurrens} from \textit{m. longus colli}; bounded internally, only a little, by \textit{v. cephalica}, covered externally by the \textit{pleura}; surrounded all round by lymphatic glands, loose uniting tissue, and \textit{plexus} of \textit{n. sympathetic}.

The left passes parallel with \textit{v. cephalica}, lies immediately upon \textit{longus colli}; and is covered to a greater extent by the \textit{pleura}; otherwise like the right.

The second portion lies close above the centre of the first rib in the space between the \textit{mm. scaleni}; below the two \textit{scaleni}; before the \textit{plexus brachialis}; behind \textit{scaleni. anticus}, before which \textit{v. subclavia} lies.

The third portion reaches from the outer border of the \textit{scalenus antic.}, to the clavicle, lies in the triangular \textit{fossa supraclavicularis}; behind \textit{ven. subclavia}, \textit{m. subclavius} and \textit{clavicula}; before \textit{plexus brachialis}; under \textit{m. platysmanum}, skin [\textit{supra-clavicular}, \textit{nerves}], and the obliquely crossing \textit{art. et ven. suprascapularis}; over the first rib.

554. Superior branches of Art. subclavia.

1. \textit{Art. vertebrales}, the vertebral artery, the largest branch of the \textit{subclavia}, supplies the spinal cord, \textit{medulla oblongata}, the small and the posterior parts of the great brain. Or: at the superior, posterior wall of the \textit{subclavia}, at the commencement from the arch. Course: vertically upwards and rather backwards, it enters between \textit{proc. transvers.} of the sixth cervical vertebra into the \textit{canalis vertebrales}, and ascends, slightly curved, to the second, turns backwards between this and the \textit{atlas}, more still between \textit{atlas} and \textit{foramen magnum} behind \textit{proc. condyloid. occipit.}, and enters the skull through \textit{lig. obturatorium} and \textit{dura mater}, round to the front of \textit{medulla oblongata}, ascends upon \textit{pars basilaris}, and unites with the \textit{art. basilaris} of the other side. Postion: at first very deep between \textit{m. longus colli} and \textit{scalenus antic.}, behind \textit{art. thyreoid. inferior}, then in \textit{canal. vertebrales}, in the interspaces covered by \textit{mm. intertransversarii} and before the \textit{nn. cervicales}; the first curvature between \textit{m. trachelomastoid.} and \textit{obliq. infr.;} the second between \textit{obliq. sup. rectus capit. minor} and \textit{lig. obturatorium}; in the cranial cavity: at the sides and before \textit{medulla oblongata}.

Branches. In the neck:

a. \textit{Rami spinales} pass through the \textit{foram. intervertebral.} to the spinal cord. Several come from \textit{art. cervicalis} and \textit{pharyngea ascendentes}.

b. \textit{Rami dorsales} pass to the deep cervical muscles above the transverse pro-
cess: anastomosing with art. occipitalis and cervical. profunda; a larger branch.

Art. meningea posterior enters through foram. magnum to the falx cerebelli.

In the cranial cavity:

c. Art. spinalis posterior, arises at the sides of medull. oblong. and divides into an ascending branch for the walls of the fourth cerebral ventricle, and a descending which passes down on the posterior surface of the spinal marrow, becomes enlarged by the rami spinales passing into it, and is thus continued as far as the inferior extremity of the vertebral column. It gives an anterior and posterior branch for the posterior roots of the nn. spinales.

d. Art. spinales anterior, larger than the former, arises close under the art. basilaris, associates with that of the other side, passes in a groove on the anterior surface of the spinal cord, as art. mediana, as far downwards as the os coccyx, continued by branches of cervical. ascendens, vertebralis, intercostales and lumbales.

e. Art. cerebelli inferior posterior, arises on the outer wall of vertebral., curves round before the roots of the vagus and hypoglossus, backwards round the medulla oblong., passes forwards between the central and lateral lobes of the cerebellum, and divides into an internal and external branch, the last of which ramifies on the inferior surface of the cerebellum, and anastomoses with art. cerebelli.

555. Art. s. truncus basilaris, the continuation of the two Artt. vertebrales, commences in the sulcus between medull. oblong. and Pons Varolii, and terminates on the anterior border of the last. Its inferior wall rests upon the clivus; its superior wall gives numerous branches to the Pons Varolii; from the lateral walls arise:

f. Art. cerebelli inferior anterior arises in the middle of art. basilar., passes outwards under nerv. facialis and acusticus to lobul. anterior cerebelli.

1. Auditiva interna passes off from it, or the basilaris itself, and goes with nerv. acusticus to the cochlea and vestibule.

g. Art. cerebelli superior arises close to the anterior extremity of art. basilaris, behind n. oculo-motorius, turns round pedunculus cerebri upon the superior surface of Pons Varolii, and supplies, divided into an external and an internal branch, the borders and superior surface of the cerebellum.

h. Artt. cerebri posteriores s. profunda, the two terminal branches of basilaris, pass forwards, diverging, bend backwards upon the superior [inferior] surface of pedunculi cerebri to the inferior of the posterior lobes of the brain; give, quite at the commencement, numerous branches to the substant. perforata grisea between the crura of the brain; receive ramus communicans, which passes off from Carotis interna, and thus completes the
heptangular circulus arteriosus Willisii, which lies over the sella turcica, and surrounds the hypophysis cerebri. It is formed: the anterior transverse wall by ramus communicans anter., the anterior, central, and posterior lateral walls by Artt. cerebri anter., communicant. posterr., cerebri profunda.

556. 2. Art. thyreoidea inferior, in the child larger, is sometimes wanting. Origin: close and next to art. vertebr., rather external (frequently in common with supra-scapularis, as thyreo-cervicalis). Course: first upwards to the lateral border of the thyroid cartilage. Position: before the first curve, carotis communis, ven. jugular. intern., n. Vagus, and sympathetic (ganglion cervicale med.); before the second curve, nerv. recurrens; behind it, art. vertebr. and longus colli; asophagus (to the left). Branches: to asophagus, trachea, m. scalenus antic., and longus colli. Farther:
   a. Cervicalis ascendens: ascends before scalen. antic., then between it and rectus capit. antic. directly upwards to the basis cranii, gives rami musculares, and especially rr. spinales, which anastomose with the vertebralis. With it is generally united:
      art. cervicalis superficialis (into a common trunk; thyreo-cervicalis). Course: transversely outwards through the fovea supraclavicular., to the border of cucullar. Position: before scalen. antic., plex. brachial., levator scapul., and omo-hyoides, one inch above the clavicle, higher than the suprascapularis; supplies cucull. scap., splenii, levator, &c.
   b. Laryngea inferior (s. thyreoidea superior, see before).
   c. Terminal branches, three; 1, at the inferior border; 2, at the sides of the posterior surface of the thyroid gland; 3, at the inferior border of cartil. cricoidea.

Art. thyreoidea infima (Neubauer) is not always present; arises from arcus aorta, carotis communis, or thyreoid. inferior; passes before the trachea to the gland.

557. Superior external branches of the Subclavia.

3. Scapularis posterior (s. transversa cervicis). Origin: generally outside Scaleni (or inside, in common with thyreoidea infer.; or between them, in common with the suprascapular.). Course: transversely outwards through plexus brachialis, curving backwards towards the superior posterior angle of the scapula; divides into:
   a. Cervicalis suprema; ascends under the cucullar., ramifying in it, levator scap., and splenius.
   b. Dorsalis scapulae winds under the levator and the angle of the scapula, descends along the spinal border to the inferior angle between rhomboid. and serratus post., and anastomoses with suprascap. and scapul. inferior. Situation: at first horizontally in the fossa supraclavicular., covered by platysmamayoid., omohyoid., later by cucullaris and levator scapulae.

4. Suprascapularis s. transversa scapulae. Or.: below art. thyreoid. inferior
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(in common with it and cervical. superfic., when the last arises internal to mm. scaleni): Course: obliquely outwards and downwards under cervical. superficial., behind the clavicle, above the superior border of the scapula (over lig. incisurae semilunaris) to the fossa supra- and infra-spinata. Situation: at first covered by sterno-cleidom., then by subclavius, before scalen. anticus, art. subclavia, and plex. brachialis, above ven. subclavia, afterwards under trapezius; on the scapula between the bone and suprasspinatus. Branches to subclavius, trapezius, supra- and infra-spinatus, and periosteum of acromion.

5. Cervicalis profunda. Or.: the furthest outwards, in common with art. intercostal. prima. Course: passes before the neck of the first rib, curving backwards and downwards on the outside of gangl. dorsale, to the inferior border of the first (and second) ribs. Branches:

a. Ramus dorsalis; passes backwards, sends a ramus spinal. through foram. intervertebr.
b. Ram. intercostalis passes forwards between mm. intercostales.

6. Intercostalis prima, supplies the first and second (and third) intercostal space. Or.: behind, under A. cervicale, profunda. Course: passes before the neck of the first rib, curving backwards and downwards on the outside of gangl. dorsale, to the inferior border of the first (and second) ribs. Branches:

a. Ramus dorsalis; passes backwards, sends a ramus spinal. through foram. intervertebr.
b. Ram. intercostalis passes forwards between mm. intercostales.

7. Mammaria (s. thoracica) interna, the internal mammary artery. Or.: in front under Art. thyreoid. inferior. Course: vertically downwards behind the sternal extremity of the clavicle and the cartilages of the first to the sixth ribs, where it divides into an external and an internal branch. Situation: at first behind m. scalenus anticus and n. phrenicus, then upon the inner side of the last, a line and a half to two lines from the border of the sternum, before m. triangular. sterni and pleura.

Branches. 1. Posterior, in the chest.

a. Artt. thymicae, in children very large, to the Thymus.
b. Art. phrenica superior, with N. phrenicus, passes between pericardium and anterior mediastinum to the diaphragm. Branches to the pericardium, Thymus.

c. Artt. intercostales anteriores; the two pass to the superior and inferior borders of the first and second intercostal spaces; supply mm. intercost. and pleura, anastomosing with artt. intercostales posterr. (see Aorta).

2. External branches of the mammaria interna.

c. Artt. intercostales anteriores; the two pass to the superior and inferior borders of the first and second intercostal spaces; supply mm. intercost. and pleura, anastomosing with artt. intercostales posterr. (see Aorta).

3. Anterior branches of mammaria interna.

d. Artt. mammariae externae (six to seven) pass directly from behind for-
wards, perforate the mm. intercostales, and divide into muscular and cutaneous branches (for mm. pectoralis and intercostales); the superior pass to the thoracic glands, and are very greatly developed in mammalia. Some branches (r. sternalis) go into the periosteum of the sternum; others perforate the last.

559. The terminal branches of the mammaria interna.

560. Axillaris, the Axillary artery,
a continuation of the a. subclavia, reaches from the clavicle as far as the inferior border of the m. pectoralis major, passing in the oblique diameter of the axillary cavity.

Situation: surrounded by lymphatic glands and loose uniting tissue behind: m. subclavius, pectoralis major and minor, lastly, m. coraco-brachialis; before: the uniting tissue between m. subscapular. and serratus posticus major; farther down before m. teres major and latissimus dorsi. Internally, it rests, at first, upon the first rib and first intercostal space, then at a distance from the thorax, and is only covered by fascia and skin; on the outer side is situated: caput humeri (m. subscapular.).

Close under the clavicle we find ven. axillaris; internally, vv. cephalica and acromialis before art. axillaris; plexus brachialis externally, one n. thoracicus before it, farther down n. medianus and cubitalis before, n. radialis behind it. We find the axillaris at the superior external border of the growth of hair in the axillary cavity. Branches: three thoracici, one subscapular, two circumflexae.

561. Above the pectoralis minor:

562. Above the pectoralis minor:
b. Thoracica II. s. acromialis arises generally in common with a and divides into:

1. Ram. deltoideus, which passes close to Ven. cephalica downwards in a groove of uniting tissue between m. pectoralis and deltoïd, and terminates in the last.

2. Ram. acromialis passes away, covered by m. deltoideus, transversely outwards, above proc. coracoïd., lig. coraco-acromiale, and the external extremity of the anterior border of the clavicula to the shoulder-joint; anastomoses with transvers. scapulae.

562. Below the pectoralis minor:

c. Thoracica III., s. longa, s. inferior, s. mammaria externa, passes downwards and forwards on the side of the thorax between m. pectoral. major and serratus magnus, then between this and the skin, terminating on the sixth intercostal space; it gives branches to the axillary and mammary glands, the muscles of the second to the sixth intercostal spaces.

563. Branches of the axillaris at the collum humeri.

d. Subscapularis. The largest branch of axillaris arises from the outer side of it between N. radialis (within) and N. medianus (without). Course: curved outwards and downwards, parallel with m. teres major, on the anterior (external) border of the scapula. Position: before m. scapularis. Branches: to m. scapularis, teres major, and two terminal branches.

1. Art. thoracico-dorsalis passes downwards along the anterior border of the Scapula, behind Art. thoracica longa, between latissim. dorsi and serratus anticus, and ramifies in them.

2. Art. circumflexa scapula, before the long head of m. triceps, turns round the attachment of this to the anterior border of the Scapula backwards to the fossa infraspinata, covered by m. infraspin., sends an anterior branch between fossa and m. subscapularis, and anastomoses with art. transversa scapul. (above) and thoracico-dorsalis (below).

e. Circumflexa humeri anterior, small, arises on the anterior outer side of axillaris, often in common with the following. Course: transversely outwards above the tendons of latissim. dorsi and teres major, around the anterior surface of collum humeri backwards. Situation: behind coraco-brachial, and biceps. Branches to collum humeri [and head, gives off the epiphysial artery.]

f. Circumflexa humeri posterior; larger. Origin: at the posterior outer side of axillaris, opposite to subscapularis. Course: transversely backwards and outwards round the posterior surface of collum humeri to the outside of it; terminates in m. deltoideus. Situation: close to Ven. circumfl. and Art. axillaris, before cap. long. m. tricipitis, latissim. dorsi, above teres
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major, below teres minor, behind os humeri. Branches to the articular
capsule, periosteum, and m. deltoideus.

564.  Brachialis, the Brachial artery.

Continuation of axillaris, reaches as far as the fore-arm, where
it bifurcates. Course: extends downwards first on the internal,
then on the anterior surface of the upper arm, so that it is situated
in front of the elbow-joint in the centre of the flexure. Situation:

565.  1. In the upper arm:

covered in front and above by m. coraco-brachialis, then by the
internal border of m. biceps; behind and above by m. triceps, then
by brachialis internus; internally by fascia brachialis and skin;
externally accompanied by m. coraco-brachialis and the internal
surface of the Humerus; in a common sheath with n. medianus.

Vv. brachiales lie on both sides; N. medianus above on the out-
side, in the middle in front, below on the inner side; N. cubitalis
above on the inner side; N. radialis behind the brachial artery.

566.  2. In the flexure of the arm:

separated before by v. mediana, aponeurosis bicipitis from the skin;
behind by m. brachialis internus from the joint; on the inside of
the tendon of m. biceps; on the outside of the n. medianus and
m. pronator teres.

Branches sixteen to twenty; external anterior for mm. coraco-
brachial., biceps, brachial. intern., and deltoid; internal posterior
for m. brachial. internus.

Nutritia humeri arises from a muscular branch, or from profunda brachii,
enters into the foramen above the centre on the inner side of the humerus.
Also the following:

1. Profunda brachii. Or.: often in common with circumfl. poster., on the
inferior border of teres major. Course: downwards and backwards, close to
N. radial., round the posterior circumference of os humeri, in a groove which
it abandons under the attachment of m. deltoide., and divides into a deep and
superficial branch. Situation: between os humeri and m. triceps, then between
triceps and brachial intern. Branches:

a. Collateralis radialis profunda, accompanying the n. radialis, between
cap. intern. and extern. tricipitis; supplies these; anastomoses with 2.
b. Collateralis radialis superficialis passes directly downwards along the lig.
intermuscl. extern. behind the condyl. extern. and anastomoses with a. re-
currens radiialis.

2. Collateralis ulnaris superior (prima), [s. profunda inferior] arises close
next to or from the profunda brachii, passes downwards on the inner side of
triceps, perforates the lig. internusc. intern. (with n. cubital.), and reaches as far as the articulation, where it supplies the triceps and brachial. intern.

3. Collateralis ulnaris inferior [s. anastomodica], arises above the elbow, passes obliquely downwards and inwards, towards condyl. hum. intern., and is lost in rete articulare cubiti, m. brachialis and pronator teres.

The brachial artery bifurcates commonly (half an inch) below, sometimes in, frequently also above the flexure of the arm into art. radialis and ulnaris (at the inferior or superior third of the upper arm, indeed, even in the axillary cavity. Cruveilhier.)

567. I. Radialis, the radial artery,

the external, smaller, and more superficial branch of art. brachialis, passes directly downwards, and rather obliquely outwards, along the internal border of the radius, as far as the articulation of the hand, turns round the proc. styloid radii and os naviculare upon the dorsal surface of the carpus, and immediately again between the first and second metacarpal bones forwards into the hollow of the hand, and forms the arcus volaris profundus. Situation:

a. From the commencement to the carpus: behind the internal border of m. supinator longus, below covered only by the fascia and skin; upon m. supinator brevis, pronator teres, flex. digit. sublim., long. pollic., pronat. quadrat., then close upon the bone on the inner side of the tendon of m. supinator longus and the n. radialis.

b. On the carpus: covered obliquely by the tendons of abductor pollic. long., flex. long., and brevis, close upon the bones.

c. In the hollow of the hand (see arcus volaris profundus.)

 Variety. It frequently inclines to the back of the fore-arm at a point higher up (two or three inches above the carpus.)

Besides many (forty) muscular branches and a transversa carpi volaris to the rete carpeum volare, the radial artery yet gives off the following branches:

1. Recurrens radialis.—Origin:—behind, close to the commencement of art. radialis (also from the brachialis). Course: runs outwards and upwards to condylus externus. Situation: between supinat. long. and brevis (above brachialis intern.). Anastomoses with profunda humeri. Branches: from the convexity downwards and outwards to mm. supinatores and radiales extern.; to the rete articulare cubiti.

2. Ramus volaris superficialis, s. radio-palmaris. Or.: above os naviculare from the inner side of art. radialis. Course: passes over the origin of abductor pollic. brevis, on the external border under aponeurosis palmaris to the arcus volar. sublimis. Branches to the muscles of the thumb, or even to the outer side of the middle and the two sides of the index fingers.
3. *Ramus dorsalis*, the termination of *art. radialis* upon the back of the carpus (see above), gives off:

a. *Transversa carpi dorsalis*, passes transversely over the middle of the back of the carpus, inwards, to the *rete carpeum dorsale*; anastomoses with *a. ulnaris*, and gives off ascending and descending branches.

b. *Interossea II. s. metacarpi dorsalis*, passes between the second and third metacarpal bones, passes at the inferior extremity forwards to the *arc. volaris sublimis*, where two branches are then given off:

1. *Art. dorsalis radialis digitii medii*, for the external border of the middle finger.

2. *Art. dors. ulnaris indicis*, for the internal border of the thumb.

c. *Interossea I.*, passes between the first and second metacarpal bone, and gives off:

1. *Art. dors. rad. indicis* for the radial border of index finger.

2. *Art. dors. ulnaris pollicis*, for the ulnar border of thumb.

d. *Princeps s. magna pollicis*, passes between the muscles of the ball of the thumb and the volar side of the first metacarpal bone to the first phalanx on the radial side.

*Rete articulare cubiti*, the anastomosis about the elbow-joint, is formed:

1. Above by *collateralis radialis, ulnaris superior* and *inferior*.

2. Below by *recurrens radialis, ulnaris*, and *interossea* (which see.)

568. II. *Ulnaris s. cubitalis*, the ulnar artery,

the internal, larger branch of *brachialis*, at first slightly curved upwards and backwards, it passes backwards and inwards, then (three lines from the origin) extends downwards on the anterior surface of the *Ulna* as far as the carpal articulation; hence, on the outer (radial) side of *os pisiforme*, above the *lig. carpi volare propr.*, to the hollow of the hand in the *arcus volaris sublimis*. Position: at first deep behind *mm. pronat. teres, flex. carp. radial, palmar.*, *flex. dig. sublimis*, and *N. medianus*, then superficially, between the tendons of *flex. sublim.* (outside) and *carpi ulnaris* (inside); upon *m. brachial, intern., flex. profund., and pronator quod.*, the *ulna*; on the outer side of *Nerv. ulnaris*; at first outside, then behind, at last inside *N. medianus*. Branches to the muscles; also:

1. *Recurrens ulnaris.—Origin*: from the posterior wall, one inch from the origin of the *ulnaris*. *Course*: deeply under the muscles towards the inside, between *condyl. internus* and *olecranon*, upwards to the *rete articulare cubiti*. 
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2. Interossea.—Origin: from the ulnaris behind, close under the last. Course: directly backwards and downwards, to the centre of the fore-arm; it bifurcates into:

a. Interossea anterior (s. interna).—Origin: above lig. interosseum. Course: on the anterior surface of lig. interosseum, between flex. digit. profund. (inside), pollic. longus (outside), perforates under pron. quadrat. the lig. interosseus, and passes upon the dorsal surface of the carpus into the rete dorsale. Branches: several artt. perforantes pass through lig. interosseus. backwards to the deep muscles; an anterior superior branch accompanies the nerv. medianus as far as the hand; an inferior passes behind pronat quadratus downwards to the rete carpi volare.

b. Interossea posterior (s. externa); smaller than the last; passes through two inches below the articulation between ulna and radius upon the dorsal region of the fore-arm, and divides immediately into:

1. Interossea recurrens (s. radial. poster.); ascends on the radial side of the ulna, covered by anconeus parvus, to the rete cubitale.

2. Interossea descendens, descends, nearer to the ulna, upon the dorsal side of lig. interosseus as far as the carpus. Branches to extens. commun. digit. 5, carp. ulnaris and skin.

3. Art. nutritia ulnaris, a small branch, about the middle of the art. ulnaris, passes through a foram. nutritium in the ulna [from below upwards]; sometimes also a branch to the radius (or even from the anterior circumference of interossea anterior).

4. Ramus dorsalis, terminal branch of ulnaris, passes under the tendon of m. flex. carpi ulnaris to the back of the carpus into the rete carpi dorsale; giving off in its passage the dorsal. ulnar. to the little finger.

5. Ramus volaris, terminal branch of the ulnaris, passes close to os pisiforme, and above os hamatum (hamulus) and lig. carp. propr., covered by aponeurosis palmar. and m. palmar. brevis, into the hollow of the hand, gives branches to the muscles of the ball of the little finger, and

a. Ram. sublimis, which externally passes into arc. volaris sublimis; and,

b. Ram. profundus, which gives off an internal branch for the volar surface of the little finger, and under the tendons of mm. flexor. digit. goes to form arc. volar. profund.

569. The vascular arches of the hand.

1. Arcus (s. rete) carpi dorsalis, is situated upon the dorsal surface of the metatarsus, covered by lig. carpi dorsale, and the tendons of the extensor muscles; is formed by ram. transvers. of art. radialis and ulnaris; gives off:

a. Rami ascendentes, which pass opposite to branches of art. interosseus anter.

b. Rami descendentes, the short roots, anastomosing with artt. perforant. arcus volaris profundi of
Artt. interosseæ metacarpi dorsales. These are larger or smaller, going along to the inferior extremity of spaces between the metacarpal bones, or to the articulations of the first and second phalanx, pass with branches of arcus volar. sublimis, and assist in forming art. digitales.

2. Arcus volaris profundus, lies close upon the palmar surface of the basis ossium metacarpi, covered by the nerves, tendons, and muscles of the palm of the hand, below slightly convex; principally formed of the transversely passing terminations of art. radialis; gives off:
   a. Rami ascendentes, very short branches for the carpus, which anastomosing with branches of radialis and ulnaris (and interossea) form the rete carpeum volare.
   b. Rami descendentes s. interossea volares, three to four; they pass in the second to the fourth spatium interos. metacarpi, at the inferior extremities of which they anastomose with the branches of arcus volare sublimis. The first and largest at the radial border of the index finger is often wanting.
   c. Rami perforantes, three, pass at the superior extremities of the second to the fourth spat. inteross. metacarpi, from before backwards to the rr. descendent. art. radialis, and form with these the small interossea dorsales. (See arcus dorsalis.)

3. Arcus volaris sublimis, lies in the palm of the hand, covered by aponeurosis palmaris, upon the tendons of flexor. digitor.; below convex; rather nearer to the carpal articulation than the deep arch; chiefly formed of ram. sublimis art. ulnaris. From the convexity arise:
   Art. digitales, three, which pass between the tendons of the flexors of the fingers to the heads of the osse metacarpi, in the second to the fourth interspaces, there anastomosing with the interossea dorsales; they bifurcate, and thus supply the radial border of the five fingers, and the ulnar border as far as the second finger. On the anterior surface of the phalanges, lying close to the flexor tendons, they send branches to the dorsal surface, which, like these, but smaller, pass to anastomose with each other by means of transverse branches, and give branches to the skin. The radial border of the index finger and thumb is supplied by ram. volaris art. radialis, which anastomoses with the arcus volaris sublimis.

Aorta descendens, the descending aorta.

570. A. Aorta descendens thoracica, the thoracic aorta.

Position: on the left side of the twelfth [eighth inferior] dorsal vertebra, seven to eight inches long, before the vertebral column (above separated by duct. thoracici); behind the left pulmonary vessels (above), the oesophagus (below), and the pericardium (in the centre); has to the left the mediastinum, to the right the oeso-
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phagus (above), Ven. azygos and duct. thoracicus close to it (above, where it winds to the left, behind it); is surrounded by much adipose tissue, and many lymphatic glands. Branches:

1. Artt. bronchiales, two to the left, one to the right; they arise sometimes from a common trunk, from the anterior wall of the aorta (also from mamm. interna or subclavia), and pass forwards to the posterior wall of the bronchus, ramifying on the bronchia and pulmonary vesicles; they give branches to the oesophagus; bronchial glands, and anastomose with the coronary arteries of the heart and thyreoidae inferior.

2. Oesophagea, five to seven, thin and long, arising in front from the aorta; they pass to the anterior surface of the oesophagus, in the mucous membrane of which they terminate, and send long branches upwards and downwards.

3. Mediastine postica, small branches for the posterior wall of the pericardium and the mediastina. Two phrenica superiores arise deeply, pass to the internal crura of the diaphragm, and anastomose with the oesophagea.

4. Intercostales posteriores, eight to nine for the second, or third to eleventh intercostal space (the first and second are supplied by intercostal. prima. See subclavia). Origin: from the lateral walls of the aorta; the superior at an acute, the inferior at a right angle. Course: the superior upwards, the inferior more horizontally outwards, over the heads of the ribs into the intercostal space next above, and divided between the heads of the two ribs into ram. anterior and posterior. Situation: behind the pleura and the trunk of sympathetic; the right behind the oesophagus, ductus thoracicus; and Ven. azygos also; the left behind v. hemiazygos and sympathetic; the two last (right and left) covered by the crura of the diaphragm.

Branches: besides many small osseous branches for the bodies of the vertebrae, the following:

a. Ramus anterior s. intercostalis, passes in the direction of the trunk, in the centre of the intercostal spaces, at first between pleura and m. intercost. intern., then between intern. and extern., and there divides into:

1. Ram. sup. s. infracostalis, the continuation of the trunk which passes on the inferior border of the rib situated above, in a proper groove, as far as the anterior third, then in the middle of the intercostal space, descending and anastomosing with a. mamm. intern., epigastrica, phrenica, circumflexa ilei.

2. Ram. inferior. supracostalis, which passes to the superior border of the rib lying below, and is lost in the periosteum and the muscles.

b. Ramus posterior s. dorsalis; passes between process. transversi, on the external border of lig. colli costae intern. backwards, and divides into:

1. Ram. spinalis, which passes through foram. intervertebrale, with a branch for the body of the vertebra, with another for the medulla spin. 

2. Ram. muscularis, a larger branch, which ramifies between longissim. dorsi and ileocostalis, and is lost in the skin.
571. B. Aorta descendens abdominalis, the abdominal aorta.

Situation: almost in the middle, yet rather to the left, before the first to the fourth abdominal [lumbar] vertebra; surrounded in the hiatus aorticus, close to ductus thoracicus and Ven. azygos by the crura of the diaphragm; in the cavity of the abdomen on the left side of Ven. cava inferior, covered by gangl. coeliacum, the corpus pancreatis, and pars horizontal. infer. duodeni, the left emulent vein, root of mesenterium, and lumbar portion of peritoneum (to the left below).

572. Anterior azygos branches (these are the arteries for the organs of digestion).

1. Coeliaca, the coeliac axis, half to one inch long, four lines diam. Origin: at a right angle from the anterior wall of the Aorta, while still in hiatus aorticus, close under artt. phrenicae inferr. Position: behind the curvatura minor of the stomach, on the right side of the Cardia, between the layers of the small omentum, upon the superior border of the Pancreas, under the left lateral part of the lobul. Spigelii, closely surrounded with plexus coeliacus. Branches pass off from a single point (tripus Hallerii), to Stomach, Liver, and Spleen (all lying above mesocolon transvers.)

1. Coronaria ventriculi sinistra, the smallest of the branches of the coeliaca. Course: to the left and above to the right side of the cardia, then again curves to the right, passes in the semicircle on the small curvature (between the layers of the small omentum), and anastomoses with art. cor. vent. dextr. hepaticae. Branches: artt. œsophageæ inferr. to the inferior portion of the œsophagus; artt. cardiacæ surround the cardia, and supply the fundus ventric.; artt. gastrique arise along the small curvature, and supply the anterior and posterior walls of the stomach; very frequently a ram. hepaticus (to the left lobe of the liver).

2. Hepatica. Course: transversely to the right, above the pancreas, to the right before the trunk of the ven. porta, gives off art. pancreatica mediae, and divides (one to two lines from origin) into a superior and inferior branch.

a. Ram. hepaticus, the superior branch, passes obliquely forwards to the Porta, where it divides into art. hepat. dext. and sinistra. Position: before foram. Winslowi in the lig. hepatico-duoden., below the ven. porta, to the left side of duct. choledochus.

1. Pylorica s. coronaria dextra, a small branch passes along the small curvature to the left, supplies the anterior and posterior surfaces of the stomach, and unites with coron. ventric. sinistra.

2. Hepatica sinistra passes through the left portion of the Porta to the left lobe of the liver, lobul. quad. and Spigelii. Branches pass transversely.

3. Hepatica dextra, thicker, passes, divided into several branches,
between the _rami_ of the _ven. portae_ to the right lobe of the liver, gives off _art. cystica_, which, with a branch above and below the gall bladder, passes from neck to fundus.

b. _Ram. gastro-duodenalis_, passes downwards between the commencement of _Duodenum_ and the head of the _Pancreas_, and from _pylorus_ along the great curvature between the layers of the great omentum. Branches:

1. _Pancreatico-duodenalis_, passes downwards on the _pars descend._ duodeni, between it and _Pancreas_, gives off _artt. pancreatic. dextra_ and _duodenales_, which anastomose with _jejunaes_ of _mesenter. superior._

2. _Gastro-epiploica dextra_, is that portion of _ram. gastro-duodenal_. which passes along the great curvature, gives branches to the anterior and posterior surface of the Stomach, and six to eight _rr. epiploici_, which descend between the laminae of the great omentum. Anastomoses at the _fundus ventriculi_ with _coron. ventric. sinistra._

3. _Lienalis_, the splenic artery—the largest branch of the _coliaes_—passes very tortuously along the superior border of the _Pancreas_ (in a sulcus) to the left, and enters the spleen at the _hilus_ divided into (four to ten small, or two principal) branches. Situation: behind the stomach.

Lateral branches:

a. _Artt. pancreaticae_ (four to six), tolerably large, to the left portion of the _Pancreas._

b. _Art. gastro-epiploica sinistra_ descends before the _cauda pancreat._, behind the fundus of the stomach, passes to the left part of the great curvature, and gives ascending branches into the left part of the great omentum.

c. _Art. breves_ (two to six), arise from one or several terminal branches close to the Spleen, and pass backwards to the _fundus_, as high upwards as the _cardia_ of the Stomach.

2. _Mesenterica s. mesaraica superior_ (seven to eight inches long) supplies the small intestines and the right half of the large. _Or._: close (one inch) below _coliaea_. _Course_: between the laminae of the _mesentery_ in the root, as far downwards as the _right iliac fossa_, a little to the left and below curved; it is lost, becoming very small in the _coecal_ region.

Situation: at first behind _Pancreas_, between it and _Aorta_, then separated from this by the boundary between _duodenum_ and _jejunalum_, as it enters below the _Pancreas_ into the root of the _mesentery_. Branches for _Pancreas_; for the small intestines from the left convex, for _colon_ and _coecum_ from the right concave side.

1. _Artt. intestinales_ (s. _jejunaes_ et _ilea_), ten to fifteen larger (eight to twelve smaller) branches, which pass downwards and forwards for two to three inches in length, then divide and unite in loops or arches with one another. After a threefold division and junction, branches pass off
from the convexity of the last loops, which form a superficial vascular rete (under the peritoneal investment) and a deep upon the mucous membrane of (fifteen to twenty feet long) the small intestines. From one artery arises in the embryo (two to three months) the

Art. amphi-osalaraica, which passes from the abdomen through the umbilical cord into the umbilical vesicle, and afterwards becomes imper-

2. Artt. colica pass from the mesenterium into the mesocolon, divide in the neighbourhood of the large intestines, and unite in larger arches, from which anterior and posterior branches immediately come off; the super-

(a) Artt. colica dextra superior, passes downwards to colon ascendens, and anastomoses by means of an ascending branch with a. colica me-

(b) Art. colica dextra inferior, s. ileo-colica, arises deeper, about the centre of mesenterica superior; passes downwards, and gives an asc-

(c) Art. colica media, arises above from mesent. super. passes forwards to the colon transversum, and anastomoses with art. colica dextra, and to the left with art. colica sinistra.

3. Mesenterica inferior, smaller than art. mesent. super., supplies the left half of the large intestines. Or.: about two inches above the place of bifurcation of the Aorta. Course: at first downwards upon the Aorta; then before the A. iliaca com. sinistra downwards, and to the left in the mesocolon de-

1. Colica sinistra superior, passes transversely outwards before the left art. spermat. and ureter, then behind the colon sinistrum and peritoneum upwards, divides into a superior and inferior arched branch, and supplies colon sinistr. as far as flexura sigmoidea.

2. Colica sinistra inferior, supplies the flexur. sigmoidea.

3. Haemorrhoidalis superior s. interna, descends in the meso-rectum to the rectum and on its posterior wall to the sphincter ani, where it anasto-

573. The lateral branches of the Abdominal Aorta, given off in pairs.

4. Phrenica inferior, one on either side, arise close under hiatus aorticus (frequently from a. coliaca, or from a common trunk), pass upwards and out-

wards, spread about the hiatus aortic., foram. quadrilat., and reaches with an external branch to the attachments of the diaphragm, where it anastomoses with artt. intercostal. and mammaria int.; it gives off


The vessels.

Artt. suprarenales superiores for the caps. suprarenales.

5. Suprarenales mediae pass before the crura of the diaphragm transversely outwards (the right behind ven. cava), and spread out upon both surfaces of the suprarenal capsules.

6. Renales, short and thick, sometimes two to four (emulgentes). Or.: at a right angle close under mesenterica super., frequently deeper. Course: transversely outwards and backwards to the hilus of the kidney. Position: surrounded by fat, behind the peritoneum and the V. renalis, before the body of the second lumbar vertebra, before the crura of the diaphragm and Psoas major. The right passes behind V. cava. infer., and is also longer than the left, which arises higher. Branches:
   a. Artt. suprarenales infer. for the suprarenal capsules and adipose tissue (artt. adipose).
   b. Three to six terminal branches pass through the hilus, before the renal pelvis and behind the veins, and form, between the cortical and tubular substance, a rete which especially supplies the cortical substance.

7. Spermatica interna. Or.: at an acute angle from the anterior wall of the aorta, under art. renalis (rarely above, rarely from this). Course: descends on the inner side of V. spermat. backwards as far as the pelvis, behind the peritoneum, before psoas and ureter; the right obliquely before V. cava, the left before the sigmoid flexure of colon. Within the pelvis, internal to psoas, before A. iliaca externa.

In the male: it extends through the inguinal canal (together with Vas deferens; and Vv. spermaticae) to the testicle and epididymis.

In the female: very tortuous, between the layers of the lig. uteri latum below the ovaria, it anastomoses with art. uterina, gives small branches to lig. uteri latum and the ovary.

8. Lumbales (three), five on either side. Origin: at a right angle from the posterior circumference of aorta before the lumbar vertebrae. Course: (like artt. intercostales) transversely outwards, behind the crura of the diaphragm (the superior), behind m. psoas (the inferior); on the basis proc. transvers., dividing into:
   a. Ram. posterior, passes with a ram. spinalis through foram. intervertebrale, partly to the bodies of the vertebrae, partly to the spinal marrow; with a ram. dorsalis to the muscles and skin of the lumbar region.
   b. Ram. anterior s. abdominalis, smaller, passes between quadrat. lumbor. and transvers. abdom. to the abdominal muscles; the branch of the first art. lumbalis along the lower border of the twelfth rib obliquely forwards; the branches of the fifth art. lumbalis along the crista oss. ilei, supplies the abdominal muscles, iliacus and glutæi.

574. At the inferior extremity of the Abdominal Aorta, the single.

9. Sacra media, small. Or.: close above or at the point of bifurcation from the posterior wall of the aorta. Course: vertically downwards, before the
fifth lumbar vertebra, the sacrum coccyx, behind the rectum. Branches: pass off laterally over the separate vertebrae to the bones and periosteum, and anastomose with art. sacrae laterales; on the basis of coccyx arched.

575. C. Iliaca communnes, the common Iliac arteries.

Origin: before the fourth lumbar vertebra these two principal trunks pass off from the anterior wall of aorta abdominalis, at an acute angle (in the male=65°, in the female=75°). Course: extending, downwards and outwards and rather backwards, about two inches long; between them a triangular space, the base of which is situated at the inferior border of the fifth lumbar vertebra. Position: behind the peritoneum and ureter (crossing with the last), on the inner side of m. psoas, on the left side of Vv. iliaca communnes; surrounded by lymphatic glands. The right passes over V. iliac. commun. sinistra to the inner side of V. iliac. commun. dextra. The left passes from the commencement on the left (external) side of the vein, and is in front covered by Art. haemorrhoidalis interna. Branches: small to the Vv. iliaca communnes and lymphatic glands, otherwise none. Each Art. iliac. commun. divides rather above Symphysis sacro-iliaca into two terminal branches: Art. hypogastrica and cruralis.

576. I. Hypogastrica s. Iliaca interna, the internal Iliac artery, the internal branch of iliaca commun., passes at first rather downwards and forwards, then slightly curved, before symphysis sacroiliaca into the small pelvis, and divides, after a course of an inch to an inch and a half, either into two (an anterior and a posterior) or into eight (in the female ten) branches. Position: behind the peritoneum, on the left side the Vv. hypogastr., A. hypog. sinistra passes over V. iliaca com. sinistra, inwards.

577. Anterior branches:

1. Umbilicalis, the umbilical artery of the embryo. Vesicalis, the vesical artery of adults.

The umbilical arteries, very large in the embryo, the blood of which they carry to the placenta, pass downwards, curved forwards and outwards, to the sides of the urinary bladder, upwards and inwards to the umbilical ring, from which they pass out into the umbilical cord and placenta, winding round the Vena umbilicalis spirally. After birth the portion between the naval and urinary bladder is closed, and from the lig. laterale vesicae. From which piece, still open and with thick walls (art. vesicalis) arise:

1. Artt. vesicales. a. Posterior on the posterior wall of the bladder from the base to the vertex. b. Anterior on the anterior surface, often arises from
art. uterina. c. Inferior, often from Art. hypogastrica; at the base of the bladder it also supplies the seminal vesicles.

2. Art. uterina arises frequently from the hypogastric, passes transversely inwards, curves from the external border of collum uteri into lig. latum, at the sides of the uterus up to the fundus, supplying with several anastomosing branches the anterior and posterior surfaces of the uterus, and penetrating into its substance. All these are very tortuous, and particularly developed during pregnancy. Branches: tubaria passes with three long branches to the fimbria and Fallopian tubes, giving off the proper ovarica.

3. Art. vaginalis descends on the side of the uterus, supplies this with many branches, also with a branch for the neck of the bladder, and terminates in an arch between vagina and rectum.

4. Art. deferentialis, generally from vesicalis inferior to the seminal vesicles and vas deferens, and art. (vesico) prostatica to the pars prostatica urethrae.

5. Art. haemorrhoidalis media, sometimes wanting, or arises from art. hypogastr. and pudenda interna; passes laterally on the anterior surface of the rectum.

2. Obturatoria. Origin: below the umbilicalis from the hypogastr., often from iliaca externa (rarely from a. cruralis), and in common with a. epigastrica. Course: horizontally forwards, on the lateral wall of the entrance to the pelvis, as far as and through (the superior angle of) the foram. ovale out upon the thigh, where it divides into an external and internal branch. Position: close under m. psoas, above nrr. obturator, behind the peritoneum.

Lateral branches in the pelvis:

a. Ram. iliacus passes forwards between fossa and m. iliacus; anastomoses with circumflexa ilei.

b. Ram. pubicus arches behind the symphy. pubis.

c. Ram. ascendens small, anastomoses with epigastrica.

Terminal branches outside the pelvis:

d. Ram. interior s. internus, between m. obturat. extern. and os pubis, arched on the inner half of foram. obturat. downwards and backwards; it gives branches to mm. adductores; to the scrotum (in the female to labia externa); anastomoses with art. circumflex. interna.

c. Ram. posterior s. externus, on the outer half of foram. obtur., terminates between the neck of the femur and m. quadratus, by means of anastomoses with art. ischiadica; it gives art. acetabuli (to the fat in the depth of the acetabulum).

578. Posterior branches of the hypogastrica:

3. Ileo-lumbalis s. iliaca anterior. Origin: sometimes with art. glutae
from the posterior wall, next to the origin of hypogastrica. Course: backwards and behind n. obturatorius, external and superior to the upper border of the Sacrum; behind m. psoas; divides immediately into:

a. Ram. lumbalis, which ascends along the bodies of the lumbar vertebrae
behind \( m. \textit{psosas} \), gives off a muscular branch for \( m. \textit{psosas} \) and \textit{quadrat. lumborum}, and a spinal branch through \textit{foram. intervertebr.} between the last lumbar vertebrae and sacrum to the spinal cord.

b. \textit{Ram. iliaca} passes transversely outwards upon the \textit{fossa iliaca}, with a superficial branch on the inner, with a deep on the outer surface of the \textit{Iliacus}, and supplies the muscles of the \textit{periosteum}.

4. \textit{Sacra lateralis}; very frequently two on either side. \textbf{Origin:} frequently from \textit{art. glutæa}. \textbf{Course:} inwards and downwards, on the anterior surface of the \textit{Sacrum} (external to the \textit{foram. sacralia anterr.}); anastomoses in front with \textit{sacra media}, and gives branches to the posterior internal bony walls. Besides these: \textit{rami spinales}, which enter through \textit{foramen sacralia anterr.} into the \textit{canalis spinalis} to the nerves, and through \textit{forr. sacræ posterr.} to the spinal muscles.

5. \textit{Glutæa (superior) s. iliaca posterior}, the glutæal artery. The largest branch of the \textit{hypogastrica} passes out from the pelvis, curving backwards and outwards: passes between the first sacral and fifth lumbar nerves to the highest part of \textit{incisura ischiadica}, above the superior border of \textit{m. pyriformis}, and immediately divides into a superficial branch, which ramifies under \textit{glutæus maximus} on the posterior and superior part of it, and into a deeper branch, which passes between \textit{m. glutæus med.} and \textit{minimus} on the superior border forwards and upwards. \textit{Nutritia Ilei} passes inside the pelvis at the inferior part of \textit{os Ilei}.

579. Terminal branches of the \textit{hypogastrica}:

6. \textit{Ischiadica s. glutæa inferior}. \textbf{Origin:} often in common with \textit{glutæa} or \textit{pudenda interna}. \textbf{Course:} before the \textit{glutæa}; passes out of the pelvis under \textit{m. pyriformis}, and above \textit{lig. sacro-spinosum} through \textit{incisura ischiadica}. \textbf{Position:} on the inner side of \textit{N. Ischiad.}, behind the \textit{pudenda}. \textbf{Branches:} internal pass transversely between \textit{m. glutæus max.} and \textit{lig. tuberosa sacrum}, and to the skin of the \textit{coccyx}; several descend with \textit{N. Ischiad.}, others to the rotator muscles; anastomoses with \textit{art. circumflexa ili}, behind \textit{collum fémoris}.

7. \textit{Pudenda (communis s. pudica interna)}. \textbf{Course:} passes out before the \textit{plexus sacral.} downwards, between \textit{m. pyriform.} (below it) and \textit{lig. spinososacrum} from the \textit{incis. ischiad. major}, turns round the external surface of the \textit{Spina}, and passes between \textit{lig. sacro-spinos.} and \textit{tuberosum} through \textit{incis. ischiadica. minor} again within the pelvis; then ascends on the inner surface of \textit{tuber Ischii}, the \textit{rami} of the \textit{ischia} and \textit{pubis}, as high as the \textit{symphysis pubis}; at that place lying close to the bones upon \textit{m. trans. perinæi} and \textit{ischio-cavernosus}. \textbf{Branches:} small for the urinary bladder, rectum, vesicule seminales, Prostata or \textit{Vagina}; close to the \textit{spina ischii} branches to the rotator muscles; on the \textit{tuber Ischii} external muscular branches, and an anastomosis with \textit{art. ischiad.} between \textit{tuber Ischii} and \textit{trochanter}; the internal are:

a. \textit{Artt. hemorrhoidales infer. s. externæ} for the \textit{rectum, sphincter,} and \textit{levator ani}. 
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Terminal branches: b. Perinæa (superficialis). Or.: at the posterior border of m. trans. perinæ. Course: from behind forwards, and from without inwards on the inner side of m. ischio-cavernos., and terminates in the centre of the scrotum as art. septi scroti. Position: above fasc. perinæi superficialis, below, m. transvers. perinæi superf. Branches: transversa perinæi passes behind transversely over the perinæum; scrotales posteriores s. labiales, at the termination of the perinæum to the posterior part of the scrotum or labia.

c. Profunda perinæi s. art. penis (clitoridis) is the name also given to that part of the pudenda from the posterior border of m. transvers. perin. as far as symphys. pubis. From it pass off:

a. Bulbosa s. bulbi urethrae, a large branch, transversely to the posterior boundary of bulbus urethrae (or to the Vagina [the nymphae]), ramifying in corp. cavernos. [spongiosum] urethrae to the glans.

b. Dorsalis penis (or clitoridis) perforates between the roots of the corp. cavernos. and the symphys. pub., the ligam. suspensor., passes close beneath the skin very tortuously upon the back of the penis to the glans, behind which it forms a vascular circle, and supplies the foreskin and glans.

c. Cavernosa s. profunda penis (or clitoridis) passes in the middle of the cavernous body along the septum, and ramifies very delicately inside it, as far as the glans, anastomosing with the bulbosa and dorsal. pen., and that of the other side through the septum. J. Müller’s Artt. helicina, the tendril-like tortuous capillary vessels of cavernosa, which terminate blindly, and are said to give rise to the erectio penis, are probably artificial anatomical products. (Henle.)

580. II. Cruralis, the external Iliac artery,

the external branch of Iliaca communis, passes from the place of division of the last in the pelvis, as Art. Iliaca externa, on to the thigh, as: femorialis, as far as the popliteal space, where it is called poplitea.

581. A. Iliaca externa.

Origin: before the superior border of symphysis sacro-iliaca from art. iliaca communis. Termination: at the femoral arch in the centre between symphysis pubis and spina ili 1ei super. Length: three and a half inches. Course: extends obliquely from above downwards, from within outwards, and rather forwards, into the pelvis. Position: covered before and internally, loosely, by peritoneum; crossed by the ureter; separated from it on the inner side of the m. psoas by fasc. iliaca; before ven. iliaca externa. Before the right art. iliaca rests the termination of the small intestines; before the left the sigmoid flexure of
colon. Behind the ligam. Pouparti, it is situated on the outer side of the vein (in the same sheath with it), on the inner side of nerv. cruralis. Branches:

1. Epigastrica (inferior s. interna). Origin: two to three lines (sometimes half an inch to two inches above lig. Pouparti from the inner side of iliaca externa, or in common with art. obturatoria). Course: 1. at first transversely inwards to beneath the spermatic cord (or lig. rotund. of the female); 2. then bends upwards, concave above; 3. lastly, directly upwards to the umbilicus. Position: 1. before Ven. cruralis, crossed by vas deferens which ascends vertically behind it, then above it anteriorly and in the inguinal canal; half an inch to an inch and a half (at the convexity of the crossing points is the abnormal origin of obturatoria, which then winds round the upper and inner boundary of the femoral ring); 2. obliquely behind the posterior wall of inguinal canal, upwards and inwards, between fasc. transversa and peritoneum, it forms the boundary between fovea inguinal. externa et interna; 3. at the outer border and the posterior surface (inside the sheath) of m. rectus abdominis. It is lost in the umbilical region, as it anastomoses with A. mammar. intern. by means of a capillary rete inside the m. rectus. Branches:

a. Art. spermatica externa, enters the inguinal canal, passes through it along the anterior surface of the spermatic cord (lig. uteri rotundum), and passes to the scrotum (labia majora) outwards; anastomoses with spermat. interna.

b. Art. pubica, passes along the crista oss. pubis internally, where it anastomoses, behind the Symphysis, with the artery of the other side.

c. Ram. obturatorius, descends on the superior and internal border of the femoral ring behind the ram. horizontal. oss. pubis to art. obturator.; is sometimes so large that the art. obturatoria appears to arise from art. epigastrica.

2. Circumflexa ilii s. epigastrica externa. Origin: opposite to the last, or below it, from the outer side of the art. iliaca ext.; sometimes double. Course: obliquely outwards and upwards to the spina ilei anterior superior, hence arched along the crista oss. ilei, between m. obliq. intern. and transvers. abdom. to the art. ileo-lumbalis backwards. Position: at first behind ligam. Poupartii between the two laminae of fasc. iliaca, then only covered by the peritoneum. Branches: ascending for the abdominal muscles and skin; descending for the fossa iliaca. In the region of the Spina the Ram. abdominalis ascends, parallel with the art. epigastrica, between m. transversus and obliquis internus, and anastomoses with artt. lumbales and intercost. inferr.

582. B. Femoralis, the femoral artery, is that part of art. cruralis which reaches from the femoral ring to the inferior third of the thigh, passing downwards, inwards and a little backwards, in the direction of a line which commences in
the centre between spina ilei anter. superior and symphysis pubis, and terminates on the inner side of the limb, below its middle. Position: for about three inches below Poupart’s ligament the artery is covered in front by the skin, fasc. lata and lymphatic glands, then by m. sartorius, which passes obliquely from above downwards and from without inwards, and inclines to the inner side of vastus intern. in the groove between this and the insertions of the Adductores. Behind it rests in a groove between m. psoas (without) and pectineus (within), upon the body of the os pubis, the eminentia ileo-pectinea, before the internal third of the acetabulum, so that a space of from one inch to one and a half is found between it and the superior part of the os femor., farther down upon the adductor magnus, the tendon of which it perforates, and passes upon the posterior surface of the thigh. Above, the vein lies to the inner, farther down on the posterior side; the nerve on the outer side of the artery. The art. and ven. femor. lie in a proper sheath, into which n. saphen. internus penetrates, whilst nerv. cruralis remains in its own sheath. Branches:

1. Inguinales, three to six, small, arise in front close under lig. Poupart.; they ramify in the glands and skin of the groin.

2. Epigastrica superficialis, arises one inch below the femoral arch, in front, perforates proc. falciform., passes vertically upwards, between the skin and fasc. superficialis, gives a transverse ram. iliacus inwards towards the spina ilei, and terminates at the umbilicus, in the skin.

3. Pudenda externa (scrotales or labiales anteriores), usually a superior and an inferior; they pass from arcus cruralis transversely inwards; the superior close under the skin to the mons Veneris, penis and scrotum (or labia majora); the inferior covered by the fascia, transversely before Ven. crural., under ven. saphena.

4. Profunda femoris, supplies the muscles and skin on the inner and posterior surface of the thigh. Origin: 1½ to 2 inches below the femoral arch, sometimes also higher, rarely deeper. Course: immediately backwards, then downwards between mm. adductores, closer to the bone than art. femoralis, perforates the adductor magn. (above the perforation for femoralis), and is lost in biceps and semitendinosus. Position: above before the termination of flexor. femoris and pectineus, lastly adductor magnus and brevis, behind adductor longus.

Branches: 1. The circumflex arteries, two.

2. The perforating arteries, three to five.

1. Circumflexa femoris interna, arises ½ to 1 inch below the commencement of prof. femor.; passes backwards and transversely inwards between m. pectineus and flexor. femor., above trochanter minor, to the internal and posterior surface of the neck of the femur. Branches: ram. superficial. to m. pectineus, abduct. long. and brevis.
Art. acetabuli to the capsule and lig. teres of the acetabulum.

Ram. anastomotici to the superior part of the scrotum, uniting with the obturatoria and pudenda.

Ram. trochantericus, between m. obturat. ext. and quadrat. femor., to the fossa of trochanter major, anastomosing with glutea and ischiadica.

2. Circumflexa femoris externa, passes behind m. rectus femor., before Psoas-iliacus outwards around the basis of trochanter major, and there ramifies, since it anastomoses with the interna, sends a branch upwards for gluteus minim. and fascia lata, another on the outer border of rect. femoris downwards almost as far as the patella.

3. Perforantes, three to five; they perforate the mm. adductores at their insertions, and then pass to the posterior surface transversely round the femur, and supply the muscles on the posterior surface of the limb. Art. perfor. prima perforates the adductor magnus below the trochanter minor, gives a branch to n. ischiadicus and a nutritia femoris superior; nutritia magna comes from the second or third art. perforans, [and takes a direction upwards]. They anastomose with the inferior branches of femoralis (also keep up the collateral circulation after ligature of the poplitea). The first also anastomoses with the circumflex. femor. and glutea; the third is the terminal branch of profunda femoris.

583. C. Poplitea, the popliteal artery,

the continuation of art. femoralis, reaches, from the inferior third or fourth of the thigh, as far as to the superior fifth or sixth of the leg, and is about seven inches long. Course: somewhat oblique, from above, downwards, and from within, outwards to the centre of the popliteal region, hence, vertically downwards. Position: deep, (especially below) in the neighbourhood of the bone, it is covered behind—from above to below by: m. semi-membranos.; fat and fascia poplitea; m. gastrocnemius and plantaris long.; lastly m. soleus; close behind it, and externally (almost together) Ven. poplitea, and behind this N. tibialis. Before it lie—from above downwards—the inner and posterior surface of the os fæmoris, the knee-joint and m. popliteus. On the inner side: m. semi-membr., condyl. intern. femor., caput intern. gastrocnemii. On the outer side: m. biceps, cap. extern. gastrocn., plantar. long., soleus. Branches; posterior:

1. Surales s. gemelle, two to four, arise at the knee-joint, pass forwards and downwards on the anterior internal surface of m. gastrocnemius; a branch with n. saphenus as far as tendo Achillis. Anterior branches:

2. Articulares genu superiores, superior articular arteries.

a. Articularis interna I., s. superficialis [s. anastomotica magna] arises from art. cruralis whilst in the sheath of m. adduct. magn., sometimes higher; the largest passes under suriorius to the condylus internus; a branch to the triceps, another with n. saphenus intern.
b. *Articularis interna II.*, passes transversely to the *condylus internus*, ramifies there and gives branches to the border of the patella.

c. *Articularis externa* arises opposite *b*, and passes transversely outwards to *condyl. externus*, and gives an:

    Art.—*superior media* for the posterior surface of the knee-joint.


d. *Articularis externa*, passes outwards and forwards above the fibula, covered by *gastrocn. extern.*, *plantar. long.*, *biceps*, and *lig. genu extern.*

e. *Articularis interna*, also passes inwards to the *condyl. tibiae*. From it, if not from the art. *poplit.* itself, arises:

    Art.—*inferior media*, which penetrates from behind through the middle of the capsular ligament into the knee-joint.

f. *Articularis infima externa*, passes transversely over the fibula outwards, covered by *m. peroneus long.* and *extens. digit. commun.*, ramifying in these as far as the fibula and knee-joint.

*Rete articularare genu,* is found on the anterior and lateral surfaces of the knee-joint, and behind *lig. patella*. It is formed by artt. *articulares genu*, connected above with the *perforantes profunda femor.*, below with the *recurr. tibiae*.

584. III. *Tibialis antica*, the anterior tibial artery,

the anterior branch of *art. poplitcea* (two or three inches below the knee-joint), passes, from the point of division of the last at the inferior border of *m. poplitceus*, immediately forwards above the superior border of *lig. interosseum* (between the superior extremity of *tibia* and *fibula*). It then extends directly downwards before *lig. interosso* as far as the inferior fourth of the *tibia*, thence inclines inwards and downwards to the dorsum of the foot, from which point it is called *art. pedicae*. Position: very deep, before *lig. interosseum*, and farther down before the external surface of the *tibia*, behind and between *m. tibialis anticus* and *extensores digit.* (commun. and *halluc. long.*); on the inner side of the *n. tibial. anticus*. At the tarsal joint: upon this, covered by *lig. cruciat*, and the tendons of *extens. halluc. longus*.—Branches:

1. *Recurrents tibialis posterior*, passes off close at the commencement of *tibialis*, upon the posterior surface of the tibia upwards to the joint; covered by *m. poplitceus*.

2. *Recurrents tibialis anterior*.—Or.: close above *lig. interosso*. Course: inwards and upwards between *m. tibial. anticus* and *condylus extern. tibiae*, close to the bone. Branches to *m. tibial. anticus*, *extens. digit. comm.*, *capitul. fibula*; anastomoses with *articul. genu extern.*

3. *Art. malleolaris externa*, arises higher or deeper, above *lig. tarsi dorsale*. Course: curves outwards and forwards around the external *malleolus* to the outer surface of *os cuboideum*, and anastomoses with *art. tarsae externae* and *peroneae*. 

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4. Art. malleolaris interna, passes transversely under tendo m. tibial. antici inwards and above the internal malleolus to the internal surface of the tarsus, and anastomoses with art. plantaris interna.

585. Pedicea s. dorsalis pedis, the dorsal artery of the foot, the continuation of tibial. antica, when it has passed out from under the lig. tarsi dorsale, passes upon the back of the foot, from behind forwards, as far as the posterior extremities of the os metatarsi I. and II., and sinks between these to the sole of the foot. Position: on the external border along the tendons of extensor halluc. longus, on the internal of extens. digit. brevis, covered by the fascia and skin, only. Branches:

5. Tarsea externa. Origin: before the collum astragali. Course: obliquely outwards, under m. extens. digitorum brevis, to the basis of the fifth os metatarsi; anastomoses with art. plantaris under the sole of the foot.

Branches: 1. Ram. posterior, anastom. with art. malleolar. externa and peronea.

2. Ram. anterior, passes forwards in a curve, anastomoses with art. metatarsae, and sometimes gives the interossea dorsalis 3.

6. Tarsea interna, passes obliquely forwards and inwards, to the articulation of os cuneiforme I. and metatarsi 1., gives branches to the great toe before, and to the metatarsus behind.

7. Art. metatarsae, arises, generally, in the interspace between first and second os metatarsi at the posterior extremity; passes transversely outwards, and forms the arcus dorsalis metatarsi, which anastomoses with tarsea externa and gives off anteriorly the artt. interossea.

8. Art. interossea dorsalis I. passes off from the art. pedicea, before this be-takes itself to the sole of the foot, into first interstit. inteross., and supplies the dorsal surface of the outer and inner border of the great toe and the internal border of the second toe; it belongs therefore to the arcus dorsalis.

586. IV. Tibialis postica, the posterior tibial artery,

the posterior branch of art. poplitea, passes downwards in the direction of the last, at an acute angle from art. tibialis antica to the posterior surface of the leg and the internal malleolus; beneath this to the groove on the inner surface of calcaneus, and divides at the boundary between the sole and the internal border of the metatarsus, into art. plantaris interna and externa. Position: as far as the inferior third of the tibia before m. soleus, then on the inner border of tendo Achillis, covered by the fascia and skin, only; behind m. tibialis posticus and flexor. digitor. longus; on the inner side of n. tibialis. On the inner side of the os calcis covered by lig. laciniat. internum above, flex. digit. long. (within) and hallucis (without) it divides, close behind caro quadrata. Branches:
1. *Nutritia tibiae*, large, passes downwards on the posterior and outer side of *tibia* as far as *foram. nutrit.* and supplies the medullary cells.

2. Art. peronea s. fibularis. Origin: at an acute angle, one inch to an inch and a half below the origin, on the outer wall of *tibialis posticus*. Course: downwards along the inner posterior surface of the fibula, separated from it by *flexor halluc. long.* and behind the external malleolus, on the outer side of *calcaneus*. Position: covered behind by *m. soleus* upon *tibialis posticus*, then between this and *flex. halluc. longus*, upon *lig. interosseum*. Behind *malleolus externus*; on the external border of *tendo Achillis* covered by *fascia* and skin, only.

a. Muscular branches backwards for *m. soleus*, externally for *mm. peronai* and a *nutritia fibulae* [directed downwards].

b. *Peronaeus anterior s. perforans*, a thinner branch, passes down on the inferior third of the tibia through the *lig. interosseum* on its anterior surface, and passes into the *rete malleol. externum*.

c. *Peronaeus posterior*, a continuation of *art. peronae*, passes along the outer border of the *tendo Achillis*, covered by *fascia* and skin, only, to the outer surface of *calcaneus*, and anastomoses with *art. malleolar. and plantar. extern.*., and gives a transverse uniting branch which passes between the *tendo Achillis* and the bones to the *tibialis postica*.

3. *Malleolaris interna posterior* arises behind the inferior extremity of *tibia*, passes close to the bone from the tendons of *tibialis posticus* and *flex. digit. long.* to the inner *malleolus* and into *rete malleolare internum*.

4. *Plantaris interna*, the smaller internal terminal branch of *art. tibialis postica*. Course: along the inner border of the sole of the foot (one inch removed from it) forwards. Position: between *abductor hallucis* (within) and *flexores digitor.* (without), covered by the *fascia plantar*.

Branches: ascending to the articulations of the metatarsal bones. Terminal branches from the posterior extremity of *os metatarsi hallucis*:

a. *Ram. internus*, passes along the inner border of the *m. abductor hallucis* superficially.

b. *Ram. internus*, anastomoses with the trunk of *art. inteross. plantar. I*. A branch passes through *fasc. plantaris* to the skin of the inner side.

5. *Plantaris externa*, the deeper external terminal branch of *tibialis postica*. Course: from the inner side of *calcaneus*, obliquely outwards and forwards as far as the posterior extremity of *os metatarsi V.*; an inch distant from the outer border of the foot; then curved inwards above *oss. metatarsi 4 to 2*, where it anastomoses with *art. pediea* (see *arcus plantaris*). Position: upon the tendons of *flex. digit. commun.* and *halluc.*, *caro quadrata*, *flex. digit. 5. brev.* and *interossei*; covered behind by *lig. laciniat.*, then by *abduct. halluc.*, *flexor digit. brevis*, *aponeurosis plantar.* (below).

Branches: to the *calcis*, to *mm. flexor. digit. brev.* and *caro quadra.*, to the *Tarsus*. *Art. plantaris digitii V. externa* passes under *flex. brevis digit. V.*, terminates at the outer border of the plantar surface of the little toe, and anastomoses with *art. dorsales tarsi* (compare *Arcus plantaris* and *Art. tarsae externa*.)
587. The vascular arches of the foot.

1. Arcus dorsalis pedis s. tarseus dorsalis, close upon the dorsal surface of the metatarsal bone, is before convex, and arises from the junction of the Art. metatarsae with the anterior branch of the art. tarsea.

From it three branches arise:

Artt. interossea dorsalis pass in the second to the fourth interstitium interosseum metatarsi, where they give off the three:

Artt. perforantes, which sinks downwards, and pass opposite to the artt. perforantes from the arcus plantaris;

whilst they divide in a forked manner at the anterior extremity into the small:

Artt. digitales dorsales, which betake themselves to the dorsal surface of the toes, from the external border of the second as far as the internal of the fifth toe, terminate on the first phalanx, and unite with the corresponding of arcus plantaris.

Both borders of the first and the internal border of the second toe are supplied from art. dorsalis hallucis, the terminal branch of art. pediæa.

2. Arcus plantaris (profundus, there is no arcus plant. sublimis present), close under the posterior extremities of the metatarsal bones in the sole of the foot, is convex before, and arises principally from the junction of:

Art. plantaris externa with art. pediæa (also tibial. postica and antica).

From it three superior and five anterior branches arise:

a. Artt. perforantes (three) ascend (see arc. dorsalis).

b. Artt. interossea, four, pass in the second to the fourth interstit. inteross., divide at the anterior extremity into two branches:

Artt. digitales plantares, which supply the outer border of the great, the inner of the fifth toe, and both plantar borders of the second, third, and fourth toes, and unite in an arch on the ungual phalanx.

588. The Veins of the great Circulation.

They form, with the exception of the two veins of the heart, two principal trunks, namely, V. cava superior, which carries the blood from the superior, and V. cava inferior, which carries it from the inferior half of the body to the right auricle of the heart. Both stand in relation by means of a lateral branch, V. azygos, which arises in the inferior half of the body and opens into the superior vena cava. With the system of the inferior cava an important one is included, the system of the Portal vein, and in the fetus the umbilical vein, besides.

589. A. Venæ cordis s. cardiæce.

1. V. coronaria magna cordis. Course: from the apex of the heart as far as
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basis ventriculi upwards in the anterior longitudinal groove; then leaves its art. coron. sinistra, turns in the left transverse groove at a right angle to the left, and opens at the posterior inferior surface into the right auricle, close to the septum atriorum, covered by valvul. Thebesii. Branches: from the walls of the ventricles and the septum; it receives besides:

a. V. cordis media s. Galeni s. posterior, passes in the posterior longitudinal sulcus from the apex as far as the transverse, and opens in a wide place shortly before the orifice of V. magna.

b. V. coronoria dextra, passes from the left border of the heart in the transverse groove to the right, and opens shortly before the orifice of V. magna.

c. V. phrenica dextra.

d. V. anonyma dextra.

e. V. anonyma sinistra.

2. Vv. minores cordis, 3 to 4 small veins on the anterior surface of the right ventricle of the heart, open into the right auricle; below it frequently v. coronaria dextra. Vv. and foramina Thebesii do not exist farther.

590. B. Cava superior s. descendens, the superior or descending cava,

corresponds to the arcus aortae and the aorta thoracica; arises in consequence of the association of anonyma dextra and sinistra—close behind the cartilage of the second right rib, one inch from the middle line of the body. Course: downwards on the right side of the sternum, from before to behind and from left to right to the superior part of the right auricle. Position: the superior portion; on the inner side of the right lung (the right anterior mediastina) and the N. phrenicus dexter; it lies to the left on the art. anonyma and arcus aortae, behind gland. thymus, before (lymphatic glands and) trachea. The inferior portion inside the pericardium (one to one inch and a half long), close before: bronchus, Art. and Ven. pulmonalis (super.) dextr.; touches on the left aorta ascendens, is free to the right. V. cava sup. possesses no valves, and therefore pulsates. Length: three inches. Breadth, at the mouth, two inches. Sometimes two Vv. cc. supp. are present. Branches: V. anonyma dextra, sinistra and V. azygos.


They correspond on the one side to truncus anonymus, on the other to carotis and art. subclavia. Origin: behind the articulatio sterno-clavicularis and from the junction of the Ven. jugularis interna and subclavia. Without valves.
Special Anatomy.

Anonyma dextra.

Length: twelve to fourteen lines. Course: vertically downwards and inwards. Pos.: parallel with art. anonyma, which is close to it on the left; one inch from the middle line; to the right and behind N. phrenicus and art. mammaria dextra. Branches: Vv. mammaria interna and thyreoid. dextra; often the v. vertebralis alone.

Anonyma sinistra.

Longer (two inches) and thicker. Course: almost horizontal, backwards concave. Pos.: above arcus aorta, behind the superior border of the Sternum, before art. anon., carot., and subclavia sinistra. Branches: Vv. mammari. interna, thyreoid. sinistra, and phrenica super., thymica, pericardiaca, and often v. intercostalis superior and v. vertebralis.

The collateral branches:

1. Vv. thyreoidea inferiores, one dextra, one sinistra. Course: like art. thy. infima; the former opens in the angle between the two Vv. anonyma, the latter into the left v. anonyma; they receive Vv. tracheales and laryng. (plexus trachealis).

2. Vv. mammaria interna, two for each artery; they receive Vv. sternoales (plexus sternalis).

3. Vv. phrenica, very long and small; they pass with N. phrenic. and art. phren. super.

4. V. vertebralis. Origin: in the deep cervical muscles, and a smaller branch from the foram. condyloid. Course: in the canal. vertebralis, passes out under the sixth or seventh vertebra, and opens close behind V. jugul. intern.; receives V. cervical. ascend. and profund. Position: behind art. subclavia.

592. 1. Jugularis interna, the internal jugular vein, corresponds to the carotis communis and externa. Or.: in the foram. jugulare with a sacciform enlargement, bulbus, passing out of the sinus transversus of the cranial cavity. Course: descends at first behind, then on the outer side of carotis interna, communis, and N. vagus (which lies in a sheath between the artery and vein behind them), and terminates, with an oval enlargement, bulbus, at the origin of truncus anonymus before Art. subclavia. From foram. jugular. to the superior border of the larynx, called cephalica interna, two inches and a half to three inches long; it is covered by m. digastricus and sterno-mastoid, on the outer side of the nn. glossophar., hypogloss., and pharynx, on the inner of the proc. styloid., before proc. transvers. of the first to the third vertebra. At the larynx it receives the short cephalica externa, which arises from the junction of facialis anterior and posterior.

a. V. facialis anterior corresponds to art. maxillar. externa. Course: external and behind art. maxillar. extern., downwards and outwards from the internal angle of the eye, to the anterior border of m. masseter over
the lower jaw to one inch beneath its angle. Position: at the angle of the eye, as ven. angularis, before the lig. palpebr. intern.; then between levat. labii alaeq. nasi and orbicul. palpebr.; upon levator labii super. and buccinat., under the zygomatici; beneath the lower jaw upon gland. submaxillaris. Branches:

1. V. frontalis, between the skin and m. frontalis, near the central line of the forehead, to the root of the nose.
2. V. suprarorbitalis, between m. corrugator and frontalis, from without inwards, anastomoses with vv. temporales; with v. frontalis over lig. palpebr. intern.; receives v. diploica frontal.
3. V. ophthalmica, passes backwards from the v. angularis between lig. palpebr. int. and trochlea, on the inner wall of the Orbita, then over N. opticus, leaves the art. ophthalm., and passes, at the internal boundary of fissur. orbital. super., into the sinus cavernosus. It receives: v. sacci lacrymal., ethmoidal. anter. and poster., ciliar. long. and vorticosæ, lacrymalis, central. retinae; lastly:
   v. ophthalmica inferior, which lies on the floor of the orbit, formed of vv. musculares and ciliares inferior., likewise anastomosing through fissura orbit. infer. with ram. profund. v. facial. anter.
4. Vv. nasales, from the back (dorsales) and alæ of the nose (pinnales s. alares.)
5. Vv. palpebrales inferiores and labiales superiores.
6. Ramus profundus s. facialis profunda unites the v. facial. with v. maxillar. interna and ophthalmica; arises from a plexus which is formed by v. ophthalm. infer., nasalis poster., dentalis superior, upon the posterior surface of the upper jaw, is connected with plex. pterygoïd., and opens below the proc. zygomatic. of the upper jaw.
7. Vv. labiales inferiores, buccales, masseterica, submentalis, submaxillares.
8. V. palatina arises in the soft palate and from plex. tonsillaris; also open into cephalica interna.

b. Vena facialis posterior. Origin: inside the parotis behind collum. condyle maxill. infer., from v. temporalis and maxillaris interna. Position: on the inner side of carotis externa. Course: behind the ramus of the lower jaw: united at an angle with V. facialis anter. It frequently opens, as it passes away before sterno-mastoideus into V. jugularis externa, and sends a large uniting branch, over m. digastricus, to V. jugularis interna. Branches:

1. V. temporalis communis passes backwards from art. temporalis, between the meatus auditor. externus and the maxillary articulation under the skin, and enters the parotis; unites behind collum condyli, with V. maxillaris interna; consists of:
   a. Temporales superficiales; these are branches which pass from
      a rete with wide meshes from the forehead, vertex and occiput
between the skin and muscular layer, unite above the proc. zygomatic of the temporal bone, and unite before the external auditory meatus with:

b. V. temporalis media; passes under fascia media; over m. temporalis from before backwards, perforates the fascia; consists of: vv. palpebral and orbitales externa.

2. Maxillaris interna corresponds to the inferior portion of art. maxillar. intern.; receives two vv. meningeae media, v. dentalis inferior, vv. temporal., profunda, pterygoidea, masseterica; they form plexus pterygoideus in the inferior part of the temporal fossa, between m. temporal. and pterygoïd. extern. and the two pterygoïdei.

3. Vv. parotideæ, auriculares poster. and anter., transversa faciei form between Parotis, m. masseter, and about the maxillary articulation, the large plexus massetericus, which is connected above the incisura semilunar. with pl. pterygoid.

c. V. occipitalis passes under m. splenius forwards, and receives several vv. mastoidea, which pass out of sinus transvers. of the cranial cavity, and they establish an important communication between the external and internal cranial veins.

d. Ven. thyreoidea superior; its branches come from the superior part of the thyroid gland, from below the pharynx, from the interior of the larynx; it opens into the short trunk of cephalica externa; likewise the laryngea and lingualis (s. jugular. externa).

e. V. thyreoidea media arises from art. thy. infer., opens into the trunk of jugular. interna.

593. Jugularis externa consists of an anterior and posterior (cutaneous) trunk, which open together behind the clavicle, and enter into the V. subclavia or V. anonyma. They have (two) valves.

1. Jugularis externa anterior, formed by one or two vv. subcutanea above the hyoid bone, descends along the inner border of m. sterno-cleido-mastoideus, and curves backwards behind the inferior termination of the muscle to the posterior trunk. A transverse branch unites the right and left vein, and generally receives the V. thyreoid. media; a superior transverse branch unites both in the region of the os hyoïdes.

2. Jugularis externa anterior. Origin: behind the angle of the lower jaw, from a branch of V. facialis posterior, V. occipitalis, and auricular, superfie. Course: oblique from above downwards, and from before backwards, over the sterno-cleido-mast.; from the angle of the lower jaw as far as the centre of the clavicle, then forwards and inwards to the v. subclavia. Position: superficial, covered by M. platysmam. and skin only; above, behind it N. auricularis; below, behind m. sterno-cleido-mast. Branches; besides the principal rami:

a superior connecting branch through the Parotis with V. jugularis interna;
an inferior, under the clavicle, to V. cephalica of the upper arm; further:

Vv. transversæ collis and scapulae; from laryngea superior, and often; V. lingualis. The superficial veins upon the dorsum linguae (vv. linguales) open between m. lingualis and mucous membrane in a plexus lingualis superior at the basis of the tongue. From it a branch accompanying the n. lingualis passes to Vv. ranine. They pass superficially beneath the tongue to the side of the frenulum, accompany N. hypoglossus between m. genio and hypo-glossus, are connected with plexus inferior at the side of the tongue, and open in the Ven. lingualis, which takes the same course as the artery (and, frequently, opens into cephalica externa).

594. 3. Vena subclavia, shorter than the art. subclavia. Origin: at the superior border of m. serratus anticus, from v. axillaris. Termination behind artic. sterno-clavic. Course: transversely inwards to the orifice of V. jugularis interna (in the anonyma), whilst art. subclav. is curved, or arches over the apex of the lung. Pos.: behind m. subclavius and clavicle, attached by fascia cervicalis; before art. subclavia (and m. scalenus anticus); close above the first rib, beneath fascia cervicalis and the skin. Valves are wanting.

Branches: V. intercostalis prima dextra, generally V. jugularis externa; transversa collis and scapulae. V. subclavia is a continuation of:

1. Vena axillaris, which is placed on the inner and anterior side of atr. axillaris, and consists of the two venae brachiales united together, which pass deeply on both sides of art. brachialis. Branches: circumflex. humeri, subscapul., thorac. extern.; they receive the V. cephalica, whilst the rest of the cutaneous veins open into vv. brachiales. The deep veins of the hand and the fore-arm correspond exactly with the distribution of the arteries of the same name, but are double, and anastomose together.

2. Cutaneous veins of the arm; they are larger than the muscular and deeply-seated veins, form plexus, and are situated between the muscular layers and the subcutaneous uniting tissue. Strongest on the dorsal surface of the hand, formed by the ascending digital veins, the plexus, concave above, sends off several branches upon the corpus, the most external of which, v. cephalica pollicis, passes on the thumb; the most internal, v. salvatella, on os metacarpi V. On the arm the cutaneous veins are more numerous on the flexor surface. They are:

a. Vena cephalica s. cutanea radialis, the continuation of cephalica pollicis, passes along the outer surface of radius to the middle of it, about the external border upon the anterior surface, and divides, one to two inches below the bend of the arm, into the mediana and cephalica brachii. The last passes at first on the outer border of the m. biceps, then inwards to the groove between m. pectoralis maj. and deltoïd., where it opens (one inch below the clavicle) into the vena
axillaris; it receives the cutaneous veins of the upper arm, shoulder, and breast.

b. *Vena basilica s. cutanea ulnaris,* a continuation of *salvatella,* passes on the ulnar border and the flexor surface of the fore-arm, and unites with the *v. mediana* (one inch to two inches and a half) above the bend of the arm. When an *ulnaris posterior* is present, it opens higher up. In the upper arm it passes on the inner border of *m. biceps,* perforates the *fascia brachii,* and opens into *v. brachialis interna* or *axillaris.* It carries the blood of the volar side of the hand and of the fore-arm.

c. *Vena mediana* passes obliquely from without inwards, and from below upwards, from *v. cephalica* to *v. basilica,* larger than either, lying in the bend of the arm over the *aponeurosis* of *tendo m. bicipit.* and *art. brachialis.* It carries the blood of the dorsal side of the hand and fore-arm, and also receives branches from the volar surface and the deep veins of the fore-arm. Varieties in these veins are particularly frequent.

595.  

II. *Vena azygos.*

This vein corresponds with the *aorta thoracica,* uniting *v. cava inferior* and *superior* with one another. Or.: in the abdominal cavity; before the first lumbar vertebra, rarely, from the *v. renalis* or *v. cava inferior* itself. Course; through *hiatus aorticus* into the thorax; on the right side of the thoracic vertebra as high as the third intercostal space; curving over *bronchus* and *v. pulmonal.* *Dextra* forwards, it opens at the posterior part of *v. cava superior* at its entrance into the *pericardium.* Situation: in the *cavum mediastinum. posticum,* before the *vv. intercostales dextra,* to the right of *aorta* and *ductus thoracicus.* It receives in front: *v. bronchialis dextra,* some *vv. asophagoae,* and *mediastineae*; to the right the eight last *vv. intercostales dextra;* to the left *v. hemiazygos* and the *intercostales superiores sinistre.*

1. *Vena lumbalis ascendens,* the connecting ramus of the transverse *vv. lumbales,* ascends, curved or in a straight line; receives a branch from *ven. iliaca communis,* and passes into the *v. azygos* upon the right, into *v. hemiazygos* upon the left side.

2. *Vena hemiazygos.* Origin: from the four last *vv. intercostales sinistre* and *v. renalis.* Course: through *hiatus aorticus,* along the left side of the vertebral column as high up as the eighth or seventh dorsal vertebra, passing before them, behind *ductus thoracicus* and *aorta,* into the *ven. azygos.* The superior (the second and third) *vv. intercostales sinistre* generally form a trunk *(hemiazygos superior),* which opens from above downwards into *hemiazygos* or *azygos,* accordingly as it has received the
superior ven. bronchial. sinistra. It receives vv. asophageæ, mediastin. and pericardiacæ.

596. C. The cava inferior s. ascendens.

Origin: before the cartilage between the fourth and fifth lumbar vertebra, behind and to the right of the bifurcation of aorta abdominalis, by the junction of the two vv. iliacæ. Course: vertical from the fourth lumbar to the ninth dorsal vertebra; on the inferior surface of the liver curved rather forwards and to the right towards the posterior portion of the right longitudinal fossa, it passes behind this through foram. quadrilaterum of the diaphragm, immediately (half an inch to three quarters of an inch) into the pericardium, and there horizontally forwards and to the left into the inferior posterior part of atrium dextrum.

Situation: to the right on the anterior surface of the bodies of the vertebra, to the right of the aorta, behind the peritoneum, the inferior horizontal portion of the duodenum, the pancreas; before m. psoas and the right crus of the diaphragm; above in a semi-canal of the liver. Without valves, except valv. Eustachii at its mouth. Collateral branches correspond to the distribution of the branches of aorta abdominalis, with the exception of art. coliaca and mesentericaæ (see the portal vein); they are:

1. Vv. lumbales and lumbalis ascendens.
2. Vv. spermaticæ. a. Testiculares et epididymææ, anastomosing with the vv. pudendæ they form a plexus spermaticus (s. pampiniformis), and with vas deferens and the art. spermatic. the spermatic cord. They leave the vas deferens on its entrance into the pelvis, and pass along the m. psoas (with art. sperm.) to ven. cava inf. [the right] and v. renalis [the left]; the left behind sigmoid flexure (therefore frequently varicose [?] ). b. Ovaricaæ, from the ovary, uterus, ligg. rotund. ; they form, like vv. testiculares, a plexus pampiniform. at the orifice.
3. Vv. renales, the right is shorter and passes more obliquely upwards than the left, which receives the spermatica sinistra, and passes over in front of the aorta.
4. Vv. suprarenales.
5. Umbilicalis (see § 559):
6. Vv. phrenicæ inferiores, two for each art. phrenica.
7. Vv. hepaticæ, arise from the capillary rete formed by vena portæ and art. hepatica in the lobules of the liver, open with eight to ten small trunks along the fossa vena cava, with two to three larger from the right and left lobes of the liver close under the foram. quadrilaterum, at an acute angle into the vena cava. They pass from before backwards (crossing also with the branches of v. portæ and art. hepatica), are not placed in a fibrous sheath, and are perforated like a sieve in their interior by the minute veins opening into them.
SPECIAL ANATOMY.

597. 1. Vena iliaca communis.

Origin: before the superior part of symphys. sacro-iliaca by the junction of vv. iliace interna and externa,—behind the division of art. iliaca communis. Termination: to the right of the superior border of the fifth lumbar vertebra. Course: obliquely upwards and inwards. Valves are wanting.

Iliaca communis dextra is situated: behind and to the outside of art. iliaca communis, is shorter, and receives no branches. It is not compressed by an artery, like the left common iliac vein.

Iliaca communis sinistra is situated: internal to and behind its artery; at the mouth of art. iliaca communis, dextra descends before it from left to right; receives: V. sacra media.

1. Iliaca interna s. hypogastrica corresponds to the art. hypogastrica, and its branches (the v. umbilicalis, only, opens into v. portae). Origin: generally from plexus, on the walls and in the organs of the pelvis, and in the external organs of generation. Course: ascends out of the pelvis before m. pyriformis and symphys. sacro-iliaca, is short. Position: behind and internal to the arteries of the same name. They and their branches are supplied with veins.

a. Plexus haemorrhoidalis surrounds the inferior extremity of the rectum, and the mucous membrane of the orifice of the anus, is formed by Vv. haemorrh. superr., branches of v. mesenterica infer., and the vv. haemorrh. mediae and infer.; branches of v. hypogastrica.

b. Plexus vesicalis, in the male surrounds Prostata and neck of the bladder, is connected with a; receives the vv. superficiales penis, and gives off vv. vesicales. In the female it is smaller, and unites with plexus vaginalis.

c. V. dorsalis penis arises from the foreskin, passes (between its two arteries) upon the back of the penis, connected with the deep veins, and enters under the pubic angle through ligam. pubo-prostaticum to plex. prostaticus. In the spongy tissue of corpp. cavernosa arise the branches of pudenda interna.

d. Plexus vaginalis arises in the erectile tissue of the introitus vaginae, connected with plex. vesicalis and haemorrhoid.

e. Plexus uterinus. The veins of the uterus form large trunks not tortuous, at the lateral margins (sivus uterini), united together transversely, and possessing erectile fibres, like the tissue of the Uterus; they unite with the vv. ovariae.

f. Vv. iliolumbalis, sacra lateralis, obturatoria, ischiadica, pudenda, glutaea.

2. Iliaca externa s. cruralis, takes a course like the art. cruralis. In the
pelvis it is situated on the inside (and behind) in the femoral ring; on the inner side (crural hernia passes down before it); below the mouth of v. saphena: behind; and at the inferior part of the thigh: on the outer side of the artery; in the popliteal region; behind, and rather outside the art. poplitae. In the foot and leg the deep veins are double for each artery, but they take a similar course. The v. iliaca externa, only, does not possess valves.

Cutaneous veins (with very thick walls):

a. Saphena interna s. magna, arises from plexus dorsalis pedis, on the internal border of the foot, passes upon the dorsal surface of os metatarsi I., and over the tarsus, curves from below upwards before the inner malleolus, then ascends on the internal surface to the posterior border of the tibia as far as behind condyl. intern. femor. (on the inner side of the tendons of mm. semitendin., gracilis, and sartorius), inclines to the front, and ascends along the anterior border of m. sartorius to the inner and anterior surface of the thigh, perforates the fasc. cruralis, and sinks one inch below the femoral arch into the v. femoralis. It receives the cutaneous veins of the thigh, of the anterior abdominal walls and Vv. pudend. externæ, and branches of the deep veins.

b. Saphena externa s. parva arises from plexus dorsalis pedis, on the outer border of the foot, passes round behind the external malleolus, at first on the outer border of the tendo Achillis, then over this to the centre of the fibula, and thus to the popliteal region, where it sinks, between nerv. tibialis and fibularis, close to v. articular infer. interna. into the popliteal vein. It covers and crosses the n. peroneus twice. It receives branches from the sole of the foot and leg, unites with v. saphena interna at the malleolus and back of the foot; and sometimes also opens into it.

598. II. Vena portae s. portarum, the portal vein, forms a tolerably independent system of vessels, the roots of which pass forth from the capillary rete of the organs of digestion, unite into one venous trunk, which again ramifies, in a dendritic manner, like an artery, in the liver, so that its blood passes along through the vv. hepatica, again into the circulation. It corresponds to Artt. cæliaca, mesenterica superior and inferior, with the exception of art. hepatica. Origin: from the vv. mesenterica superior and linealis, united at an acute angle, behind the head of the Pancreas, the duodenum, in the centre before the vertebral column, to the left of the Vena cava inferior. Course: from below upwards, and from left to right, four inches long, to the left extremity of the transverse fossa of the liver, in which it bifurcates. Situation: behind cap. pancreatis and pars descend. duodeni, art. and ductus hepaticus, before v. cava. infer.; within the capsula Glissonii, between the two layers of lig. hepatico-duodenale.
Branches: to the trunk of *ven. portae* also pass *v. gastrica (sinistra) superior* and *cystica*; from the trunk passes off in the *Porta (sinus v. portae)*:

a. *Ramus dexter*, the shorter and thicker branch for the right lobe of the liver.

b. *Ramus sinister*, for the left and the two central lobes, receiving in the embryo the right branch of the umbilical vein, and gives off *ductus venosus Arantii*, which unites *v. portae* and *v. cava inferior*.

The two branches pass off from one another at a right angle, quickly divide, continually becoming smaller, and form, at last, around the glandular lobules of the liver, a capillary rete, from which the *vv. hepaticae* come off.

1. *Lienalis s. splenica* arises in the cells of the spleen, passes through the *Hilus* and transversely to the superior border of the *pancreas*, behind and below *art. lienalis*, towards the right to the *mesenterica superior*. It receives *vv. breves, pancreaticae, gastro-epiploica sinistra*, and:

   a. *V. mesenterica inferior*. This arises from *ven. hemorrhoid. superior* in the *plexus hemorrhoidalis of the rectum* (therefore connected with *v. hypogastrica*) and *vv. colica sinistra*; passes obliquely to the right and above *mesocolon descendens*, before the *vasa renal. and behind the pancreas* to the splenic vein, near to its confluence with *v. mesenterica superior*, in which it even often opens.

   b. *Mesenterica superior*. It lies on the right and anterior side of the artery of the same name, arises from *vv. colica dextra* and *intestinales*, *gastroepiploic. dextra*, and receives in the embryo the *v. omphalo-mesenterica* from the umbilical vesicle, which in the third month of foetal life, together with its artery, again disappears.

Anastomoses of the portal vein: 1. between the *vv. hemorrhoidal* and *hemorrhoid. interna*. 2. Between the veins of *colon transvers*, *descendens*, and *v. cava inferior*.

599. *Vena umbilicalis*, the umbilical vein, arises in the embryo from the capillary rete formed by the *two artt. umbilicales* in the *Placenta*. Passing through the umbilical cord and ring into the belly of the foetus, it advances to the inferior surface of the liver (in the left anterior longitudinal sulcus), and bifurcates into a larger connecting branch for the left branch of the portal vein, and a smaller left (*ductus venosus Arantii*), which carries the blood into the *ven. cava inferior*. It becomes impervious (in one month) after birth, and then passes as *lig. teres hepatis*. It is larger than the portal vein of the foetus, and valveless. Branches: about twenty small ones for the liver.
The Veins of the vertebral column, to which also vv. azygos and hemiazygos belong, connect together the veins of all parts of the trunk, so that, if even one of the two cavæ is obstructed in any place, the circulation of the blood is, in consequence, uninterrupted. They are partly external, upon the arches of the vertebrae, partly internal, in the canalis spinalis, and they form rete in the whole length of the vertebral column.

1. Internal:
   a. Plexus spinales interni anteriores; they lie close upon the bones, on the posterior surface of the bodies of the vertebrae; they appear as a broad longitudinal canal, consisting however of transverse canals lying close together, with thin walls, connected at the foram. magnum with sinus occipital.; they receive the blood from the vertebrae and the dura mater.
   b. Plexus spinales interni posteriores; between dura mater and vertebral arches, the meshes are wider; they form a ring with the anterior plexus between two vertebrae, besides two canals passing close to the middle line; they anastomose with the:

2. External:
   a. Pl. spinales externi posteriores; they are placed with wide meshes upon the vertebral arches between the transverse and spinous processes; more narrow in the neck (pl. colli poster.) where there is an anastomosis with sinus transversus, (through foram. condyloid. post. and mastoid.)
   b. Pl. spinales externi anteriores; do not exist throughout the spine; pl. colli anter., pl. sacralis.

The Lymphatic vessels, Vasa lymphatica s. resorbentia.

I. The Trunks.

Ductus thoracicus, the thoracic duct, the common trunk of the lymphatics of the entire inferior and the left superior half of the body, measures transversely in width two lines, has a few valves, and frequently divides into two or several trunks, which again unite.

Origin: before the first to the second lumbar vertebra, to the right of the Aorta, to the left of the right internal crus of the diaphragm, close under the hiatus aorticus; by the confluence of three (to six) short thick ramuli, the central one of which comprises the lymphatics of the organs of digestion (chyliferous vessels), whilst the lateral consist of the united lymphatics of the inferior extremities and the pelvis. One or two of the united ramuli is enlarged, one to two inches, before the commencement
of duct. thoracic.; the place is called Ampulla s. cisterna (chyli) Pecqueti, s. receptaculum chyli. Course: tortuous, before and through the hiatus aorticus upwards, rather to the right on the anterior surface of the bodies of the vertebrae, to the right of aorta, to the left of the v. azygos. Passing almost in the central line as far as to the front of the fourth dorsal vertebra, it inclines to the left behind the aorta, on the left side of esophagus, passes out on the inner and posterior side of art. subclavia sinistra from the thorax, and curves, before the seventh cervical vertebra and behind the v. jugular. intern. sinistra, in an arched form outwards and forwards to the angle between v. jugularis interna and subclavia sinistra, where, provided with a valve, it opens singly or divided. Situation: the inferior part in the right, the superior in the left mediastinum.

602. 2. Truncus lymphaticus dexter s. major, the right lymphatic trunk,

receives the lymphatics of the right half of the head, neck, chest (the right lung, the right heart, and half of the liver and pharynx), and the right superior extremity; is in connexion by means of branches with ductus thoracicus. It arises: about one inch above the angle of vv. jugularis interna and subclavia dextra, in which it opens, from three small trunks, in which the lymphatics of the right arm from without, those of the right half of the chest from within, those of the head and neck from above, flow together. The small trunks sometimes open into the veins (subclavia jugularis).

603. II. The Lymphatics and Lymphatic glands of the inferior half of the body.

1. Inferior extremity.—a. Lymphatic glands:

1. Glandula tibialis antica, lies before and above lig. interosseum; is not always present; is formed by the deep lymphatics of the foot.

2. Glandulae poplitae, two to four small glands in the popliteal region along the vasa poplitea, formed by the deep lymphatic glands.

3. Gl. inguinales (seven to twenty), surrounding the opening of the v. saphena magna, and are situated below the lig. Pouparti, in the fossa (fossa ovalis) between m. psoas and pectineus on the thigh, three inches in length, two in breadth. The deep (two, three to seven) are sometimes wanting; they are situated behind the fascia cruralis (round about the vasa cruralia), and unite through the opening in the last (where the v. saphena perforates) with the superficial, which lie upon the v. saphena and proc. falciform., also, immediately with the gl. iliace by means of the femoral ring.
b. **Lymphatics:**

1. The deep accompany the deep-seated blood-vessels on the anterior and posterior surface of the inferior extremity. The anterior pass into the *gl. tibial. antica*, the posterior into the *gl. poplitea*, and thence along the *v. cruralis* into the *gl. inguinal. prof.*

2. The superficial arise in the skin of the foot, the posterior partly from the sole, corresponding with *v. saphena parva*; the anterior come off from the back of the toes, incline inwards, ascend on the inner side of the leg, then upon *Sartorius* to the superficial inguinal glands, accompanying the *V. saphena magna*.

3. The surface of the external parts of generation. The superficial lymphatics of the *scrotum* and *penis* (or the inferior portion of *labia majora*), betake themselves to the deep and most superior inguinal glands, also those of the *rectum*; they correspond to the *vasa pudenda externa*.

4. Anterior inferior abdominal walls, the loins and buttocks.—Their superficial lymphatics, as well as some which accompany *vv. epigastric. and circumflex. ilei*, pass to the superficial and superior inguinal glands.

5. Internal surface of the pelvic and abdominal walls:

a. **Lymphatic glands:**
   1. *Gl. iliaca externa* (six to eight), along the *vasa iliaca externa* and *commun*. upwards to the fifth lumbar vertebra; three thereof are placed close behind the femoral ring on the outer, the inner, and anterior surface of the femoral vessels.

2. *Gl. hypogastrica* (nine to twelve), upon and close to *vasa hypogastrica*, are traversed by the lymphatics from the interior of the organs of generation (*vas. pudenda interna*).

3. *Gl. sacrales* (four to five), laterally before the *promontorium* in the *mesorectum*.

4. *Gl. lumbales s. aortica* (twenty to twenty-five), on the sides of the *aorta* (especially this) and *vena cava*, upwards.

b. **Lymphatics:**

1. *Plexus iliacus externus.*—The lymphatics pass out of the inguinal glands, through *fascia cribiformis*, behind the *v. cruralis* into the pelvis, under the peritoneum to the *gl. iliaca*, forming a plexus about the artery; on the other side to the *gl. hypogastrica*, where they form

2. *Plexus hypogastricus*, about *art. hypogastrica*, and also

3. *Plexus sacralis* on the posterior pelvic wall, passing into the

4. *Plexus lumbalis* (and *gl. lumbalis*). This plexus extends around the *aorta abdominal. and v. cava inferior*, receives the lymphatics of the kidneys, testicles, and spermatic cords, and the female internal organs of generation, and forms the lateral roots of the *ductus thoracicus*.

5. Of the urinary organs:

1. Lymphatics of the kidneys and supra-renal capsules, are superficial and deep. The last pass forth at the *hilus* of the kidney, form plexuses,
and open into the *plexus lumbalis*, after they have united with those of the supra-renal capsules, and received those of the ureters.

2. Lymphatics of the urinary bladder open into *plexus hypogastricus*.

6. Organs of generation:

1. Lymphatics of the testicle pass in the spermatic cord, and in the spermatic vessels, forming a *plexus spermaticus* to the *plex. lumbalis*.
2. Lymph. of corpora cavernosa pass with the art. pudenda under the *symphysis pubis* to the *plex. hypogastricus*, to which also those of the seminal vesicles and preputial glands proceed.
3. Lymph. of female internal organs of generation. Those of the *collum uteri* pass to the *plexus hypogastricus* and *plexus sacralis*; the remaining lymphatics of the *uterus* to the superior angles of the last, and thence, united with those of the *tuba*, the *ovaria*, and *ligg. lata*, with the *vasa spermatica* to *plex. lumbalis*.

604. III. The Lacteals [lymphatics] and Lymphatic Glands of the organs of digestion.


*Gland. mesenterica*, 130 to 150, and situated in rows between the laminae of the *mesenterium*, the largest at the origin, and at the extremity of *vasa mesaraica superioria*. The former, are *gl. duodenales*, they lie before the *duodenum*; the latter are *gl. ileo-colicæ*, in the angle between *ileum* and *colon*. (They readily inflame.)

b. The lymphatics are particularly numerous in the so-called *Jejunum*. The superficial arise from the serous and muscular coats; the deep, *vasa lacteae*, which, during the process of digestion carry white chyle from the villi of the mucous membrane, and pass from gland to gland around the *truncus coeliacus*, to form the middle root of the *ductus thoracicus*.

2. Of the large intestines.  a. Lymphatic glands.

*Gland. mesocolica*, twenty to fifty, are placed connected with the *gl. mesentericae*. They are most numerous in the *mesocolon transversum*, along the vascular arches of *art. and vv. colicae*.

b. Lymphatics. Those of the *caecum, colon ascendens*, and *transversum*, pass through *gl. mesocolici* to the *gl. mesentericae*; those of the *colon descendens* and *rectum* to the *gl. lumbales* and *sacrales*.

3. Of the stomach.  a. Lymphatic glands.

1. *Gl. gastro-epiploicae superiores* (four to six) are situated in the small omentum on the small curvature along the *art. coronar. ventric. sinistra*.

2. *Gl. gastro-epiploicae inferiores* (six to eight) in the great omentum on the great curvature, along the *art. coron. ventric. dextra*. They are especially accumulated about the *ostia pyloricum* and *cardiae*, and they send their *vasa efferentia* to the gland. *celiaca*.

b. Lymphatics. The superficial form a plexus beneath the peritoneal investment; the deep, likewise, upon the mucous membrane, and they incline,
partly, to the great, partly to the lesser curvature, to the *gl. lienales* and *gl. pylorica*.

   1. *Gl. lienales* are placed in the *hilus* of the spleen.
   2. *Gl. pancreaticæ*, at the superior border of the *pancreas* along the *art. splenica*.

b. Lymphatics. Those of the spleen are said to carry a red lymph (Hewson); the superficial come from the covering, the deep from the Parenchyma; they form a *plexus* in the *hilus*, and pass, with the lymphatics of the *pancreas*, along the *art. lienalis* to the *gl. cæliaca*.

5. Of the liver. a. Lymphatic glands.
   1. *Gl. hepaticæ*, small glands, in the porta, they pass into the
   2. *Gl. cæliace* (sixteen to twenty), which are placed round about the *tripus Halleri*, receive the lymphatics of the superior organs of digestion, and assist in forming the lateral roots of the *ductus thoracicus*.

b. Lymphatics. Those upon the superior surface of the liver pass partly forwards through the diaphragm behind the *proc. ensiformis* to the *gl. mediastinae antice* (others to the smaller curvature of the stomach), partly from before to the posterior border; on the inferior surface of the liver they pass from before, backwards: those which pass to the right of the gall-bladder, to the *gl. lumbales*; those which lie to the left, to the *gland. cardiaæ*; those which surround the gall-bladder in a plexus, to the *gl. hepaticæ* and *celiace*. The deep lymphatics pass out on the *ductus hepaticus*, and the *Ven. portæ* inside the *capsula Glissonii*, and proceed to the same glands.

605. IV. Lymphatics and Lymphatic glands of the superior half of the body.

1. Of the superior extremity. a. Lymphatic glands.
   1. *Gl. cubitales*, two to three superficial in the bend of the elbow, three to four deep at the same place above *condyl. internus*, behind *v. basilica*.
   2. *Gl. brachiales*, five to seven small glands along the *art. brachialis*.
   3. *Gl. axillares*, ten to twelve in the axilla, and round about *art. axillar.*, connected by means of a *plexus axillaris*; they receive the lymphatics of the superior extremities and thoracic parietes, and pass with four to five *vasa efferentia* into the *plexus subclavius*, and thence into the *truncus communis*.

b. Lymphatics. The superficial pass with *vv. cephalica* and *basilica*, the deep with the arteries; both terminate in the *gl. axillaris*.

2. Of the external walls of the thorax.—The lymphatics of the anterior and lateral parietes ascend over *m. pectoralis* and *serratus major* to the *gl. axillares*; those of the posterior walls upwards and downwards (under the tendon of *m. longis. dorsi*), to the same.

3. Of the internal thoracic parietes. a. Lymphatic glands.
   1. *Gl. intercostales* (sixteen to twenty); they are small, and lie close to the dorsal vertebrae on the anterior surface of the heads of the ribs; some
between the mm. intercostales; they send their vasa efferentia into ductus thoracicus and

2. Gl. mediastinae posteriores (eight to twelve). They are placed along the aorta thoracica and oesophagus, receiving the lymphatics of the oesophagus and pericardium.

3. Substernales, they pass along the art. mammaria interna, one in each intercostal space, close to the sternum.

4. Gl. mediastinae anteriores are placed, partly (three to four) upon the diaphragm before the pericardium, partly (eight to ten) round about the arcus aort., ven. cava superior and innominata at the basis cordis. Their vasa afferent. come from the convex surface of the liver, the diaphragm, pericardium, the thymus.

b. Lymphatics:

1. Plexus intercostales consists of the deep lymphatics along the artt. and vv. intercostales, receive the lymphatics of the vertebral columns, pass through gl. intercostales and mediastin. poster., and into the duct. thoracicus. They have roots in the mm. intercost. and pleura costalis.

2. Pl. mammarius internus. The lymphatics of the superior half of the anterior abdominal walls ascend behind proc. ensiform., united with those on the external surface, by means of the gl. substernales as high upwards as the gl. cervicales inferiores, and into the ductus thoracicus and truncus lymph. dexter.

3. The lymphatics of the diaphragm pass to the pl. intercost. and hepatic. and to the gl. substernales.

4. Of the Thoracic viscera: a. The lymphatic glands. Glandulae bronchiales s. Vesalianæ (twenty to thirty, larger) are situated along the bronchi and their point of bifurcation, the largest usually at the division of trachea, the smallest (gl. pulmonares) penetrate the substance of the lungs. In youth yellowish white, they become in time (from the tenth year onwards) darker, blue and black, and readily ossify.

b. Lymphatics of the lungs. The superficial form beneath the pleura a close rete and pass, generally inwards to the gl. bronchiales at the roots of the lungs. The deep arise from the lobes of the lungs and pass to gl. bronchial. and gl. oesophageæ. Vasa! efferentia of the bronchial glands pass to gl. tracheales and oesophag. and with these into the ductus thoracicus and trunc. lymphatic. dexter.; several also into v. jugularis interna.

c. Lymphatics of the heart. The superficial, beneath the membr. serosa, generally pass on the right border; the deep arise from the internal membrane of the heart; they pass with the last from the pericardium, and sink into the pl. aorticus before aorta and art. pulmon., and into the ductus thoracicus. The lymphatics of the thymus gland and pericardium pass into the gl. substernales, mediastin. anteriores and bronchiales.

5. Of the head and neck. a. lymphatic glands of the head.

1. Glandula subauriculares, under and behind the auricle, behind the insertion of m. sterno-cleido-mastoïd.; they are, like the rest (gl. mastoideæ,
THE VESSELS.

occipitales) of the lymphatic glands of the skull (which are only found on the back of the head) very small and less numerous.

2. Gl. submaxillares, the largest in the face, they lie at the basis mandibulae (eight to ten) and along the art. maxillaris; they open into gl. cervicales superficiales.

3. Glandula parotidea, deep, lying superficially between parotis and m. masseter.

4. Gl. zygomaticæ, under the zygoma, they open into gl. submaxillares and cervical. superf.

5. Gl. faciales profundiæ, behind m. buccinator, and on art. maxillar. interna, they receive the deep lymphatics of the face; its cavities and the dura mater; they open into gl. cervical. profundiæ.

b. Lymphatics of the head. The superficial accompany the art. temporal. superf. to the gl. parotid., and the art. occipitalis to gl. mastoideæ. The deep vasa lymphatica meningea pass on the art. and v. meningea med. to the gl. jugulares. No one has, at present, been able to follow lymphatics into the substance of the brain. The superficial lymphatics of the face pass along the blood-vessels to the gl. submaxillares; the deep pass out from the temporal, and pterygo-palatine fossæ and the nasal cavities. Those of the tongue, pharynx, velum palati and larynx, open into the gl. faciales prof. and gl. cervicales.

c. The lymphatic glands of the neck are placed upon its anterior surface.

1. Gl. cervicales superficiales are situated generally along the V. jugular. externa, in the triangular space between clavícula, mm. sterno-cleido-mastoid. and trapezius, covered by platysmamyoides; also several small ones under the os hyoides.

2. Gl. cervicales profundiæ pass in numbers along the V. jugular. and carotis intern., from the process. mastoid., as far downwards as the superior opening of the cavity of the thorax, before the vertebral column on the sides of the pharynx and œsophagus, and are connected with gl. tracheales.

d. The lymphatics of the neck come from the pharynx, œsophagus, larynx, trachea, pass through the gl. cervicales, and out of these into a common trunk, which empties itself upon the left side into the ductus thoracicus, upon the right into the truncus lymphaticus dexter.
OF THE NERVES.

NEUROLOGIA.

"The knowledge, then, of what is termed the Economy of an Animal Body is to be acquired only by an intimate acquaintance with the distribution and uses of the nerves; and this knowledge of the natural relations leads directly to the comprehension of the signs of disturbed function, or the symptoms of disease."—Sir C. Bell. *The Nervous System of the Human Body.* Preface, 3d edition.

"At first this intricate network seems accidental; neither arrangement nor system is apparent; but when the minute twig discovered by one anatomist in London is as surely found by another at Pavia, as two astronomers, at different spots on the globe, trace in the heavens, with the same certainty, the discoveries of Herschel, there can no longer be a doubt of the nerves being distributed with regularity and system.

"There is no such thing as a nerve deviating or being wanting (an occurrence frequent in the vascular system), without the loss of some essential faculty." Introduction.
NEUROLOGY.

Literature:

— "Ganglion." Idem.
— Luminousness. Idem.
Swan. A Demonstration of the Nerves of the Human Body.
T. W. King. The Course of the Motor Cords; also on Reflex Action. Med. Times, Nov. 1844.
THE NERVES, NEUROLOGIA.

606. The nervous system, systema nervosum, the organ of psychical life, of sensation, and (in reciprocal action with the muscular tissue) also that of motion, consists of two principal portions, the central and peripheral, both of which are uninterruptedly united together, and are not even different in substance. The central nervous mass is compressed into the cranium and medullary canal of the spine; the peripheral penetrates (as nerves) the organs of the body, and spreads itself out like the branches of a tree from the central portion.

607. 1. The tissue of the Nervous system.

It consists of two portions, opposed to one another, which are found in the nerves as well as in the central portions; these are:

608. a. The primitive fibres. They are cylindrical, isolated in their whole course, undivided, with soft, peculiar contents, and surrounded by a delicate envelope. In the nerves we observe an external sheath, consisting of fibres of uniting tissue, which, taking a longitudinal direction, are connected with the envelope of the whole nerve, and an internal delicate limiting membrane, which appears to consist of fibres arranged spirally, and closely surrounds the nervous contents (neurine) of the primitive fibre. Both sheaths become transparent by means of dilute acetic acid. The neurine is (in the fresh state) homogeneous, milk-white, soft, readily coagulated by cold, alcohol, common salt, &c., and then presents in the middle a central stripe (cylinder axis Purkinje), which is not yet coagulated. In consequence of yielding or laceration, whilst macerating in water, the primitive fibres appear knotty (varicose). In the central parts, the primitive fibres are more delicate, and are not surrounded by an external sheath; but they are, otherwise, in the same condition as in the nerves. They form the white substance of the former.

609. b. Ganglion globules (globuli gangliorum), the nucleated bodies of the nerves, form kidney-shaped, three or four-cornered cells, in which is found a clear vesicular nucleus, and within this a nucleolus. The contents of the cell are soft, granular, brownish yellow, or gray. The nucleolus yellowish brown, solid. They are probably surrounded by an internal sheath, but fixed by an external (often reddish) fibrous capsule. They are placed in masses
between and round about the primitive nervous fibres. Their external vaginal processes give a weak, gray appearance (especially to the n. sympathetic), misled by which they have been regarded as vegetative, organic, nervous fibres, since they stand in relation with forms of uniting tissue, only (Valentin).

The ganglion globules of the central portions are extremely delicate and difficult to isolate; the vaginal formation is here, also, doubtful. They form the gray, yellow, and brown substance of the brain and spinal marrow.

The white or medullary substance is formed of primitive fibres. The gray or cortical substance of ganglion globules; it is more plentifully supplied with vessels than the white.

610. 2. The chemical elements.

The medullary substance of the brain consists of four-fifths water; Cholesterine; Cerebric acid, free, or united with soda or phosphate of lime; Oleophosphoric acid, free, and with soda; Oleine and Margarine; Oleic and Margaric acids; Albumen, with sulphur (Frémy). Moreover, the sheaths of the nerves, with vessels and uniting tissue, are to be attended to in the examination. The medullary substance contains more fat, the cortical substance more albumen, the spinal marrow more fat and less albumen, the nerves more albumen than the brain. (Vauquelin).

611. The peripheral portion of the Nervous system, nerves, nervi, are long portions formed of bundles (fasciculi), lying close together, and cords (funiculi) of primitive fibres, which place the surfaces of the body and muscles in connexion with the central portions, and are, partly, the conductors of sensations from the periphery to the centre; partly, the conductors of movements from the latter to the former. There are two kinds, white and gray:

The white nerves (animal or cerebro-spinal) are strong, bright, transversely striped, spread out in the muscles of the trunk and in the skin, and are surrounded by a sheath of strong, fibrous, uniting tissue, the Neurilemma, which blends, externally, with the amorphous uniting tissue of the surrounding parts; internally, in the outer sheath of the delicate nervous fasciculi (see before). The primitive fibres of the white nerves (diam. 0.080—0.084 of a line) are strongest in the muscles of voluntary motion, and most delicate in the nerves of the senses.

The gray nerves (vegetative) are soft (see nervi molles), but tolerably strong, diaphanous, reddish gray, not transversely striped; their neurilemma very strong, and provided with an annular layer.
They form a plexus about the vessels (which serve for their support), and proceed to the involuntary muscles (see *n. sympathicus*). The more primitive fibres there are found in them, the more they resemble the white nerves, e.g. the nerves of the heart.

1. Course. Every primitive fibre passes uninterruptedly, and without branches, from the central to the peripheral extremity, generally outwards and downwards. The nerves mostly enter the organs from within; or rather, they pass to their actually free surface.

2. Combinations take place in this way, only that fasciculi pass over from one nervous trunk into another, the primitive fibres always passing in an isolated condition, never coalescing with one another. The different kinds of combination are as follows:

a. *Anastomosis, loops.*—A part of the fasciculus of a trunk is detached, and passes away as a distinct branch (ramus). It goes into the sheath of another trunk, and applies itself to this, thus forming a simple anastomosis. When an interchange of fasciculi takes place between two trunks, a reciprocal and decussating anastomosis arises.

b. An interlacement, *plexus,* signifies the combination of anastomosing branches into a network, the meshes of which are empty, or are filled by other tissues. From each root of the plexus each of the nerves passing off from it contains, at last, separate fasciculi. *Plexus gangliosus* signifies a plexus, the meshes of which are filled up with ganglion globules.

c. Nervous ganglia, *ganglion nervosum,* is a smaller or larger intumescence, formed by the accumulation of peripheral ganglion globules. In addition to these, their sheaths and vaginal processes, a larger or smaller number of primitive fibres are found in it which pass through the ganglion, singly, or forming a plexus, and entwining about the globules. The ganglion is surrounded by a strong neurilemma, in which the capillary vessels ramify.

612. 3. *Origin and terminations.* The roots of the nerves are the immediate continuations of the primitive fibres of the brain and spinal cord. The posterior roots contain finer, the anterior coarser, fibres. United into fasciculi and trunks, they divide, as before described, and, finally, spread out in the substance of the organs in *loops,* so that the primitive fibre is reflected at its extremity and returns to the centrum, no proper termination to it being present.

The plexus, in which the terminations of the nerves resolve
themselves, are, like the capillaries, variable, according to the organs into which they enter.

In the contractile tissues (muscles, and so forth), the nerves are said (by C. Burdach) to terminate with narrow loops, in the parts endowed with sensation (the skin, organs of the senses, &c.), with plexuses and wide loops.

Moreover, each single muscular fibre and cell of an organ is not pervaded by a corresponding nerve fibre.

4. The vessels (capillary and lymphatic) of the nerves are dispersed in their neurilemma.

[Pacinian bodies, corpuscles. Observed by Pacini in 1831. "Small corpuscles or globules, of an elliptical figure to the eye, dull white or opalescent, of about two-thirds of a line long, lying attached to the digital branches of the median and ulnar nerves." They are also found along the nerves of the sole of the foot.—See the article in Cycl. of Anat. and Physiol.].

613. The Central parts.

Brain and spinal cord, consist of the same elements as the peripheral. The primitive fibres and ganglion globules are accumulated in masses, and united into definite shapes, which are not separated from one another by means of external sheaths.

The white substance consists of fasciculi of primitive fibres which are continued from the nerves, interlace, decussate, and either pass through the gray substance of the central organs or receive it between them. According to Valentin there are, even here, no terminations to the nerves; but, as in the peripheral, only places for their reflection; so that every primitive fibre is closed in a circular manner, and by that it might be decided that in the central organs no other fibres exist as such which continue into the nerves.

The gray substance exists under different colours, partly as external (the cortex of the brain), partly as internal (in the spinal marrow) masses, in the deep layers of which (in the brain) fibres are also found, together with the ganglion globules (Lauth).

1. The spinal cord sends off from thirty-one to thirty-two nerves upon either side, the posterior roots of which are subservient to sensation, those of the anterior to motion. Higher upwards the fibres of these roots decussate in the medulla oblongata, as the right pass off to the left, and the reverse. From this point (almost) all the fibres pass upwards into the brain through Pons Varolii in the crura cerebri, and partly into the cerebellum.

According to Budge, the spinal cord contains motor fibres in its
whole thickness; according to Valentin, the nervous fibres of the flexor muscles are situated in the anterior columns of the spinal cord and pass over those of the extensor muscles in the posterior. The motor and sensitive nerves of the viscera pass along in the spinal marrow (See *N. sympathetic*).

2. The brain sends off twelve pairs of nerves. These are, partly, nerves of sensation (and of the senses), partly nerves of motion, and partly of both together (mixed nerves). They are abstractedly of the three nerves of the higher senses (for smell, sight, hearing), which may be considered as parts of the brain, in accordance with the spinal nerves, and the skull has been regarded as consisting of three vertebrae. Accordingly there might be an anterior (*n. oculo-motor, abducens trigeminus*) and a posterior intervertebral nerve of the skull (*N. glossopharyng.* , *vagus with accessorius* and *hypoglossus*). We cannot, however, refer to, in all, an anterior and posterior root. They arise from the posterior part of the basis of the brain.

The hemispheres of the *cerebrum, corp. callosum, hypophysis* and *pineal gland*, are the means neither of motion nor sensation; it appears, accordingly, as if the mental functions (thought) were dependent upon them.

In the *cerebellum* the nerves of the large intestines, of the bladder and organs of generation, terminate; in the optic tubercles and striated bodies those of the stomach and small intestines; in the *corpora quadrigemina* (by going through *Pons Varolii*) the nerves of the trunk.

The vessels of the central parts are very fine, and consist of the primary vascular coat only; they form close rete in the gray, but are more sparingly diffused in the white substance. They spread out on the surface in the *pia mater* (see after), and from here supply the substance (and from the processes which the last sends into the cerebral cavities, as *plexus choroidei*). The arteries quickly pass into capillary vessels. Lymphatic vessels are not known in the substance, but probably in the envelopes. For the membranes of the brain, see Brain and Spinal Marrow, § 624.

614. The *Brain, Encephalon*,

is a mass consisting of nervous substance, which, surrounded by three concentric membranes, fills up the cranial cavity, and contains, in its interior, four spaces connected together. Its surface is covered by a gray (cortical) substance, from one to one and a half lines thick, the (medullary) substance lying under that is white.
Weight: from three and a half to four pounds and one-third; greatest longitudinal diameter, six inches; transverse, five inches; vertical, four and three-quarter inches. It is divided into the three following portions:

615. 1. The great brain, cerebrum, fills up the cranial cavity, with the exception of the fossae occipitales inferiores, is semi-oval, four inches deep, about three pounds weight, and rests with its basis upon the anterior and central cranial fossæ, and upon the tentorium cerebelli. A deep fissure divides the cerebrum into two lateral halves or hemispheres, of equal size, each of which contains, in the interior, a cavity (ventriculus lateralis), consists of three lobes, and which, on the surface, are distinguished by the convolutions, gyri, like intestines, which are limited by irregular fossæ (sulci) not very deep, and which do not generally correspond upon the two hemispheres. On the inferior surface of the brain we see, in the middle from before to behind, proceeding from the centre of the brain, also before and between the crura cerebri, a perforated place, the substantia perforata media, before it two roundish tubercles, corpora mamillaria, before these a gray enlargement, tuber cinereum, elongated into the infundibulum to which the glandula pituitaria is connected. Before the tuber cinereum the decussation of the optic nerves presents itself. Upon both sides of the basis cerebri we see the fossa Sylvii, which separates the anterior from the middle cerebral lobes, and the origin of the twelve pairs of nerves, of which the olfactory nerve is situated in a particular excavation. Behind that part of the hemispheres which is situated over the cerebellum is a little hollowed out. On the external surface of the brain we see a fissure, the continuation of the fossa Sylvii, which separates it into a horizontal and ascending portion. The superior surface presents the great longitudinal fissure, fissura cerebri longitudinalis, and the irregular gyri and sulci. On the internal surfaces of the hemispheres, which are turned towards each other, there is a tolerably constant gyrus fimbriatus which forms an arch around the great cerebral commissure. We generally admit three lobes on each hemisphere; but according to Arnold and others we must receive five, an anterior, middle, superior, posterior, and the Insula or lobus intermedius (according to Burdach, lobus caudicis). The last presents the gyri breves.

616. 2. The small brain, cerebellum, is situated in the inferior cranial fossa, covered by the tentorium. It projects a little behind the posterior cerebral lobes, is roundish and flattened from above downwards; its transverse diameter measures four inches, its lon-
gitudinal two and a half, the vertical two. Weight, four ounces; it is said to be greater in the female than in the male (Cuvier). In proportion to the size of the great brain in children $= 1 : 20$, in the adult $= 1 : 7$. Its superior surface is divided by a projecting line from before to behind into two sloping, its inferior by a fissure, vallecula, into two rounded lateral halves, hemispheria cerebelli, which are convex below, and have between them at their posterior circumference a triangular space, which receives the tentorium and the crista occipitalis interna. The anterior boundary presents a crescentic excavation, incisura marginalis anterior, which surrounds the corpp. quadrigemina; before it protuberantia annularis is situated; and from it proceed the crura cerebelli ad pontem, ad corpp. quadrigemina and ad medullam oblongatam. Between the two hemispheres the process. vermiform. is situated, which is divided by a transverse fissure, sulus transvers, Reilii, into a superior and inferior portion, and forms the roof of the fourth ventricle. Other transverse fissures give to the surface of the lesser brain a laminated appearance.

617. 3. The central portion of the brain, mesencephalon, isthmus encephali, consists of several parts at the basis and in the interior of the brain, which unite together the large and small brains and the spinal marrow. To this belong: medulla oblongata, pons Varolii, crura cerebri and corpp. quadrigemina.

**Parts of the Central and Great Brain.**

618. I. On the Basis.

1. The medulla oblongata, the conical enlargement at the superior extremity of the spinal marrow (bulbus medullae), the immediate continuation of which it is, and with which it forms an obtuse angle, is from fourteen to fifteen lines long, nine broad, six thick; it commences at the foramen magnum and terminates at the pons Varolii, as its anterior surface rests upon the clivus. It contains white and gray substance intermingled, and presents on its anterior surface a longitudinal fissure which goes as far as the pons, and a posterior which expands into the fourth cerebral ventricle. On each half, which arises by this arrangement, we see three enlargements:

   a. Corpora pyramidalia, the anterior pyramids, lying close together. Each of these is a white narrow (below one line and a half, above two lines) fasciculus of fibres which decussate with the fibres of the other side in its inferior third only, and above pass into the pons Varolii.
b. Corpora olivaria, much shorter than the last (six lines long),
on the outer side of which they are placed, directed downwards
and inwards. Above they are separated from pons Varolii by a
deep fossa, below they are bounded by arched fibres, internally by
the roots of N. hypoglossus, and they reach as far as the central
line. On their outer border, fasciculi of fibres ascend from the
spinal cord (funiculus siliquae externus), and pass through pons
Varolii to the sides of corpp. quadrigemina (crura ad corp. qua-
drig.), and form the superior roof of the aqueductus Sylvii.

The posterior surface of the medulla oblongata is covered by the
cerebellum, and presents above a V-shaped fissure, calamus scrip-
torius, which forms the anterior wall of the fourth ventricle;
externally the

  c. Corpora restiformia s. crura cerebelli inferi oria, the posterior
pyramids, the superior extremity of which is enlarged in the form
of a nipple, and are, in a manner, the roots of the cerebellum, con-
sist of tortuous fibres.

2. Pons Varolii s. protuberantia annularis, white, cubical,
placed above med. oblong. from the centre of clivus to the proc.
clinoid. postt., in a depression before the small brain, below the
corpp. quadrigem. and the cerebrum. In the middle of the inferior
surface, directed obliquely upwards and forwards, it presents a
longitudinal sulcus (for'art. basilaris), on the sides of which the
prolongations of the corpp. pyramidalia proceed; farther, trans-
verse fibres, from which the crura cerebelli pass off; and from be-
tween which N. trigeminus arises. From the anterior border, the
crura cerebr i pass forth; from the lateral, the crura cerebelli; at
the posterior, the pyramids enter. The superior surface forms the
floor of the fourth ventricle.

3. Crura cerebri, two thick, cylindrical, white cords, six lines
long, diverging from the anterior border of the pons, forwards, up-
wards and outwards to the great brain, where they become broader
and flatter, and are embraced by tractus nerv. opticorum. Below
and at the sides free, they unite above with the corpp. quadrige-
mina and crura cerebelli superi oria. They form the continuations
of the pyramids. Between them is a triangular space which is
filled up by the three following parts:

4. Substantia perforata media, basis ventriculi 3; this gray
perforated plate consists of two triangular fasciculi (separated
from the crura cerebri by a black line), and forms the poste-
rior part of the floor of the third ventricle. Here arises N.
oculomotorius.

5. Corpora mamillaria s. bulbi fornicis, two half globules, the
size of a pea, externally white, internally gray, (in the foetus, one only,) separated by a fissure, united by means of gray matter; they form the extremities of the anterior, descending crura of the fornix.

6. **Tuber cinereum**, a gray, soft mass in the triangular space between (and before) the corp. mamillar. and tracti optici, the floor of the third ventricle; above it lies the commissura anterior; under it the

7. **Infundibulum**, a reddish, hollow body, directed obliquely forwards, two lines long, to which

8. **Hypophysis** (s. glandula pituitaria) is attached. It consists of an anterior larger and whiter, and a posterior smaller and yellowish lobule, lies in the sella turcica, is very vascular, and weighs from five to ten grains; on its sides the plexus cavernosus. In the foetus and the lower animals hollow.

9. **Tractus nervorum opticorum**, two white, flat bands, fifteen lines long, arising behind from thalamus opticus and corp. geniculatum; they wind around the crura cerebri on the outside and behind, at the place where they enter into the brain, then pass, on the outer side of tuber cinereum, inwards and forwards, and unite before the tuber cinereum.

10. **Chiasma nervorum opticorum**, a quadrangular flattened ganglion, the internal fibres of which decussate, while the external pass directly forwards; it lies before the hypophysis, behind the lamina cribrosa. Its anterior border is united, by means of a vertical lamina terminalis, with the anterior commissure, which is situated above it. From this the optic nerves pass off.

11. **Lamina cribrosa cerebri** s. substantia perforata anterior, a thin, white plate before the chiasma, perforated by many vessels, bounded in front by the commencement of corp. callosum. From it the olfactory nerves arise.

619. II. The Azygos Parts in the centre of the Cerebrum.

1. **Corpus callosum** s. commissura maxima, a white flat band, three and a half inches long, eight to ten lines broad, and two to three thick, in the centre between the great hemispheres (one inch distant from their anterior, two from their posterior border), visible from above in the deep longitudinal fissure, consisting of transverse fibres (striae transversae Willisii). Its superior arched surface presents two longitudinal striae (striae longitudinales Lancisii), between which a slight depression is found (raphe); upon it the artt. callosae and the free border of fals cerebri are situated. Its
inferior concave surface forms upon either side the roof of the lateral ventricle, is situated in the middle line, in front, above the septum; behind, above the fornic. Its posterior thick and free extremity (spleenium) with the lyra s. psalterium, that is, the inferior transverse fibres, covers the corp. quadrigemina and coronarium, and touches the monticulus cerebelli. Its anterior extremity is reflected upon itself (genu), and passes from above downwards and from before backwards, terminating, in a beaked manner (rostrum), before the commissura anterior at the basis of the cerebrum.

2. Septum pellucidum, the translucent partition, a thin, triangular, vertical plate higher before than behind, expanded between the anterior part of corp. callosum and the fornic, consists of two layers (between which the canal. septi pellucidi [fifth ventricle]), and forms the internal walls of the lateral ventricle.

3. Fornix, a \(\text{s.} \) shaped medullary arch, passing in the direction of the corp. callosum, consists of two laminae which, beneath the septum, are placed close to one another, between and upon the optic tubercles, and before and behind separate from each other. Its anterior crura (columnae) incline downwards and forwards around the optic tubercles, in consequence of which a semilunar space, foramen Monroi, arises (through which the lateral communicates with the third ventricle). They then curve between thalamus and corpus striatum to the corp. mammillaria, and, from these, may be traced, as far as tenia semicircularis and corp. quadrigemina, backwards, to the optic tubercles. Its posterior crura are more widely separated from one another (between them the lyra), and curve round the posterior surface of the thalamus outwards and downwards to the pedes Hippocampi in the lateral ventricles.

4. Conarrium s. glandula pinealis, a conical reddish-gray corpuscle (four lines long, two to three lines broad), between the two anterior of the corp. quadrigemina, invested with Pia mater, surrounded by Vv. Galeni, is situated behind the commis. posterior of the third ventricle, below the lyra, its free apex directed backwards. It is connected by means of two crura with the optic tubercles, is sometimes hollow, and contains the yellow and white sand of the brain (phosphate and carbonate of lime).

5. Corpora quadrigemina s. bigemina (lobus opticus of the lower animals), are the two larger anterior (nates) and the two smaller posterior (testes) elevations which are situated in a quadrangle of ten lines long and eight broad at the superior extremity of the crura cerebri above the commencement of aquæduct. Sylvii (hence
pons Sylvii) under the splenium fornix, before the cerebellum, behind the optic tubercles. In front fibres pass to the optic tubercles and the commissura posterior of the third ventricle, behind they enter the crura cerebelli superiora.

620. The Ventricles of the Brain.

1. The lateral ventricles, ventriculi laterales s. tricornes. Each hemisphere of the cerebrum contains a large L-shaped cavity, which is situated rather towards the basis, separated from the other by the septum pellucidum and fornix only, and in communication by means of the foramen Monroi. It is partly filled with the plexus choroideus. Its roof (centrum semiovale Vieussens) consists of the transverse fibres of the corp. callosum. We distinguish four portions:

   a. Cella lateralis, the lateral chamber, is the central, superior, longitudinal space, which is deeper internally in the angle between septum and fornix on the one side, and thalamus and corp. striatum on the other, than externally. Corp. striatum and thalamus form its floor.

   1. Corpus striatum, a club-shaped, gray mass, perforated by veins, which passes backwards into a point, and is situated in a deep fossa on a plane with the insula (foss. Sylvii), on the outer side of thalamus. It is traversed by white striae which penetrate the thalamus.

   2. Thalamus nervi optici, the optic tubercle. Its superior, vaulted, longitudinal surface looks into the lateral ventricle (covered by plexus choroideus); before it the anterior crus of the fornix curves downwards; the corpus striatum surrounds it externally (separated by stria cornea [taenia semicircularis]), with which it forms a centrum for the hemisphere, and is associated with that of the thalamus of the other side by means of commissura mollis; its internal vertical surface forms the lateral wall of the third ventricle; below, it receives the crus cerebri in an excavation, and behind and internally it joins the posterior commissure. Quite internally on the posterior surface, above the crus cerebri, external and internal to the corpp. quadrigemina, are situated upon either side the two geniculate bodies, the corp. geniculatum internum which passes into one of the anterior, and externum which blends with one of the posterior of the corp. quadrigemina.

   3. Stria cornea [taenia semicircularis], a white, band-like, me-
dullary stripe between corp. striatum and thalamus; above which is situated the lamina cornea, that is, a thickening of the internal membrane of the ventricle (with the vena striata).

b. Cornu anterius. It extends from the lateral chamber before the clavate extremity of corpus striatum, forwards, downwards, and outwards, into the anterior lobe of the brain. The anterior cornu is bounded before by the genu of corp. callosum, internally by septum pellucidum.

c. Cornu posterius s. cavitatis digitata passes from the posterior extremity of the lateral chamber into the posterior lobes of the brain, is externally convex, behind pointed, very insignificant, is situated near the basis, and presents on its inferior wall a gray projection [Hippocampus minor], which depends upon a convolution on the base of the brain, and is covered by white medullary striæ which give to it a digitate appearance (pes hippocampi minor), and pass on to blend with the fornix.

d. Cornu descendens s. inferiorius, extends in an arched form from the posterior extremity of cella lateralis, around the optic thalamus and crus cerebri, forwards and downwards into the middle cerebral lobe. Its superior concave wall is placed close upon the inferior convex, which forms the Pes hippocampi major, cornu Ammonis. This is a cylindrical enlargement, thicker before and curved within, on the internal concave border of which a narrow thick edging, tania (s. fimbria), and under that a gray, notched stripe, fascia dentata, is found. The external surface consists of whiter, the internal of gray, spiral, convoluted substance; the white passes on to the corpus callosum and fornix; the gray depends upon a convolution at the basis of the brain. (Compare pes hippoc. minor.)

2. The middle cerebral ventricle, ventriculus tertius, a narrow fissure in the middle line, above and behind broader, near the basis of the cerebrum, lying between the two optic thalami which form its lateral walls, and are covered with gray matter. Its floor is curved downwards; its posterior portion, white and strong, inclined forwards, corresponds to the space between the crura cerebri; its funnel-shaped centre, to the corp. mammillaria and infundibulum; its anterior portion extends as far as to the posterior border of the chiasma.

Anterior wall, formed by crura anter. fornicis, before this commissura anterior and lamina terminalis, presents the foram. Monroi. The posterior wall, formed by corp. quadrigem., commissura posterior, presents under this aditus ad aqueductum Sylvii. The roof is formed by fornix and lyra.
Openings:
1. Foramen Monroi, in front and above, leads into the right and left lateral ventricles.
2. Aditus ad aqueductum Sylvii, behind.
3. Aditus ad infundibulum, below, leads into the infundibulum.

Commissures:
1. C. anterior, a white cylindrical cord, passing before the anterior crura of the fornix from one hemisphere to the other. From it the lamina terminalis passes vertically downwards to the chiasma.
2. C. Posterior, smaller than the last, in other respects like it, uniting the two thalami, lying before the corpp. quadrigemina, under the pineal gland with which it is united.
3. C. mollis, a gray band stretched like a bridge between the anterior extremities of the thalami, passes transversely through the centre, nearer to the roof than to the floor of the cerebral ventricles.

3. The Aqueduct of Sylvius [iter à tertio ad quartum ventriculum], a three-sided canal, passes from the posterior extremity of the third ventricle, backwards and downwards, under the pineal gland [its commissure and the posterior commissure] and the corpp. quadrigemina, above the centre of the crura cerebri to the fourth ventricle.

4. The fourth ventricle, ventriculus quartus s. cerebelli, a rhomboidal space between the cerebellum and the isthmus, the former of which forms the posterior wall (roof), the latter (the floor). It is broad in the centre, in front narrow, and it passes backwards into a point. The floor, that is, above, the posterior surface of the pons Varolii, below, that of the medulla oblong., is rhomboidal, and bounded laterally, below, by corpp. restiformia. The roof consists above of the crura cerebelli superiors and valvula magna, in the centre of the vernis inferior; below, of a fibrous plate from the neurilemma of the spinal marrow. The superior angle receives, below, the valvula magna of aqueductus Sylvii; the lateral angle reaches to the corpus rhomboid. of the cerebellum; the inferior angle presents a fissure between medulla oblongata and cerebrum, through which the fluid in the fourth ventricle communicates with that beneath the arachnoidea of the spinal cord. The interior is smooth, covered with a serous membrane, and contains, like the other cerebral ventricles, a plexus choroides.
The Parts of the Cerebellum.

621. I. On the hemispheres.

1. The superior lobes. They are, an anterior layer, and a posterior crescentic; both are separated by the sulcus horizontalis from
2. The inferior lobes. These exist in greater number according as they are arbitrarily divided. We usually distinguish an anterior (lob. biventer), posterior, middle lobes, and
   a. Tonsilla (s. lobus medullae oblongata); lying, generally, internally in a depression on the anterior and middle lobes, behind and close to the corp. restiforme of its side, surrounding with its internal concave surface the medull. oblongata, and extending, with its anterior extremity inwards, into the fourth ventricle.
   b. Flocculus (lobul. nervi pneumo-gastrici), placed behind the crus cerebelli ad pontem and N. vagus, below Nn. facialis and acousticus, before the tonsilla.
3. The medullary body of the hemispheres. In the interior of each hemisphere we find a white nucleus, from which fifteen to sixteen principal branches pass off, which again ramify, are surrounded by a brown substance, and thus produce the arbor vitae. From the central point of the vertical, olive-shaped nucleus, corpus rhomboideum s. ciliare, the indented surface of which is formed of yellow and gray substance, pass out—
4. The crura cerebelli, of which there are three upon either side.
   a. C. cerebelli superiora (s. ad corp. quadrigem., ad testes), are placed before the superior vermis, pass, united, through valv. Vieussens., converging upwards and forwards under the corpp. quadrigem., to the cerebrum.
   b. C. cerebelli inferiorea s. corpp. restiformia, pass from the medull. oblong. (which see), forwards and upwards, to the hemispheres of the cerebellum.
   c. C. cerebelli lateralia s. ad pontem. They are situated before the two preceding, at the anterior circumference of the cerebellum, and pass over internally into the pons Varolii.

622. II. The Vermiform processes, Vermis,
is the central portion of the cerebellum, divided by the sulcus horizontalis into a superior and inferior portion, contains, likewise, in its interior, a medullary nucleus, from which medullary striae pass into its two divisions.
1. The superior vermiciform process, vermis superior, projects in
the middle line on the superior surface of the cerebellum, like a crest, and presents:

a. Mons cerebelli, that is to say, the largest portion of the vermis superior; its summit (cacumen) is situated rather in front, under the splenium corp. callosi; behind (declive) and at the sides it is sloping.
b. Lobulus centralis, the smallest part, is placed in the anterior excavation of the cerebellum, behind the corpp. quadrigemina, below the mons, above the anterior valve.
c. Folium cacuminis, is placed in the posterior excavation, transversely behind the mons, and unites the two posterior lobes of the hemisph. cerebelli.

2. The inferior vermiiform process, vermis inferior, lies, curled up like a worm, in the longitudinal fossa (vallecula) between the inferior lobes of hemisph. cerebelli, into which it passes, like the vermis superior; behind and above pons and medull. oblongata. Four prolongations pass off from it (branches):

a. An anterior, the apex, in the anterior excavation, enlarged and clavate anteriorly (this is, nodulus Melacarne); it projects into the fourth ventricle.
b. Two lateral, passing from a longitudinal uvula (uvula vermis) in the central line, and the broadest and highest part of the inferior vermis, lying before it (pyramis vermis), into the lateral angle of the fourth ventricle.
c. A posterior (tuber valvulae) is situated in the posterior excavation, and unites the posterior inferior lobes of the hemisph. cerebelli.

d. The great valve, valvula magna cerebri, s. Vieussenii, s. velum medull. anterius, a thin, semi-transparent, gray plate, spread out between the two crura cerebelli superiors. The anterior convex surface forms the posterior wall of aqueductus Sylvii; the posterior concave looks towards the vermis superior; the anterior border is connected with the posterior corpp. quadrigemina; the posterior border with the medullary substance of the vermis inferior, above the nodulus Melacarne.

e. The small posterior valve, velum semilunare s. medullare posterius, a thin medullary plate, situated between medulla oblong. and vermis inferior, the short central portion turned freely towards the fourth ventricle, whilst the convex external border is attached from the flocculus as far as the corpp. quadrigemina.

623. The Structure of the Brain.
The gray centre of the medulla spinalis continues into the
medulla oblongata, enclosing a canal in its interior, which passes into the longitudinal sulcus of the sinus rhomb., in consequence of which this fossa becomes covered with the gray substance (stratum cinereum). In some places it is more particularly collected together (ale cinerea and subst. ferruginosa). The anterior crura of the gray substance of the medulla spinalis form the (denticulated) nuclei of the olivary bodies (corpp. denticulata), and are surrounded by white substance, the posterior, in like manner, the nucleus of the corpora restiformia. The white fibres of the spinal cord everywhere surround the gray substance in the prolongations, form the pyramids and the so-called eminentia teretes of the sinus rhomb., and cross each other in several places (Decussation). They then proceed into the pons, crura cerebri, the cerebellum, and so forth.

The pedunculi cerebelli, passing off from the cord-shaped bodies of the med. oblong., form with their white mass the medullary centre (meditullium album) of the cerebellum, which (except in the vermis) encloses, as in the olivary body, a gray denticulated nucleus, and divides externally into lobes, which are again overlaid with gray substance, whereby arises the arbor medullaris or arbor vitae (see before). The separate lobes and lobules are, as also in the cerebrum, united together by means of arched fibres, the so-called massa explementi which fill the intervals between them. The pons consists of two transverse and two longitudinal layers of fibres, between which the gray substance is deposited. The pedunculi cerebelli superioris s. ad corpp. quadrigemina pass away inwards under this (surrounded upon both sides by the laqueus which passes into the corp. quadrigem.), and strengthen the peduncles of the cerebrum. Hypophysis cerebri, and particularly tuber cinereum and infundibulum, consist almost entirely of gray substance, the nucleus of the medulla spinalis appearing in view. The infundibulum has a hollow in it. The peduncles of the cerebrum are continuations of the fibres from the medulla oblongata (from the pyramids, funiculi siliqua of Burdach) and cerebellum. They consist of three fasciculi: basis, covering (tegumentum), and cord (laqueus), which are separated by black substance (which passes upon them into the three cerebral ganglia). The inferior layer passes into the corpp. striata, the superior or tegumentum into the optic thalami, the laquei into the corp. quadrigem., the white mass of which they form. The four tubercles have each four gray nuclei. The glandula pinealis attached to them has a granular structure like that of the pituitaria, and consists of a grayish-red substance. The optic
tubercles have in the interior three distinct gray nuclei, one internal, external, and superior. The commissure (central) uniting the optic tubercles, as well as the border found between them in the third ventricle, also consists of gray substance. Still more distinct and larger are the three gray nuclei of the striated bodies, nucleus caudatus lenticularis and teniaformis. The stria corneā consists of medullary matter, and only appears yellow when looking through a vein. From the cerebral tubercles the great medullary striae, only, pass out, the radiatio medullaris, fibres, which, as they decussate with those of the corp. callosum, form the hemispheres of the cerebrum. From the corp. striatum fibres spread out towards both sides; in front and behind fasciculi of fibres go into the fornix, which they call the forceps. Those which cover the lateral ventricles are called tapetum. The anterior commissure consists, also, of white and gray matter. The corp. albicantia (with gray nucleus) are the commencements [?] of the fornix; they pass, as radix ascendens, into the columnella forniciis. Each right and left gives off a medullary plate, the septum pellucidum, between which is the ventriculus septi pellucidi, communicating with the third ventricle. The columnella pass into the body of the fornix. This divides into the crura, and passes into the lateral ventricles. The peripheral part of the fornix passes in an arch around the corp. callosum (gyrus forniciatus), and terminates as, unicus, the hook. The fibres of the crura form in the cornua of the ventricles, with others of the corp. callosum, the pes hippocampi major and minor. The first has two layers of medullary and two layers of gray substance; on it, as in the small, the gray is the cortical substance, covered by medullary fibres. The fibra explemctoria here also fill up the intervals between the fibres of the radiatio medullaris cerebri of the peripheral fornix and of the corpus callosum. Medullary laminae do not only pass from one convolution to another in an arched manner, but a distinct mass also unites the anterior and inferior lobes in the fossa Sylvii (fasciculus uneiformis. Reil.)

624. The Membranes of the Brain.

The brain and spinal cord are enveloped by three membranes which pass, immediately, into one another at the foramen magnum. Those of the spinal cord, see § 628. The membranes of the brain:—

1. The dura mater, s. meninx fibrosa, a fibrous sac, the external rough surface of which is firmly attached to the internal cranial bones, and here serves as periosteum; the internal, smooth, and
moist surface is inseparably connected, by means of uniting tissue, with the *arachnoid*. It is connected externally with the external periosteum at the *foramina* of the skull, through which the nerves pass out, and forms prolongations internally which enter into the fissures of the brain. These are:

a. *Falx cerebri*, passing from the *foramen caecum* and *crista galli*, at first narrow, then broader, in the centre of the cranial vault from before backwards, where its base falls vertically upon the *tentorium*. The superior convex border reaches from *for. caecum* as far as *protuberant. occipitalis*, and contains the *sinus longitudinalis superior*; the inferior concave touches the *corp. callosum* behind only, and contains a small vein (*sinus longitudinal. inferior*); the lateral surfaces separate the hemispheres of the cerebrum from one another.

b. *Tentorium cerebelli*, a septum, placed transversely, is situated beneath the posterior lobes of the *cerebrum* and above the *cerebellum*; is maintained in mutual tension with the *falx cerebri*. The external larger circumference attaches behind to the *lineae transversae*, in front to the superior angle of the *petrous* bone, and contains the *sinus transversus*. Its internal smaller boundary is concave, and encircles the *pons Varolii* and *corpp. quadrigemina*. The *apices* of the external circumference are attached to the *proc. clinoid. posterr.*, those of the internal to *proc. clinoid. anteriors*, as they pass away under the former (decussating), and bound the *fossa pituitaria*. The *sin. cavernosi* are placed inside them.

c. *Falx cerebelli* passes downwards from the *protuberantia occipitalis interna*, vertically, to the centre of the posterior circumference of *foramen magnum*, where it divides into two folds for the lateral parts of the foramen. The *basis* is in contact with the *tentorium*; the posterior border attaches itself to *crista occipital. poster*. The *anterior* looks towards the base of the posterior fissure, the lateral surfaces towards the inner surfaces of the posterior lobes of the *cerebellum*.

Structure. The *dura mater* consists of two fibrous layers, which in several places separate from one another, and form triangular canals for the reception of veins: these are the *sinus*. The fibres of the layers decussate in various directions. Between the internal layer and that of the *arachnoid*, along the *longitudinal sinus*, we find in the adult the white *corpp. (glandul.) Pacchioni*, which often project into the *sinus*, and produce thinning of the cranial bones.
625. *Sinus venosi durae matris.* They consist of the internal coat of the vessels, strengthened by fibres of the *dura mater*, and they have small valves. The *sinus* of either side are in communication, by means of transverse *sinus*, with those of the other side, and by *venae diploiceae* and *emissaria Santorini* with the external cranial veins. They empty their blood into the *V. cephalica* (s. jugular.) *interna.*

*Vene diploiceae* are situated between the two tables of the bones of the skull in the diploe, and enter into communication, internally, with the *sinus* of the cranial cavity, externally with the external veins of the head. In each half of the skull four large branches are found:

1. *Frontalis* passes through a small foramen at the *incis. supra- orbit.* to the *V. supraborbit.*
2. *Temporalis anterior* passes from *angul. parietal. anter.* to *V. temporalis.*
3. *Temporalis posterior* passes behind and above *proc. mastoid.* outwards, or opens into *sin. transversus.*
4. *Occipitalis,* the largest, opens, in the neighbourhood of the middle line on the *linea semicircul. infer.,* into the *V. occipitalis.*

*Emissaria Santorini* are canals which connect the *sinus* with the external veins, through peculiar foramina in the cranial cavity. The largest passes through *foram. mastoid., parietale,* and *condyloid, posterius.*

The *sinuses* which meet together in the *torcular Herophili*:

1. *Sinus longitudinalis superior,* is situated in the superior border of the *falx cerebri,* receives on either side seven to ten *Vv. cerebri superr.* from the surface of the brain, and some smaller from the *falx major,* is connected by means of *foram. parietale* with *Vv. occipitales,* by means of *for. cacum* (in children), with the nasal veins, and falls from above into the *torcular.*

2. *Sinus tentorii medius s. quartus,* lies at the *basis of falx cerebri* above the centre of the *tentorium,* from before to behind, where it opens into the anterior boundary of *torcular.* It forms the continuation of the *V. magna Galeni,* which arises from the two *Vv. cerebri interni,* and receives at the anterior part the

3. *Sinus s. V. longitudinalis inferior.* It passes along the inferior concave border of *falx cerebri,* is narrow, and sometimes absent.

4. *Sinus transversi s. laterales,* a right (usually wider) and a left, passing off laterally from *torcular,* and passing in the *sulcus transversus,* at first on the posterior border of the *tentorium,* horizontally, then in the *fossa sigmoidea* downwards, inwards, and
forwards to *foram. jugulare*, and passes into the *bulbus ven. jugularis*. They are connected by means of an *emissarium Sant.* in the *foram. mastoid.* with *Vv. occipital. superficiales*, and receive, besides the veins of the *posterior cerebral lobes*, *cerebellum* and **internal ear**, the *sinus petrosus superior*, and partly the *occipitalis posterior*.

5. *Sinus petrosus superior*, passes along the superior angle of the *petrous* bone in the *tentorium*, connected at the apex with *sin. cavern.*, and opens behind and externally in *sin. transvers.*

6. *Sinus occipitalis posterior*, descends singly or double from the *inferior circumference* of the *torcular*, in the *falx cerebelli* to the posterior border of *foram. magnum*, opening right and left into the *sin. transvers.*, and into *plexus venos. spinalis.*

*Torcular Herophili s. confluens sinuum,* is the expanded point before the *protuberantia occipitalis interna*, where the above-mentioned *sinus* meet together with five (or six) orifices.

*Sinus* which meet together in the *confluens sinuum. anterior*, between the apex of the *petrous* bone and the *sphenoid* of either side:

7. *Sinus petrosus inferior*, passes in the groove between the *internal inferior border* of *os petros. and the pars basilar. oss. occipitatis*, between *foram. lacerum posticum and anticum*, connected in front with *sin. cavernos. and occipital. anter.*, opening under *sin. transvers.* at the anterior circumference in the *V. cephalica interna.* It unites the anterior and posterior *sinus* of the *basis cranii.*

8. *Sinus occipitalis anterior (transversus) s. basilaris,* a *transverse venous plexus* lying upon the *clivus*, uniting the *sin. petros. infer.*, as also the *sinus cavernosi* of the right and left side with each other.

9. *Sinus cavernosus*, situated at the sides of the *sella Turcica*, between the apex of the *petrous* bone and the *fissura sphenoidalis*, is wide and cellular by means of numerous fibrous bands, is perforated by *carotis interna, plexus caroticus* and *N. abducentis*, and has on the external wall the *N. oculo-motorius*.

At the anterior external extremity (*sinus ophthalmicus*) it receives the *Vv. ophthalmica, V. fossae Sylvii* connected with that of the other side below the *hypophysis* by means of *sinus circularis inferior*, by means of *foram. lacerum anterius* with *plexus pterygoid.*, and opens behind into the *sinus petrosi.* Into it open:

10. *Sinus circularis Ridleyi*, which surrounds the pituitary gland in the *sella turcica.*

11. *Sinus spheno-parietalis s. alee parvæ*, lies on the lateral
wall of the cranial cavity, between the anterior and middle fossae, uniting with V. meningea media; it receives the anterior diploica temporalis, and opens into the sinus cavernosus (ophthalmicus).

The vessels and nerves of the dura mater.—Arteries: meningae anterior, from ethmoidalis; media, from maxillaris interna; posteriores, from pharyngea ascendens, occipitalis and vertebralis.

Veins: Vv. meningae, double for each artery, open into the sinus and into plexus pterygoideus. Lymphatics are wanting (Arnold); those on the internal wall belong to the arachnoidea.

Nerves: branches from the first division of trigeminus and trochlearis, two long branches near the middle line.

2. Arachnoidea (the serous membrane). The external surface of the pia mater is covered with pavement epithelium, which extends over the convolutions of the brain like a bridge, passes upon the internal surface of the dura mater, firmly attached to it by uniting tissue, and thus forms a closed sac, which does not enter the cerebral cavities, lies between pia and dura mater, and contains in its cavity, even during life, a serous fluid (fluidum cerebro-spinale) which may be pressed out in drops, or in a jet, after piercing it.

3. Pia mater s. meninx vasculosa, the soft, vascular envelope, a thin membrane formed of a vascular rete, and uniting tissue, lies close upon the surface of the brain, surrounded by the internal layer of the arachnoidea; enters the sulci and ventricles, and forms

The plexus choroidei, which folded in a curly form are situated, one in each ventricle, but continue uninterruptedly into one another, and send numerous blood-vessels into the substance of the brain. They are covered with epithelium, which is distinguishable from the ciliated epithelium of the ventricles.

626. Vessels of the Brain.

The brain is largely supplied with blood, the course of which is retarded by the convolutions of the arteries. These quickly ramify on the surface, and penetrate thus into the cortical substance: other branches pass into the cavities, form the plexus choroidei, and supply from this point the medullary substance.

There are the two carotides internae and vertebrales.

The cerebrum is supplied by branches from both, the cerebellum from those of the vertebral alone; namely:

a. The cerebrum by: art. corporis callosi and its two Rr. com-
municantes, art. fossae Sylvii, choroidea and profunda cerebri.

b. The cerebellum by: artt. cerebelli inferior, media and superior.

Veins do not accompany the arteries; they are found plentifully on the surface, and fall into the sinus of the dura mater.

a. In the interior of the cerebrum pass:

1. V. choroidea, arising at the anterior point of cornu descend. of the lateral ventricle; it ascends in the plexus choroid., the veins of which, as well as those of the cornu Ammonis, it receives and unites with.

2. V. corporis striati, which passes from the stria cornea between corp. striatum and thalam. n. optici, whilst still in the lateral ventricle, to

3. V. cerebri interna s. magna. This enters into the third ventricle through foram. Monroi, passes into its plexus choroid. from before backwards, unites between corp. callos. and quadrigem. with that of the other side into a short (two to three lines thick) trunk, the vena Galeni, which, at the junction of tentorium and falx cerebri, enters into the last and the sinus quartus.

b. The veins of the cerebellum open into the Vv. vertebrales, into the sinus transvers., petrosi and occipitalis posterior.

627. The Spinal Marrow, Medulla spinalis, μελός, βαχίτης.

This is the medullary column, flattened from before backwards, which passes downwards into the canalis spinalis as the immediate continuation of the medulla oblongata, surrounded, like the brain, by membranes. Its surface is white. Its length measures, in the adult from fifteen to eighteen inches; its circumference, at the inferior extremity of the cervical portion = eighteen lines, in the lumbar portion = twelve (intumescentia cervicalis and lumbalis), whilst the dorsal portion is the smallest, on which account the nerves arising from it are also the smallest. Its superior extremity passes uninterruptedly into the medulla oblongata at the foramen magnum; its inferior termination, on account of the long lumbar and sacral nerves, which lying close together, are called cauda equina, reaches, in the foetus, as far as the sacrum, in the adult to the second lumbar vertebra, where it terminates in a conical form (conus medullaris) and presents two ganglia, as an exception, only. On its anterior and posterior surfaces a fissure is observable in the middle line (fissura mediana); at the base of the anterior fissure a
transverse porous *commissura alba*, but upon that of the deeper posterior fissure, gray substance (*comm. grisea*) which is situated in the interior of the spinal marrow. This posterior fissure is, according to Arnold and Valentin, in the fresh medulla, merely a groove which only above and below passes into a fissure. We may regard the spinal cord as consisting of two lateral halves. Each half is divided by a *sulcus lateralis* (for the posterior roots of the spinal nerves) into a larger *anterior* and a smaller *posterior* column, between which and the anterior roots of the spinal nerves, even a yet smaller, central, may be detected. In the commencement of fetal life a canal is found in each half.

*Structure of the Spinal cord.* White substance forms the exterior, *cortex*, of the spinal cord, and gray the *nucleus*.

The *gray* substance consists of ganglion globules (see before). It is very vascular, of various colours (darker in children), and presents, upon a transverse section, generally, this figure (\(\ast\), above and below rather \(v\)-shaped; hence in the gray substance a centre and cornua, or crura, are described. The cornua are directed outwards towards the roots of the spinal nerves, lying, however, closer to the posterior surface.

The medullary substance consists of longitudinal fibres (nerve tubules) which pass close to, but independently of, one another, are separated by sheaths (*pia mater*), at least the larger, from each other, forming broader or narrower fasciculi, and at last the two (three) columns of either side, observable externally. According to Valentin, the fibres are the immediate continuations of the spinal nerves, which pass upwards, and the medullary substance contains no more fibres than those taken together. Free extremities are not found. Above (see Medull. Oblong. § 618.) the posterior columns, divided into three to four fasciculi, go forwards, obliquely through the gray substance, and proceed onwards as the anterior pyramids, since the fasciculi of the two sides decussate (*decussatio*), whilst the anterior columns pass directly into the posterior pyramids (*corpp. restiform.*)

628. The *membranes* of the *spinal cord*, the immediate continuations of the cerebral membranes.

1. *Dura mater*, a long fibrous cylinder, extending from *foram. magn.* to the termination of *canal. sacralis*. The *external* surface is separated from the vertebral canal by means of uniting and adipose tissue, in which the *plexus venosi spinales (interni)* is found. It does not perform the office of periosteum to the vertebrae. The *internal* surface is covered with the *arachnoid*, and connected in
many places with the pia mater. Behind it is free; before it is connected by processes with lig. longitudinale posterius. Laterally, sheaths pass off with the nerves through the foramina intervertebralia, for the posterior and anterior roots of which there are openings (two) in it. The superior extremity is firmly attached to the circumference of the foram. magnum, and passes into the dura mater of the brain; the art. vertebrales perforate it at this point. The inferior extremity forms a wide sac around the cauda equina, divides into several sheaths (from five to six) for the sacral nerves, and is firmly connected with lig. sacro-coccyg. postic. Vessels: arteries are rami spinales, the artt. cervicales, dorsales, lumbales and sacrales. The veins pass into the plex. spinales interni. Nerves have not yet been found, the dura mater is however sensitive.

2. Arachnoidea. Between the dura and pia mater an epithelium layer is placed, as in the brain, which covers the uniting tissue of the two surfaces, opposed to each other, and is regarded as a proper tunic; that is, the arachnoid membrane. It envelopes the nerves of the cauda only, as far as the foramm. intervertebr., and is then reflected upon the dura mater. Between dura and pia mater a space is also found, filled with cerebro-spinal fluid, which facilitates the movement of the spinal cord.

3. Pia mater, is stronger than that of the brain, dirty white, sometimes, in the cervical region, dotted with blackish spots. It forms the neurilemma of the medulla spinalis, to which it is firmly applied, into the fissures of which it enters, and envelopes the nervous fasciculi. It is strengthened by fasciculi of fibres, which are only lost in the cranial cavity; it is formed besides of uniting tissue and vascular rete. On either side the thin edge of the fibrous lig. denticulatum is attached, from the free, thicker edge of which (from twenty to twenty-one) denticulations pass outwards, and connect themselves with the dura mater in the intervals between the anterior and posterior roots of the nerves. The first denticulation is placed in the foram. magn. between art. vertebral. and n. hypogloss.; the last at the first lumbar vertebra. From this point, the inferior extremity of conus medullaris, the pia mater terminates in a delicate thread, filum terminale, which above, only, contains a little gray medullary matter, and is attached below in the sacral canal to the termination of the dura mater.

The Peripheral portion of the Nervous System.

629. A. The cerebral nerves, nervi cerebrales.
There are twelve pairs, of which the first, second, and eighth
are destined for the organs of the senses entirely, the third and seventh pass forth between the anterior and middle, the ninth and twelfth between the middle and posterior cranial vertebrae.

630. I. *N. olfactorius*, the nerve of Smell.

Origin: from the basis of the anterior cerebral lobe with three white roots; the external, longest, passes in a curve from the fossa Sylvii inwards and forwards; the middle, short, directly forwards, and the internal rather curved inwards, arises from the substantia perforata anterior. Each root consists of several smaller. They are united into a three-sided nerve (tractus olfact.) which runs in a sulcus on the inner side of the inferior surface of the anterior cerebral lobes, is soft, striped with gray, and surrounded by the pia mater. It lies upon the cribiform plate, and terminates with the:

*Bulbus cinereus*, a club-shaped, flat enlargement, three lines long, and usually of gray substance. This olfactory bulb is, in young embryos and in the lower animals, hollow, and connected with the lateral ventricles. From its inferior surface many delicate nn. olfactorii, covered by dura mater, pass downwards through the foramina of the cribiform plate in two rows.

The external row (from twelve to sixteen nerves) spreads out in a rete upon the mucous membrane of the two superior nasal conchae.

The internal row (from nine to twelve nerves) expands in tufts upon the mucous membrane of the septum of the nasal cavity, in the centre almost to its floor.

631. II. *N. opticus*, the nerve of Sight.

Origin: from thalamus opticus, the posterior mass of which passes into the optic tracts, corpp. geniculata and quadrigemina. Course: 1. As tractus opticus (which see). 2. As chiasma n. optic. (which see). 3. From the chiasma the n. opticus, even now covered by the dura mater, passes forwards and outwards, through foram. opticum into the orbit and to the globe of the eye, the coats of which it perforates behind, rather internal to its axis, and expands as the retina (which see). In the foram. opticum it lies above and internal to art. ophthalmica; in the orbita, surrounded by the four mm. recti, and much fat; ganglion ophthalm., nervi et vasa ciliares lie close to it. Its sheath (of the dura mater) passes from the foram. opticum into the sclerotica. It nowhere divides into filaments, but has in its centre a deficiency (porus) for the vasa centralia iridis.
III. *N. oculo-motorius*, the nerve of Motion for the muscles moving the globe of the Eye.

Origin: between the **crura cerebri**, and from them, with a series of filaments, the most internal meeting in the subst. perforata media (therefore the simultaneous movement of both pupils, see gangl. ophthalm.), it passes forth between pons Varolii and corpp. mammillaria. Course: at the commencement flat, between art. cerebri poster. and cerebelli superior, then round the last upwards, outwards and forwards as far as sella turcica, where it perforates the dura mater and the **sinus cavernos.**, and passes at the most internal part through **fissura orbitalis superior** into the orbit. Before that it divides into a ram. superior and inferior, which separate in the orbita and unite (not always) with plexus caroticus. Situation in the **cavernous sinus**: external to carotis, above n. abducens, internal to n. patheticus and ophthalmicus; immediately in the orbits, below n. frontalis and patheticus, internal to ram. nasalis.

1. **Ramus superior**, below and for m. rectus super., and for lev. palpebr. super., in which it soon ramifies with many branches.

2. **Ramus inferior**, much larger, between n. opticus and abducens, internal to m. rect. externus; it immediately divides into three branches:
   a. **Ram. internus**, to the internal surface of m. rect. internus.
   b. **Ram. inferior**, to m. rect. inferior.
   c. **Ram. externus**, passes on the outer border of m. rectus inferior to m. obliq. inferior, and gives off the short root of gangl. ciliare.

*N. oculo-motor* is the motor nerve for all the muscles of the globe of the eye, with the exception of m. obliquus superior and rectus externus.

IV. *N. Trochlearis s. patheticus*.

Origin: with three to four filaments from valvula cerebelli anterior s. magna, between the cerebrum and cerebellum, behind the corpp. quadrigemn.; it inclines round the crus cerebelli super. and appears at the basis before the pons Varolii, external to crus cerebelli, internal to n. trigeminus. Course: forwards through a canal of the **tentorium** to the outer wall of the **sinus cavernosus**; passes through the broadest part of the **fissura orbit. super.**, at the same time with ram. frontalis, into the orbits. Here it passes inwards and forwards, obliquely over the ram. super. n. oculo-motor., and the posterior extremity of mm. levator. and rectus sup., to the superior border of m. obliquus superior. Situation: as far as sella
turcica, between pia mater and arachnoid, below the oculo-motorius; in the sinus cavernosus, on the outer side of the last nerve, above n. opthalm., united with it by means of several filaments; in the orbits, close under the periortita, internal to ram. frontalis, where it gives off filaments to the ram. lacrymalis. Branches: ram. tentorii, from out of the sinus cavernosus backwards to sin. transversus; it comes, according to Arnold, from ophthalmicus.

N. trochlearis, long and thin, supplies the obliquus superior, is the n. respiratorius oculi, according to Sir C. Bell.

634. V. N. trigeminus s. quintus, the Trifacial nerve.

Origin: with two roots; the larger posterior (ganglion) root, from corp. restiforme (continuation of the posterior columns of the spinal cord); the anterior, smaller root from the surface of the pons, in the anterior lateral part of which, both (the small root from within) become visible in a fissure, as they are united into a trunk. Course: the trunk passes from the pons as a flat fasciculus upwards, outwards and forwards, through a canal which the dura mater forms with the superior border of the apex of the petrous bone. Here the fibres of the posterior root (portio major) separate and interlace, and form alone the ganglion Casseri, whilst the anterior root (portio minor) passes away under the posterior surface of the ganglion, and with the third branch of the ganglion forms the n. maxillaris inferior. [The two portions of this nerve are generally separated at their exit from pons Varolii by a few of its fibres.]

Ganglion Casseri, the semilunar ganglion, consists of soft gray substance traversed by white fibres; it is flat, convex in front and externally, lies on the anterior surface of the apex of the petrous bone, in a depression, firmly united with the dura mater. The three following branches pass off from its convexity:

Ramus ophthalmicus.
Ram. maxillaris superior, and
Ram. maxillaris inferior.
They diverge as they pass out, and the last is accompanied by the small (motor) root of the n. trigeminus. From the Cass. ganglion a few fibres pass to the tentorium and to the dura mater of the petrous and sphenoid bone; others to the plexus caroticus.

635. Ramus I. trigemini s. N. ophthalmicus,
the smallest and most superior of the three branches of gangl. Casseri, passes forwards, outwards and upwards, on the outer wall
of *sinus cavernosus*, gives a filament backwards which accompanies another of the *trocchlearis* to the *tentorium*, and divides into three branches, which pass through the *fissura orbitalis superior*, at different points, into the *orbita*. Position: below *n. trochlearis*, external to *n. oculo-motorius* and *abduces*.

Branches from without inwards are: *N. lacrymalis*, *n. frontalis*, *n. nasalis*.

1. *N. frontalis*, the frontal nerve, the continuation of *ophthalmic*, and its thickest branch, passes horizontally forwards under the *periorbita* and obliquely above the *lev. palpebr.*, sends frequently a small branch which passes over the *m. obliq. sup.*, and under the *troclea*, out of the *orbita*, and into the superior eyelid. In front it divides into:

   a. *N. supraorbitalis*, the external larger branch, which passes through *foram. supraorbitale*, out of the *orbita*, sends numerous branches downwards to the superior lids (one of which anastomoses with *n. facialis* beneath *n. orbicularis*), two others upwards to the skin of the forehead, which may be followed as far as the lambdoidal suture, but only supply the skin and periosteum. A smaller branch passes through a small foramen in the *foram. supraorbit.* into a canal on the frontal bone, and to the skin of the forehead on the *tuber frontale*.

   b. *N. supratrochlearis*, the smaller internal branch, passes out between *for. supraorbit.* and (above) the *troclea* of *m. obliq. sup.*, and divides into *superior* branches for the top of the forehead, and into *inferior* for the upper lid and back of the nose, where it anastomoses with *n. nasalis*. Sometimes two *nn. supratrochli.* are present.

2. *N. nasalis s. naso-ciliaris* passes between *ram. super.* and *infer.* of *oculo-motor.*, inwards and forwards, obliquely over *n. opticus*, beneath *m. rectus* and *obliq. super.*, to the internal wall of the *orbita*, and divides at the superior border of *m. rectus intern.* into *n. ethmoidalis* and *infratrochlearis*. Before this one or several *nervi ciliares* pass off from it, and the

   a. *Radix longa ad ganglion ciliare*, a minute, sometimes double filament, which separates even in the cranial cavity (in the *sinus cavernos.*), where also a grayish filament (*radix media*) from *plexus carot.* *n. sympath.* is applied, and accompanies it to the posterior angle of the

   *Ganglion ciliare s. ophthalmicum.* This lenticular, flat, grayish-red ganglion lies in a considerable quantity of fat on the outer side of *n. opticus*, two to three lines distant from the optic foramen, beneath *art. ophthalmica*. The *radix brevis* from *oculo-motorius* enters at its posterior in-
ferior angle. From its anterior border two small fasciculi pass off the

_Nervi ciliares._ They pass along in a tortuous manner with _art. ciliares_, anastomosing with one another; they perforate the _sclerotica_ around the _n. opticus_, pass evenly between this and the _choroidea_ to the ciliary ligament, and some, thence, to the _iris_, where they divide; others pass immediately to the _retina_. The superior fasciculus has four, the inferior five to six filaments.

c. _N. infraorbitalis_ passes on under _m. obliquus superior_ with _art. ophthalmica_, escapes from the orbit beneath the _trochlea_, and divides into:

1. _Ramus internus s. septi mobilis_, upon the mucous membrane of the anterior part of the septum.

2. _Ramus externus_ gives a branch to the conchæ and anterior part of the septum; passes into the sulcus of the nasal bone, and comes forth between the bones and cartilage, and ramifies upon the skin of the _ala nasi_ as far as the point where it anastomoses with _n. facialis_.

b. _N. ethmoidalis_ passes immediately through _foram. ethmoidale anterius_ from the orbit into the cranial cavity, passes from behind forwards upon the superior surface of the cribriform plate of the ethmoid bone near the _crista galli_, and sinks into the nasal cavity through an anterior foramen, where it divides into an internal and external branch.

1. _Ramus internus s. septi mobilis_, upon the mucous membrane of the anterior part of the septum.

2. _Ramus externus_ gives a branch to the conchæ and anterior part of the septum; passes into the sulcus of the nasal bone, and comes forth between the bones and cartilage, and ramifies upon the skin of the _ala nasi_ as far as the point where it anastomoses with _n. facialis_.

3. _N. lacrimalis_, the smallest branch of _ophthalmicus_, passes along the superior border of _m. rectus externus_ on the outer wall of the orbita, with _art. lacrimalis_, and divides into an external and internal branch.

1. _Ramus externus s. nerv. zygomaticus_ passes through the malar bone, uniting with _n. facialis_ on the cheek.

2. _Ramus internus_ passes through the lacrimal gland, ramifies in it, then perforates the upper lid with a branch which reaches as far as the _tarsus_, and with another which is lost in the skin of the anterior temporal region.
636. *Ramus II. trigemini s. N. maxillaris superior.*

The superior maxillary nerve, in point of size and position in the middle between *I.* and *III.*, passes, after a short course, through *foram. rotundum* into the *fossa sphenomaxillaris*, where branches pass off from it in all directions, accompanied by branches of *art. maxillaris interna*. It divides (Arnold) into three principal branches, which correspond to those of the *ophthalmicus*.

1. *N. subcutaneus male* corresponds to *n. lacrymus*, enters the *orbita* through *fissura orbital. infer.*, passes along the inferior wall forwards, and divides into an ascending *ram. lacrymus*, which enters the lacrimal gland from below, anastomoses with *n. lacrymal.*, and gives filaments to the external angle of the eye; and a horizontal *ram. malaris*, which passes along through the anterior malar foramen, with a filament for the skin of the cheek, with another (often double) to the anterior part of *m. temporalis*, and there anastomoses with *n. tempor. profund.* (See *maxillaris inferior.*) [A temporal branch also ascends, perforates the outer wall of the orbit, afterwards the temporal fascia, and supplies the skin about the external angular process of the frontal bone].

2. *N. spheno-palatinus* corresponds to *n. nasalis*, a shorter branch, descends vertically into the *fossa sphenopalatina*, and enlarges on the outer side of the foramen into the *Ganglion spheno-palatinum s. rhinicum s. Meckelii*. This grayish-red, soft, three to four-cornered *nasal ganglion*, is larger than the ophthalmic, with which it is frequently in connexion by means of a filament (Tiedemann). It consists of two roots; the *short* consists of several filaments from *nerv. spheno-palatin. ;* the long, *radix mollis*, that is *ram. profundus* *n. Vidiani*, from the *plexus caroticus n. sympathetic*, is grayish-red, and under *n. Vidianus recurvem* in a sheath. Two or three filaments pass through *fiss. orbitalis infer.* into the *n. opticus*. Through it pass:

a. *Nn. palatini*, descending vertically. They are:

1. *Palatinus anterius s. major*, passing through the posterior palatine canal, at the inferior orifice of which it inclines forwards upon the palatine vault. Before that it gives off *ram. nasalis inferior*, for the middle nasal chamber and the inferior concha; farther, *several filaments*, which pass upon the internal walls of the *antrum Highmori* to the last molar teeth; lastly, a *ram. staphylinus* for the uvula. Its terminal branches pass on the alveolar
borders and in the central line to the glands, and the mucous membrane of the palate, and to the gums.

2. *Palatinus posterior s. medius* passes in a proper canal, and, having left it, backwards to the posterior nasal opening.

3. *Palatinus externus s. parvus*, for the palatine arches and tonsils.

b. *Nn. nasales posteriores*, very fine, pass inwards through the for. *spheno-palatinum* into the nasal cavity, advancing, when there, between the bones and mucous membrane on the outer wall and on the septum. They pass, contrary to the branches of the first division, in the vault, so that the proper nerves of smell are surrounded in a circular manner by these nerves of sensation, like the optic nerve by the *nn. ciliares*.

1. *N. naso-palatinus Scarpce s. n. septi narium* passes inwards, before the *sinus sphenoidalis*, below its opening to the nasal septum, and on this almost horizontally forwards to the *canalis incisivus*, through which it passes to the mucous membrane of the mouth behind the incisor teeth, without anastomosing with that of the other side, and without forming a ganglion.

2. *Nn. nasales superiores*, three to four, pass vertically downwards on the posterior part of the outer wall of the nasal cavity, between the mucous membrane and periosteum, supplying the concha and nasal chambers, and the *pharynx* at the orifice of the *tuba Eustachii*, with a ram. *pharyngeus* (Bock).

3. *N. Vidianus s. petrosus superficialis s. recurrens* passes from the posterior part of ganglion *Meckeli* backwards, through the *canalis Vidianus*, enters between temporal and sphenoid bone, perforating the mass of cartilage in the *foram. lacerum anter.*, into the cranial cavity, and into a sulcus on the anterior surface of the petrous bone, through *hiatus canal. Fallopiae* to the bend of *n. facialis*, with which it anastomoses. Below it, passes the *n. petrosus profundus*, a larger branch, and of a more gray hue, which lies in the *can. caroticus* on the outer side of *carotis*, and ascends to the gangl. *Meckelii* from the *plexus caroticus*, where it anastomoses with the branches which pass to the *nerv. oculo-motorius*.

3. *Nervus infraorbitalis*, the continuation of the trunk, corresponds to the *n. frontalis*, enters through *fissura orbital. infer.* into the *canalis infraorbitalis*, passes to its anterior orifice (above and
external to art. infraorbit.), where it divides into fibres on the face, and sends branches upwards:

a. *Rami palpebrales,* to the skin, and under *m. orbicularis,* to the *conunctiva* of the inferior eyelid; internally:

b. *Rami nasales,* to the skin of the *ala nasi*; downwards:

c. *Rami labiales,* to the upper lip, for the skin and mucous membrane. These last are very numerous, and they anastomose particularly with *n. facialis.*

Before its entrance into the *canal. infraorbitalis* the trunk gives off:

1. *N. dentalis posterior superior:* it often arises with two to three filaments (between which *art. alveolaris poster.)*, descends forwards upon the *tuber maxillare,* gives branches to the *m. buccinator* [they most likely perforate this, and supply the mucous membrane], the fat of the cheek, and the gums. The superior branch penetrates, above *tuber maxillare,* the inferior below it, between the bony plates of the upper jaw, into the *canal. alveolar. poster.,* forms there a *plexus,* from which one filament passes off for each root of the molar teeth, and terminates in the dental pulp.

Inside the *canalis infraorbitalis* the trunk gives off:

2. *N. dentalis anterior superior,* arising half an inch behind *foram. infraorbitale,* is very large; it passes vertically down in a canal between the bony plates of the upper jaw to a plane with the floor of the nose, and ramifies close to that into:

a. Ascending branches, which are lost in *spina nasalis anter.,* give a branch to the nasal mucous membrane and inferior concha; and:

b. Descending branches, for the *first molar,* the *cuspidati,* and *incisor teeth.*


The inferior maxillary nerve is the largest and most posterior of *trigeminus,* consisting of a *posterior external fasciculus,* which comes from the *gangl. Casseri,* and an *anterior internal fasciculus,* that is, the small root (motor fibres) of *trigeminus.* Course: passes quickly out of the cranial cavity through *foramen ovale* into the *fossa zygomatica,* where it immediately divides into eight branches, of which the three first belong to the posterior, the five others to the anterior fasciculus.
1. *N. temporal. superficial. s. auricularis anterior.* The temporo-auricular nerve corresponds to the *lacrymalis* and *subcutaneus* of the first and second division. Origin: outside and behind the third division, with two roots, which surround the *art. meningeae media*, and contain two filaments of *gangl. oticum*. Course: backwards and rather downwards behind the *collum condyli* of the lower jaw, where it divides into an ascending and descending branch.

a. *Ram. temporalis* inclines backwards and upwards around *condylus*, between the articulation and external auditory meatus, perforates the *parotis*, and passes, in company with *art. temporal.*, into the temporal region close beneath the skin, in which it ramifies to the vertex. At the condyle it gives one (important), sometimes two, *ram. communicantes* to *n. facialis*, farther branches to the temporo-maxillary articulation, to the skin of the *meatus auditor. extern.* to the tympanic membrane; in the temporal region a connecting branch with *n. temporal. profund.*, and a plexus for *art. temporalis*.

b. *Ram. auricularis* forms a plexus behind the *condylus* about the *art. maxillar. interna*, perforates the *parotis* with five to six branches which pass to the lobe of the ear; others anastomose with filaments of *plexus cervicalis*; one branch unites with *n. dentalis*; another enters the maxillary articulation.

*Ganglion oticum* (Arnoldi). This flat, oval *otic ganglion* is situated close under the *foram. ovale* on the inner side of *n. maxillar. infer.*, where the *portio minor trigemini* joins it closely; internal to the cartilaginous *tuba Eustachii* and the origin of *m. circumflexus palati mollis*, before *art. meningeae media*. It has three roots:

1. The long one comes from *n. tympanicus* of *glosso-pharyngeus*.

2. The short from *portio minor* (especially of *pterygoid. internus*) of the *trigeminus*.

3. The central, soft, from the first cervical ganglion of *sympathicus*, the filaments of which pass along the *art. meningeae media*. From it, constantly, arise, from the upper portion:

1. *Nerv. ad tensorem tympani*, a soft, grayish-red filament, passing along by means of *tuba Eustachii* to the tensor of the tympanic membrane. Another nerve comes from *n. pterygoid. internus* to this muscle, which perforates the *otic ganglion*, and receives a little of its substance;
on this account the *memb. tympani* cannot be directly moved at the instigation of the will. Usually:

2. Two filaments to *n. auriculo temporalis*.

3. One filament to the *chorda tympani* (Krause), and one likewise to *m. circumflexus palati mollis* (Cruveillier).

[The translator takes the liberty of adding, in this place, a paragraph from M. Longet's work (Anat. et Phys. du Système Nerveux, par F. A. Longet, 2 vols., Paris, 1842), vol. ii. p. 501: "As for the ganglia which constitute the cephalic portion of the great symptomatic, I have myself often insisted upon the double connexion of each of them with a *motor* and *sensitive cerebral nerve*; and I have proved, against the opinion of Arnold, that the spheno-palatine ganglion does not form a exception, and that it likewise receives filaments from a cranial *nerve* which presides over movement. All these ganglia (ophthalmic, spheno-palatine, otic, and sub-maxillary) having been described with details suitable to the trifacial nerve, I have only to remind the reader that the common *motor oculi* or the *facial nerve* furnishes their *motor* roots, whilst the glosso-pharyngeal or the *trifacial* sends to each of them the sensitive roots."

2. *N. alveolaris inferior*, descends at first between *m. pterygoid. extern.* and *internus*, then between *internus* and the *ramus* of the lower jaw, separated by an aponeurosis from *n. lingual* and *m. pteryg. intern.* through *foram. alveolare poster.* in the *canal. alveolaris* in the same sheath with *art. dental. inferior*. From this branches are given off to each root of the inferior molar teeth. As far as the entrance to the canal the *ram. mylo-hyoides* accompanies it; in the canal it bifurcates at *foram. mentale* into two rami:

a. *Ramus dentalis incisivus*, very fine, passes farther along the canal, and supplies the *cuspidati* and *incisor* teeth.

b. *Ramus mentalis*, stronger, passes out at the *foram. mentale*, ramifies in the skin and mucous membrane of the under lip, particularly at its free border, and forms, with *n. facialis*, a *plexus mentalis*.

3. *N. lingualis*, the nerve of the sense of touch and sensation of the tongue, corresponds to *n. nasalis* and *palatinus* of the first and second division, is situated farther forwards than the last, takes a curve forwards and downwards, at first between *m. pterygoideus extern.* and *pharynx*, then between the two *pterygoidei*, *pteryg. internus* and the *ramus* of the lower jaw; thence directly forwards along the superior border of the sub-maxillary gland, between this and the mucous membrane of the mouth, above *m. mylo-hyoides*, lastly obliquely beneath the sublingual gland, on
its internal side to the border of the tongue, and between m. mylo-
and genio-glossus into the substance of the tongue; it lies above
n. hypoglossus, and terminates in tufts upon the mucous membrane
and the papillæ at the borders and the tip of the tongue. Between
the mm. pterygoidei it receives the chorda tympani, which blends
with it behind at an acute angle; farther a connecting branch
from n. alveolaris inferior. It gives branches to the tonsilla, the
mucous membrane of the cheeks, and the gums; from its inferior
surface filaments pass to the ganglion linguale; lastly, also, to
the gland. sublingualis, and there forms a pl. sublingualis.

Ganglion glotticum s. linguale s. maxillare. The lingual
ganglion is placed in the curve of n. lingualis between it and the
gland sub-maxillaris, at the side of the root of the tongue, oppo-
site the last molar tooth, covered by the mucous membrane. Its
three roots are received; 1. from the chorda tympani of n. faci-
alis (motor); 2. from nerv. lingualis (sensitive); 3. from the
first cervical ganglion of n. sympatheticus. From it branches pass
off; 1. to the ductus Whartonianus (for the excretion of saliva
in the act of tasting); 2. to the n. lingualis (as from gangl. otic-
cum to the auricularis from g. ophthalmicum to the n. opticus)
of hypoglossus.

4. Nervi masticatorii, the three branches, contain the fibres of
the portio minor n. trigemini. They are:

1. N. mylo-hyoides passes downwards in a sheath, with nerv.
alveolaris inferior as far as foram. alveolare poster., then in
the sulcus mylo-hyoid. of the lower jaw, and ramifies in m.
mylo-hyoides, and the anterior belly of m. biventer (the
posterior belly of which is supplied by n. facialis).

2. N. massetericus inclines backwards and over incisura semi-
laris, and sinks into m. masseter. Above, a
deeper branch goes to the temporal fossa and to the maxillary
articular.

3. N. temporalis profundus, frequently double, passes upwards
close to the wall of the temporal fossæ, anastomosing with
branches of masseteric., buccinator., and temporalis super-
ficialis; with lacrymalis and subcutaneous, and loses itself
in the musc. temporalis.

4. N. buccinatorius, a larger branch, penetrates the m. ptery-
goid. extern., gives temporal twigs, passes downwards be-
tween m. pterygoid. ext. and temporal., behind proc. coronoid.
to m. buccinator, anastomosing behind duct. Stenonianus in
a curve with nerv. facialis, and giving branches to the muscles
of the angles of the mouth.
5. *Nn. pterygoidei externus* and *internus* to the muscles of the same name. The last gives filaments to *m. tensor palati* and *tympani* by means of *gangl. oticum*. (Hence the *membrana tympani* is stretched by the pterygoid muscles in loud sounds, &c.) [?].

Distribution of the *Trigeminus*:

a. It perforates all the muscles of the face;

b. Supplies the pterygoid muscles (with *motor* nerves);

c. Supplies the skin of the whole face;

d. The teeth, gums, and jaws;

e. Enters into the organs of smell, sight, hearing, taste, endowing them with common feeling, but not the specific sensation of smell, sight, &c.; and also nutrition, e. g. in the conjunctiva of the eyes.

638. VI. *N. abducens*, the nerve for the *external rectus* muscle.

*Origin*: with two roots: a. from the posterior border of *pons Varolii*; b. from the superior part of *corpus pyramidale*. *Course*: upwards and rather outwards from under the pons, perforates the *dura mater*, and passes inwards over the apex of the petrous bone into the *cavernous sinus*. Here it lies on the outer side of *carotis* and to the inside of the veins of the *sinus*, and receives two branches from *plex. caroticus* and one from *n. ophthalmicus*; it then passes directly forwards through the *fissura orbitalis superior* into the *orbita*, [between the two origins of] *m. rectus externus*, lying there on its internal surface above the *n. oculo-motorius*, under *n. ophthalmicus*.

639. VII. *N. facialis s. communicans faciei*, formerly known as *portio dura pars VII.*, is a mixed nerve, which arises with two roots; the *larger anterior* (motor) root from the posterior border of *pons Varolii*, in the fossa between this and the *medulla oblongata*; the *smaller posterior* (sensitive), from *corpus restiforme*, where the auditory nerve arises (hence the guidance of the undulations producing sound to the ear by means of *n. facialis*). *Course*: external to and above in front of *n. acusticus*, with which it passes along to the *meatus auditorius internus*.

*Pars petrosa*. In the auditory meatus the nerve gives a small filament to *n. acusticus*,—it enters the *canalis Fallopii*, forms at the *hiatus c. Fall*. a curve—the bend—around the cavity of the
tympanum, and passes out through the **foram. stylomastoideum** to the face. At the bend the small root forms a ganglionic enlargement, this is:

**ganglion geniculatum**, a grayish-red, triangular ganglion which receives the *n. Vidian. superficial.* (of *nerv. trigemin.* ) and gives off; a. some minute filaments which again sink backwards into the auditory nerve with a reddish enlargement; b. a filament, which passes to the long root of **gangl. oticum**. Before it leaves the canal the *n. facialis* gives off:

1. **Ram. ad fenestram ovalem** going along through a small canal in the posterior part of the **fenestra ovalis**.
2. **Nervus stapedii**, passes obliquely inwards to the muscular portion of *m. staped*.
3. **Chorda tympani**, that is, a nerve which runs along a canal peculiar to it (**canal chordae**), in the posterior wall of the tympanum, backwards and upwards, then forwards in the arch through the cavity of the tympanum, free, between the long crus of the incus and the manubrium of the malleus, and passing forth from a small foramen in the centre of **fissura Glasseri**, it applies itself to *n. lingualis*, and gives a long motor root to the **ganglion linguale**.
4. **Rami communicantes cum n. vago**, come from the auricular branch of *n. vagus*, two small branches.

Having made its exit at the **foram. stylo-mast**. the *n. facialis*, whilst situated behind the **parotis**, gives off the following branches:

5. **N. auriculo-occipitalis s. occipitalis posterior**, inclines, from the **stylomastoid foramen** upwards, and divides into a larger **ram. occipitalis**, which ramifies in the *m. occipit.*, the periosteum, and on the vessels, and anastomoses with a filament of **plex. cervicalis**; and into a **ram. auricularis**, which supplies the **nn. retractor** of the auricle [and the other muscles] and anastomoses with the **rr. temporales** of *n. trigemini* and **facialis** and the auricular branch of *n. vagus*.
6. **N. stylo-hyoideus** inclines obliquely outwards to the *m. stylohyoid.*, and anastomoses with the *n. sympathetic* and first cervical nerve.
7. **N. digastricus** to the posterior belly of *m. digastricus*, gives branches to the **carotis**, and unites with *n. vagus, trigeminus* and **sympathicus**.
8. **Rami parotidei posteriores** come partly from the trunk, partly from the branches, and terminate in the substance of the **parotis**.

After this the trunk curves forwards in the anterior half of the
parotid, and divides into three, rarely two, diverging branches, which form a large plexus (*plexus parotideus s. anserinus*) which surrounds the *art. temporalis* with a posterior loop. From this pass into the face:

1. *Nn. zygomatici*, five branches. The three first (also *temporales*) arise close under the auricle, ascend above the zygomatic process, give branches to the auricle, to the temple, *mm. frontalis* and *orbicularis*, at the outer angle of the orbit, and unite with one another, with *subcutan. male* and *temporal. superficialis*. The fourth, frequently a branch of the third, is situated more deeply, ramifying below in the *m. orbicularis*. The fifth is larger, sends a superior branch to the inferior eyelid to the *n. infraorbitalis*; an inferior to the *art. auricular. inferior* and filaments to the fat below the malar bone.

2. *Nn. faciales s. buccales*, four branches, passing over *m. masseter* forwards, supplying the *ductus Stenonian*, the vessels and muscles of the face, of the inferior part of the forehead, of the nose, of the lower eyelid downwards as far as *risorius Santorini*. They anastomose with *n. infraorbitalis* and its plexus.

3. *N. marginalis maxillae inferioris s. labio-mental*, descends to the angle of the lower jaw, bends forwards and passes over the horizontal ramus of the lower jaw with a superior branch for the upper portion of the lower lip, with an inferior branch to the chin joining the *plexus mentalis* of *n. mentalis* (see trigemin.)

4. *Nervi ad plexum platysmamyoidem*, generally three branches, descend on the vertical ramus of the lower jaw to the *m. platysmamyoides* anastomosing with the last nerve and the third cervical; they reach to the region of the larynx.

640. VIII. *Nervus acusticus*, the nerve of Hearing, formerly *portio mollis paris VII.*, arises: 1. In the rhomboidal fossa, behind *n. facialis*, from *corp. restiforme*; 2. From *crus cerebelli superius*, around which it bends; coming forth behind the *pons* and passing on the outer side of *n. facialis*, which it receives in a groove, outwards and upwards to the *internal auditory meatus*. Here it unites by means of filaments with the *n. facialis*; and divides into an anterior (*n. cochlea*) and a posterior (*n. vestibuli*) principal branch which pass through the foramina in the base of the auditory meatus to the labyrinth.
1. **N. cochleae**, passes through the anterior foramen with spirally-arranged fibres, becoming the more so as they approach the modiolus, sending its branches through the *tractus spiralis foraminulentus*, which form loops upon the *lamina spiralis*, and terminate at the *infundibulum*.

2. **N. vestibuli**, passes backwards and divides into three branches which go through three fosse to the vestibule. A grayish-red enlargement is found on it, like the auditory nerve which is generally rather reddish.
   a. **N. saccularis major**, passes obliquely forwards to the superior fossa and its canaliculi into the *saccus oblongus* and the ampulla of the superior and external semicircular canals.
   b. **N. saccularis minor**, more horizontal to the *saccus hemisphericus*.
   c. **N. ampullaris inferior**, deeper, through the external fossa to the ampulla of the posterior semicircular canal.

641. IX. **N. glosso-pharyngeus**.

Origin: with a series of filaments (two roots) from *corp. restiforme*, above *n. vagus*, below *n. facialis*; passing out between *corp. restiforme* and *olivare*. Course: the trunk passes, a distance of from one half to three quarters of an inch outwards, forwards and rather upwards to the anterior part of *foram. jugulare*, separated from the *n. vagus* by a vessel, forms two ganglia, passes out from the cranial cavity, and divides into two branches. Situation: in the *foram. jugulare*; in front and above, before *n. vagus* and *accessorius*, before and on the inner side of *v. jugularis interna*, in a canal of *dura mater*; below the foramen: united with a ramus of *n. sympathetic*, curved forwards and downwards on the outer surface of *carotis interna*, on the internal of *m. stylo-pharyngeus*, removed from *v. jugularis int.*, *n. accessorius* and *vagus*. Junctions: with *n. vagus*, its auricular and pharyngeal branch with *plexus caroticus*; and with *n. facialis* in the *m. digastricus*.

1. **Ganglion jugulare** (Ehrenritter, J. Müller), lies (from a half to one line long and broad) upon the posterior fasciculus of *glosso-pharyngeus*, the anterior and posterior roots of which unite above and below it, in the superior part of the *foram. jugulare*. Below it (from two to four lines) lies a larger ganglion.

2. **Ganglion petrosum** (Andersch). It is oval, one and a half to two lines long, situated in the *vellocula* of the petrous bone, and receives on its superior and anterior part:

*Nerv. tympanicus s. Jacobsonii*. The tympanic nerve ascends by means of a peculiar canal (upon the crest between *canal caro-
SPECIAL ANATOMY.

ticus and fossa jugularis) to the inner wall of the tympanum, is surrounded by a thin ganglionic mass (gangliolum tympan.) receives a filament from plex. caroticus, and gives a branch to the fenestra rotund. and ovalis. Below the last the trunk bends round, forwards and downwards, passes through tuba Eustachii, perforates its cartilage, and terminates in the glands about its orifice. Two branches, besides, pass off on a plane with the fenestra ovalis.

a. N. petrosus profundus minor, passes through a canal of the septum between tuba Eustachii and canal. caroticus in the last to the plex. carotic., where it unites with ram. prof. n. Vidian.

b. Ram. communicans n. petrosi-superficialis minoris, passes in a canal behind the tubae Eustachii upon the anterior surface of the petrous bone to n. petros. superf. minor (see nerv. facialis), which passes through foram. spinos. to gangl. oticum.

(Plexus tympanicus major, Jacobson’s anastomosis is principally formed by a., lies upon the internal wall of the tympanum, supplies the mucous membrane and osseous substance, and is probably in connexion with the chorda tympani.)

3. Ramus pharyngeus, divides into from two to three branches, which form, with those of n. vagus, the plex. pharyngeus, and supply m. constrictor super. and med. and the posterior part of the pharynx.

4. Ramus lingualis, the nerve of taste, the continuation of the trunk, passes in a curve, convex behind, from the carotis interna to the root of the tongue, giving, in this course, branches to m. stylo-pharyngeus, which lies before it, to the tonsils above, to the mucous membrane of the root of the tongue, where it anastomoses with n. maxillaris inferior. In the root of the tongue it divides immediately into an external branch for the mucous membrane of the border and the inferior surface, and an internal branch for the posterior third of the mucous membrane, as it forms a plexus about the foramen cæcum. Both unite with n. maxillar. inferior and trigemini.

642. X. N. Vagus s. pneumogastricus, the Vagus nerve.

Origin: with from twelve to sixteen filaments (united into from six to eight fasciculi) from the central columns of medulla oblong. between corp. olivare and restiforme. Course: under the cerebellum obliquely downwards, forwards and outwards to the anterior part of the foram. jugulare. It here lies in an especial sheath
(of dura mater) behind nerv. glosso-pharyng.; before v. jugular. interna; it forms a ganglion to which nerv. accessor. Willisii is applied. Below the foram. jugulare it forms a plexus ganglio-
form.; is placed at first before, then on the inner side of ven. jugularis, n. accessor. and hypoglossus; it passes downwards along the neck behind carotis (within) and jugularis (without), in one sheath with them, separated from n. sympatheticus (which is behind and outside) by uniting tissue, to the thorax, and from this with the oesophagus through the diaphragm, where it terminates in the plexus solaris on the stomach.

643. (I.) The cranial portion.

a. Ganglion. jugulare n. vagi, lies, almost enclosed in dura mater, in the superior part of the for. jugulare, oval, flat, and two lines long, receives a few filaments from n. accessorius, glosso-pharyng., sympatheticus and facialis. From its ante-
rior external side arises:

1. N. auricularis. The auricular branch passes round the bulbus v. jugul. forwards, gives a filament to n. Jacobsonii, passes through a canal behind proc. styloideus into the canal. Fallopiae, here anastomoses with n. facialis, passes through a canal in the proc. mastoid. again outwards to the skin of the posterior part of the external auditory meatus. (Important on account of the sympathy existing between the Ear, Lungs, and Stomach.—Arnold.)

2. Connecting twigs with the gangl. cervicale I. (See this.)

644. (II.) The cervical portion.

b. Plexus ganglioformis s. nodosus, lies half an inch below the foram. jugulare, and is a loose plexus of the fasciculi of the vagus, the meshes of which are filled with a grayish-red fat. It unites with nerv. hypoglossus, glosso-pharyng. and sympa-
theticus, sometimes also with the first cervical nerves. From it arise:

1. Nn. pharyngei. The superior pharyngeal nerve unites with n. hypoglossus, passes to m. constrictor super., and the mucous membrane. The delicate middle unites with n. pharyngeus, the glosso-pharyng., and passes with these also to the superior part of the pharynx. The inferior descend obliquely, unite with n. sympatheticus, and termi-
nate in m. constrictor medius and crico-pharyngeus. They form:
Plexus pharyngeus, lying on the lateral walls of the pharynx, entwining around the art. pharyng. ascendens, and terminating in the muscles and the mucous membrane. At the superior part fibres generally come from glossophar., in the middle from n. vagus, below from vagus and sympathetic.

1. N. laryngeus superior. The superior laryngeal nerve (principally a sensitive nerve) arises on the inner side, and passes along it close to the pharynx, obliquely behind the carotis interna forwards and inwards, and divides into:

a. N. laryngeus externus, the smaller inferior branch arising sometimes from the trunk of the vagus itself, passes downwards and inwards, and at the side of the larynx forwards, between m. constrictor infer. and thyroid. cartilage, and is lost in the m. crico-thyreoides and upon the internal surface of the larynx—in the m. crico-arytenoid. It receives two filaments of sympathetic, and gives some to n. cardiacus behind carotis interna (this is, plex. laryngeus); farther, to m. constrictor infer. and thyroid. gland.

b. N. laryngeus internus, continuation of the trunk, passes between os. hyoid. and larynx, enters into the last with art. laryngea super., and divides beneath the mucous membrane in a radiating form into anterior and posterior branches. It supplies the mucous membrane of the epiglottis, the thyroid cartilage, membr. hyo-thyreoid., of the vocal cords, of the mm. arytenoidei [merely perforating them in order to reach the mucous membrane], and anastomoses upon the posterior surface of the cricoid cartilage with nerv. recurrens.

c. Several vascular branches pass over and under the point of bifurcation of carotis, forming plexuses about these vessels.

d. Rami cardiaci, from two to four, arise below the region of the point of bifurcation of the carotis, pass downwards upon it, anastomosing with one another, and passing into the plexus cardiacus (of sympathetic). To these also belongs the ram. descendens, which passes from the posterior part of the vagus, in the inferior part of the neck above the carotis, partly to the cardiac plexus, partly to the oesophagus, and anastomoses with n. sympathetic.

645. (III.) The thoracic portion of the Vagus.

Upon the right side of the trunk passes between ven. and art. subclavia; upon the left, between carotis communis and art. sub-
clavus into the chest. Course as far as the roots of the lungs; upon the right side: behind v. anonyma and cava super., in the sulcus between trachea and æsophagus downwards to a point behind the roots of the lung; upon the left: behind v. anonyma to the left of arcus aortae and behind bronchus sinister. Hence it passes into the cavum mediastinum. postic., divided into two branches, upon the right side, behind, upon the left, before, the æsophagus, through the foramen æsophageum into the abdomen. Branches:

1. Nerv. recurrens s. laryngeus inferior, arises upon the right side (where it is frequently double) before the art. subclavia, upon the left, before the arcus aortae, externally to the ductus Botalli, at the place where the vagus passes backwards; it bends itself under the vessels, and passes upwards behind them on the outer side between trachea and æsophagus, perforates m. constrictor pharyngeus infer., and enters the larynx; terminating in the m. crico-arytænoideus [and m. arytænoidei]. It gives branches to the mucous membrane [?] and to the muscles as well to the constrictors as to the dilators of the larynx; also to the æsophagus and the trachea [the muscular fibres behind]; anastomosing with n. laryngeus super. and n. sympatheticus by means of some rami cardiaci. It is principally a motor nerve.

2. Rami cardiaci thoracici, are from five to six larger, and several more delicate branches, which pass into the following plexus, or are lost upon the external surface of the pericardium.

Plexus cardiaci, formed of vagus and sympathetic, entwine about the great vessels of the heart, and are separated at the point of reflection of the pericardium into superior and inferior, but connected with each other as well as with those of the æsophagus and trachea.

3. Rami tracheales inferiores, lie on the anterior surface, close above the bifurcation of the trachea, intermingling at this point with nerv. sympatheticus into a

Plexus trachealis anterior, which is connected with the internal cardiac plexus, and proceeds into the plex. pulmonalis anterior, which covers the bronchi in front.

On the posterior surface of the trachea, a plexus tr. posterior also arises, from six to seven branches, which is connected with the pharyngeal and cardiac plexus, and gives branches to the mucous membrane of the bronchi.

4. Plexus pulmonalis posterior, frequently arises from the trunk of the vagus; from four to six branches, upon the right and left side of the lungs. The left is the larger. Both are connected together with plex. trachealis, and enter the lungs with
the bronchi. Some filaments are lost in the pulmonary artery. Its posterior filaments belong to *n. sympathetic*, from its three superior ganglia.

5. **Plexus esophageus inferior**, formed by the internal principal trunk of the vagus, which descends farther on the esophagus below the bronchi, entwines around it, and penetrates between its coats. The *right vagus* passes more towards the posterior (*pl. esoph. post.*); the left more towards the anterior surface (*pl. anterior*). Both anastomose with each other by large branches.

646. (IV.) The abdominal portion of the Vagus.

The *right trunk* enters behind, the left before the esophagus, through the *foram. esophageum*. Each is lost in a fasciculus, *rami gastrici*, and forms a *plexus gastricus*.

1. **Plex. gastricus anterior**, formed by the left *n. vagus*, lies upon the anterior surface along the small curvature from the Cardia to the Pylorus; gives branches to the *fundus ventriculi*; to the small omentum as far as fossa transversa hepatis.

2. **Plexus gastricus posterior**, formed by the right *n. vagus*, lies behind the cardia, is smaller than 1, and passes, principally, into the *plex. solaris*.

**Connexions of the n. vagus**: with *n. trigeminus*, facialis, glossopharyngeus, accessorius Willis., hypoglossus, cervicall. superr. 3, and sympathetic.

**Function.** The *vagus* is entirely sensitive until its connexion with *n. accessor. Willis.*, then a motor nerve likewise.

647. XI. **N. accessorius Willisii**, the spinal accessory Nerve.

**Origin**: from the posterior part of the central columns of the spinal cord, between the posterior roots of the fourth to the sixth cervical nerves (sometimes even deeper) and *lig. denticulatum*; with six to seven radical filaments, which are strengthened by the posterior roots of the first (to the third) cervical nerves, but only pass in a sheath with them, and often present a small ganglion, but which belongs to the cervical nerves. Course: upwards on the sides of the spinal marrow, always becoming more distant from it; over the first cervical nerve, strengthened by some filaments, through the *foram. magnum* to the cranial cavity. It here passes in a curve downwards, forwards, and outwards, enveloped by the *dura mater*, to the *vagus*, passes into its sheath, on the outer side, and behind it, through *foram. jugulare*, pass-
ing on it and its ganglion, and dividing into its two branches. It is a motor nerve, and holds the same relation to the vagus as the posterior root of a spinal nerve does to the anterior.

1. Ram. internus, passes downwards, partly into the nerv. pharyng. superior, partly through the plex. ganglioform (probably into the laryng. superior, and) into the thorax, to the nerv. recurrens, the pharyngeal and gastric plexus.

2. Ram. externus, the posterior branch, the continuation of the trunk, descends behind ven. jugular. interna outwards and backwards, perforates m. sternocleidomast. at the superior third, gives branches to it, becomes enlarged by means of branches from the second and third cervical nerves, and enters the m. trapezius on the internal surface, ramifying in it as far downwards as its inferior extremity.

648. XII. Nerv. Hypoglossus, the lingual Nerve.

Origin : between corp. pyramidale and olivare, with ten to fifteen filaments, which unite into two fasciculi, in a row with the anterior roots of the spinal nerves, behind the art. vertebralis. Course: the two fasciculi, covered by the pia mater, perforate the dura mater separately, become covered by it, and ascend to the foram. condyloid. anterius, through which the united trunk passes out of the cranial cavity (one line thick). Hence it passes downwards and forwards, situated internal to and behind n. accessorius, vagus, and v. jugularis interna; inclining in a curve from above, behind and internally over vagus and carotis (over the place of bifurcation) forwards, upwards, and inwards, to the tongue. Here it is situated, at first, internal to and under m. digastricus, then, above art. thyreoid. and lingualis, external to them, internal to m. stylo-glossus. Finally, it passes upwards and forwards into the flesh at the inferior surface of the tongue, covered by gland. submaxillaris and m. mylo-hyoideus, where it terminates at the apex.


Ram. descend. hypoglossi, arises from the commencement of the curve, descends outside the carotis before the vagus (in the same sheath), anastomoses with it, the third cervical nerves [sometimes the second or even the fourth], gives
branches to *m. omo-hyoideus* [and a long filament for the posterior belly], *sterno-, hyo-, and thyroideus*, and passes behind the last to the *plex. cardiac. super.*, and with another branch to the *nerv. phrenicus* in the *mediastin. anticum*. 

*Nerv. hypoglossus* is a motor nerve only.

**649. The Spinal Nerves, Nervi spinales.**

From thirty-one to thirty-two pairs are enumerated, namely: eight cervical, twelve dorsal, five lumbar, five sacral, and one to two coccygeal pairs of nerves.

They arise with two roots from the sides of the anterior and posterior columns of the *medulla spinalis*, connected with the gray matter in the interior.

The anterior (motor) root is smaller than the posterior, separated from it by means of the *ligam. denticulatum*, and arises from a narrow white line. The posterior (sensitive) root is stronger, arises from the gray lateral sulcus, and is provided with a ganglion (*ganglion spinale*).

**Course.** Both roots, enveloped in arachnoid, approach each other, without anastomosing, and pass out, even still surrounded by a sheath of the *dura mater*, through a corresponding intervertebral foramen. The superior spinal nerves pass off horizontally, and are shorter, the inferior at so much the more of an acute angle with the spinal cord, the nearer they approach its termination. The two roots unite into one trunk after their exit from the intervertebral foramen, which immediately divides into an anterior and posterior, and branches for the *n. sympathetic*. Fibres from the anterior as well as from posterior roots are united in these branches.

a. *Ganglia spinalia*, reddish, firm ganglia, formed by the posterior roots of the spinal nerves, are situated one in each intervertebral foramen; but those of the sacral and coccygeal nerves, while still within the *canalis spinalis* and the *dura mater*. They are so much the larger, the stronger their roots and the branches passing off. The anterior roots of the spinal nerves are merely applied to their anterior surfaces (according to Cruveilhier they are also united to them by fibres).

b. The anterior branches of the spinal nerves are, with the exception of the first and second cervical, much stronger than the posterior, flat, and pass forwards and outwards before the transverse processes. In the neck, the loins, and sacrum, they form loops by means of ascending and descending branches, in consequence of which a *plexus* arises, from which the nerves pass off
to the extremities, in particular. In the back (nn. intercostales) they pass singly, without forming a plexus.

c. The posterior branches, much smaller than the anterior, pass between the transverse processes (foram. intervertebr. posterr. Cruveilhier), and through the foram. sacralia post. backwards, divide into several branches, and soon terminate in the muscles and the skin of the back from the occiput to the coccyx.

650. 1. The cervical nerves, Nervi cervicales (eight pairs).

Their posterior branches pass at first transversely inwards between m. complexus and semispinalis, perforate the trapezius from before backwards, and take a retrograde course beneath the skin transversely outwards; they also unite with the plexus. Those of the two first are larger than the anterior. The anterior branches form, principally, the plexus cervicalis brachialis.

651. a. The four superior cervical nerves

supply the skin and muscles of the occiput, nape of the neck and cervical region, and form the plex. cervicalis, from which n. phrenicus arises.

1. Nerv. cervicalis I. s. infra occipitalis Aschii, one of the smallest spinal nerves, passes forth under art. vertebralis (rarely over it) between occiput and atlas, behind proc. obliquus, and divides below the curvature of the art. vertebralis. Its larger anterior root contains from three to four fasciculi, the smaller posterior from two to three. It is situated farther forwards than the rest of the posterior roots, applies itself to the n. accessorius, and is said to be sometimes wanting. Its ganglion lies in the foram. invertebrale.

a. Ramus anterior, passes on the inner side of art. vertebr. in a sulcus of the Atlas, and bends downwards to form a loop with the second cervical nerve. Branches to the articulation of the occiput, hypoglossus, gangl. cervicale I., vagus and sympat., art. vertebralis, mm. recti capitis antici and laterals, between which it pierces

b. Ramus posterior, larger than a, passes in the space between mm. capit. obliqui and rect. postic., supplies these and m. lateralis, biventer and complexus.

652. 2. N. cervicalis II.,

far larger than I., passes through between atlas and dentatus, farther backwards than the rest of the spinal nerves, and divides beneath m. capit. obliq. inferior, into:
a. *Ram. anterior*, passing under *m. obliq. capit. inferior* forwards and outwards; gives branches to: the loops with the first and third cervical nerves, *ram. descend.* and *hypoglossi, nerv. vagus, accessorius, m. rect. capit. antic. major, sterno-cleidomast.*

b. *Ram. posterior*, sometimes larger than *a*, gives ascending and descending branches to the posterior loops, besides to: *mm. obliquus capit. infer., trachelomast., complexus, splenius, semi-spinal. cervic.,* and the

*Nerv. occipitalis major.* This perforates the superior extremity of the *biventer cervicis* and *m. cucullaris*, supplies these, ascends between nape and occiput internal to, *art. occipital.,* is then situated beneath the skin, gives a curved branch to the middle line, others outwards and upwards, and reaches as far as the middle line of the vertex. It unites with *ram. poster.* of the third cervical, probably, also, with the temporal nerves.

653. 3. *N. cervicalis III.,*

passes obliquely upwards and outwards between the muscles, and transverse processes, through the second intervertebral foramen, and divides immediately into:

a. *Ram. anterior.* Uniting with the second and fourth cervical nerves, the first cervical ganglion of the *sympathicus, recur-rens hypoglossi,* it passes from behind into the centre of *m. sterno-cleidomast.,* and gives:

1. *N. occipitalis minor,* frequently only a branch of the *occipit. major,* passing forth behind *m. sterno-cleidomast.* over *m. splenius capit.* and *proc. mastoid.* upwards, to the outer border of the *occiput,* ramifying in the skin. Branches to the muscles, to *n. facialis,* and the:

*N. auricularis superior* for the skin of the superior part of the external ear and *m. attolens;* it unites with *n. facialis* and *occipit. major.*

2. *N. auricularis magnus,* inclines round *m. sterno-cleido- mast.,* forwards and upwards to its anterior border, where it divides (at the angle of the lower jaw), giving an auricular branch to the posterior part of the auricle from below upwards, which unites with *n. facialis,* and another to the *occiput,* which unites with *n. occipitalis.*

3. *Nn. subcutanei colli (3).* The superior inclines from behind over *m. sterno-cleidomast.,* obliquely forwards and upwards, external to *v. jugular. externa,* supplies the skin
with an anterior branch, going through the parotis as far as
the angle of the mouth, and unites with nerv. facialis, with
a posterior branch directly upwards to the skin on the ante-
rior part of the auricle. The central unites with the last,
giving branches upwards to the chin, downwards to the
inferior region of the neck; the inferior inclines before the
ven. jugular. externa inwards, sends branches to the most
inferior region of the cervical skin, and on the chest.

b. Ramus posterior, contributes to the posterior loop, passes
under proc. spin. of the second vertebra and into the skin of
the centre of the nape of the neck. Branches to: m. tracheo-
mastoid., transversal., complexus, splenius capitis., semi-spinal,
cervic. and trapezius.

654. 4. N. cervicalis IV.,
passes out through the third intervertebral foramen, between the
third and fourth cervical vertebrae, gives branches to art. vertebrale,
and divides into:

a. Ram. ant., giving branches to m. rectus capitis. antici majore,
longus colli, scalen. med., levat. scapul., to the third and fifth
loops. From the last:
1. Nn. supraclaviculares, for the most part cutaneous nerves,
which radiate in the inferior trigonum cervicale between m.
sterno-cleido-mast., trapezius and clavicle; the anterior to
the clavicle and mammary gland, the central to the axilla,
the posterior to the scapula.
2. Nerv. phrenicus respiratorius internus (Ch. Bell), the
diaphragmatic nerve, arises from the fourth cervical nerve,
and is strengthened by filaments from the third, fifth, and
sixth, even from the second and seventh; it unites with the
superior cervical ganglion, sometimes with hypoglossus and
vagus. Course: before m. scalenus anticus, downwards
and inwards, and between art. and v. subclavia into the
cavum mediast. antic. of the thorax. It is, here, between
Pleura and Pericardium, before the roots of the lungs,
without distributing any branches; on the left side it passes
round the apex of the heart (therefore longer). It divides
into two principal branches, which radiate upon the superior
surface of the diaphragm, and partly pass to its inferior
surface, where they anastomose with the plexus phrenicus
sympathici. It is a mixed nerve, and gives rise, by its
motor filaments, to the involuntary respiratory movements
of the diaphragm, the two anterior thirds of which it
supplies.
b. *Ram. posterior* is small, is distributed in the *m. multifid., complexus*, gives other branches, and terminates in the *m. splenius capitis*, or upon the skin.

**Plexus cervicalis**, formed by the loops of the four superior cervical nerves (their anterior branches), is situated behind *m. sternocleidom. and ven. jugularis interna*, before the superior extremity of *m. scalenus med. and levat. scapulae*, the third and fourth cervical vertebrae. Its branches have been described.

655. b. The four inferior cervical nerves supply more especially the skin and muscles of the superior extremity, as their strong anterior branches interlace, upon their exit from the intervertebral foramina, and form, with the first dorsal nerve, the *plexus brachialis*. The posterior branches are small, incline round *m. multifidus, &c.*, supply *splenius, biventer, &c.*, and terminate upon the skin of the middle line, at the inferior region of the neck.

656. **Plexus brachialis.**

Situation: oblique from the inferior lateral region of the neck as far as the inner side of the head of the *humerus*. Its *superior* broader portion lying between the *mm. scaleni*, covered by a *fascia*, is situated above *art. subclavia* in the *trigonum cervicale inferius*, and is connected above with *plex. cervicalis* and *n. phrenicus*. Its *central* narrower portion between *clavicle* and *first rib*, behind *art. axillaris*. Its *inferior* portion in the axilla, behind the *m. pectoralis major*, before the *scapulo-humeral* articulation, separated from this by the tendons of the *m. subscapularis*, surrounds the *art. axillaris*. The branches are spirally interwoven.

657. a. Respiratory nerves, the branches of the *pars supra-clavicularis.*

1. *N. dorsalis scapulae*, arises from the *ram. anter.* of the fifth cervical vertebra, descends obliquely backwards through the *m. scalen. medius*, above *levator. scap.*, and with *art. dorsalis scapulae* on the internal surface of *mm. rhomboidei*; distributes muscular branches.

2. *N. thoracicus longus (posterior) s. respiratorius externus Bellii*, arises with three roots, from the fifth to seventh cervical nerves, which perforate the *scalenus medius*. Its trunk descends on the external surface of *serratus antic. major* as far as its inferior extremity, before *m. scapularis*; its branches pass in arches into the *Serratus Magnus.*
3. *Nn. thoracici anteriores*, arise from the anterior portion of the brachial plexus, above the *m. subclavius*, from the fifth to seventh cervical nerves, pass inwards, before and behind *art. axillaris* to *m. pectoral. major and minor*; a filament along the *clavicula*. Branches: to *m. subclav., deltoid.*, even to the skin of the mammary gland.

4. *N. suprascapularis* arises from the fifth, and is enlarged by the sixth and seventh cervical nerves, passes backwards, outwards, and downwards along the *m. omo-hyoid.* and with the *vena transversa scap.* goes through the *incisura scapul.,* beneath the *lig. transvers.*, whilst the artery passes over it. (In consequence of becoming enlarged the vein presses upon this nerve; hence pains about the shoulder in diseases of the heart.) It supplies *m. supra- and infra-spinatus.*

5. *Nn. subscapulares*, two branches, arise from the fifth to seventh cervical nerves, sometimes from *n. axillaris*, pass backwards and downwards, giving branches to *m. teres major,* and sinking into *m. subscapularis.*

6. *N. marginalis scapulae s. subscapularis longus*, arises from the inferior central part of the plexus, passes with *art. subscapul.* to the outer border of the shoulder blade, giving branches to: *m. serrat. antic. maj. and latiss. dorsi.*

658. b. The nerves of the arm, branches of the *pars axillaris* of the brachial plexus.

There are three cutaneous and four muscular nerves.

Of these, the

- **N. Axillaris** supplies the *m. deltoideus* and *teres minor*;
- **N. musculo-cutaneus** — the *flexors* of the fore-arm;
- **N. radialis** — the *extensors* of the fore-arm and the hand, and the *supinators*;
- **N. medianus and ulnaris** — the *flexors and pronators* of the hand and fingers.

659. Cutaneous nerves.

1. *N. cutaneus brachii internus (minor s. ulnaris)*, arises from the loops of the seventh cervical and first dorsal nerves, passes into the axilla on the internal posterior side of *ven. axillar.,* then on the internal side of the *humerus*, perforates the *fasc. brachial.* in the middle third and inclines outwards. It supplies above, the
skin of the arm, on the posterior surface, downwards as far as the olecranon, on the inside; as well as the anterior surface; uniting above the olecranon with the principal trunk of the middle cutaneous nerve.

2. *N. cutaneus medius s. internus major*, arises from the inferior portion of the plexus or from *n. ulnaris* and *medianus* (at first on the *ven. axillar.*; then on the *ven. basilica*), afterwards between them, downwards along the boundary of the anterior and internal surface of the upper arm, beneath the fascia, giving above branches to the axilla and to the skin along the *m. biceps*, and divides into an external branch for the anterior surface and an internal for the ulnar border of the fore-arm, the branches of which extend as far as the carpal articulation.

In the bend of the arm it is situated over *ven. mediana*, rather internally, towards the *condylus internus*. (The outer side of the vein is therefore selected in venesection.)

3. *N. cutaneus externus s. musculo-cutaneus s. perforans Casserii*, arises close to the *n. medianus* or with it, from the fifth to the seventh cervical nerves, perforates the *m. coracoideus* and passes obliquely between *biceps* and *brachial. intern*., outwards, passes downwards to the *v. cephalica*, and close to this on the fore-arm, in the inferior half of which it divides into a volar and a branch for the radial border, which terminates in the skin over the carpal articulation. Branches to: *m. coraco-brachialis, biceps, brachialis internus*, and to the skin of the anterior surface of the lower arm.

660. **MUSCULAR NERVES.**

4. *N. axillaris s. circumflexus humeri*, arises from the inferior, middle part of the plexus, curves inwards and backwards, behind *anconeus long.* [triceps] around the highest part of the *humerus* with *art. circumfl. humeri post.*, and terminates in the skin between the axilla and upper arm on the posterior surface. Branches to: *m. subscapul.*, [*?] *teres major [*?] and *minor, deltoid*, to *art. axillaris*, the shoulder joint, and into the bones; lastly:

*N. cutaneus humeri posterior superior* [there are generally two, even three branches], perforates the *m. deltoideus*, and ramifies in the posterior, superior, and outer region of the upper arm.

5. *Nerv. ulnaris s. cubitalis*, arises from the inner part of the plexus, from the sixth to the eighth cervical, and first dorsal nerve, passes downwards on the inner side of *art. axillar.* and *brachialis* behind *ven. axillaris*, perforates the fascia, and goes between
m. triceps and the lig. intermuscl. intern. under the skin to the groove behind the condylus internus, between it and olecranon, without giving off branches. Hence it passes between proc. coronoid. of ulna and flexor carpi ulnaris [between the origins of this muscle], and passes on the ulnar side of the anterior surface of the forearm, and divides in its inferior third into a volar and dorsal branch. At this point it lies under m. flex. carp. ulnaris and digitor. superficialis, above the profundus; at first over, then internal to art. ulnaris. Branches to m. flex. carpi ulnaris., digit. superfic. [profundus]; one branch accompanies art. ulnaris to the skin of the volar surface of the carpus, as it perforates the fascia antibrachii.

a. Ram. dorsalis manus, passes between flex. carpi ulnaris and ulna, supplies the skin on the ulnar border of the forearm and divides on the carpus.

a. Ram. sublimis supplies the back of the fifth and fourth fingers on each side, that of the third finger on the ulnar side, with one branch.

b. Ram. profundus (small) winds round over the capitulum ulnae upon the back of the hand, where it anastomoses towards the radial side.

b. Ram. volaris, the continuation of the trunk, passes on the inner side of art. ulnaris under the tendon of flexor carpi, and enters, between lig. carp. vol. commune and proprium, passing close to the os pisiforme into the hollow of the hand, and divides into:

a. Ram. sublimis, supplies the ulnar side of the little finger on the palmar surface.

b. Ram. medius, supplies the radial side of the little and the ulnar side of the fourth (ring) finger.

c. Ram. profundus, supplies the muscles of the little finger, forms a loop on the os pisiforme with the corresponding branches of the former; passes on the arcus profundus arteriosus to the mm. interossei, adduct. pollicis [and the two lumbricales nearest the little finger.]

6. N. medianus; arises from the fifth cervical to the first dorsal nerves, from the outer part of the plexus, often united with n. musculo-cutane.; surrounds art. axillaris; passes downwards on the outer side of art. brachialis, on the inner of m. biceps, afterwards over the artery and to its inner side, through plica cubiti to the forearm, without giving branches. Descends from the centre of the bend of the elbow over art. ulnaris and behind m. pronator teres [often perforating it], is then situated in the inferior half of
the forearm between *flexor digitor sublimis* and *profundus*; finally, it passes between the tendons of *flexor. digit. sublim.* and *carpi radialis* behind *lig. carpi volare proprium* to the hollow of the hand, where it divides into four branches.

Branches to: *art. interossea*, to the hollow of the hand (*r. cutaneus longus*) [or palmar cutaneus], and to all muscles of the flexor side of the fore-arm, except *flexor carpi ulnaris*.

a. *Ram. volar is internus*, supplies the skin of the hollow of the hand, the third *lumbricalis* [sometimes], and the collateral surfaces of the third and fourth fingers.

b. *Ram. medius internus*, supplies the second *m. lumbric.* and the collateral surfaces of the second and third fingers.

c. *Ram. medius externus*, supplies the first *m. lumbric.*, and the collateral surfaces of the second and first fingers, and the external of the last.

d. *Ram. externus*, muscular branches for *flexor. brevis, abductor*, and *opponens pollicis*.

[e. *Ram. interosseus*, accompanying the *art. inteross. ant.*, supplies the *pron. radii quad.*]

7. *N. radialis s. spiralis*, in size and course resembling the median, arises from the fifth to the eighth cervical nerves from the posterior part of the *plexus*. Course: it winds round the posterior surface of the upper arm outwards, forwards, and downwards towards the fore-arm, as it passes down upon the anterior internal surface of *condylus externus*, and divides at the flexure of the arm. Position: at first behind *art. axillaris*, and separated by it from *n. ulnaris* and *medianus*, then close to the bone in a sulcus between the heads of the *triceps m.*, finally passing out obliquely between *brachialis internus* and *supinator longus* over the *condylus externus*.

Branches: a long cutaneous branch, which reaches down as low as the back of the hand, and to all the *extensor* muscles, except *m. extensor carpi ulnaris* [*?*].

a. *Ram. dorsalis s. ram. superficialis*, continuation of the trunk, passes (on the outer side of *art. radial.*) under *supinator longus* upon the dorsal surface of the fore-arm, perforates the fascia below its centre, and divides into an external and internal branch.

a. *Ram. anterior*, passes down upon the *extens. pollic. brevis*, gives branches to the volar surface of the skin of the ball of the thumb, and terminates as *n. dorsal. radialis pollicis* on that organ.

b. *Ram. posterior*, supplies the dorsal side of the collateral
surfaces of the first and second, and those of the second and third fingers.

b. *Ram. profundus s. muscularis*, passes through or under *m. supinator brevis* upon the dorsal surface of the fore-arm, supplies the extensor muscles, and passes close upon the *lig. interosseum* (as *n. interosseus externus*), to terminate upon the carpal articulation.


The first passes out between the first and second dorsal, the last between the twelfth dorsal and first lumbar vertebra. Their roots are smaller, and lie more widely asunder than those of the other spinal nerves; their trunks also are less developed. They traverse a greater length of the *canal. spinalis*, form their ganglia, and soon divide after their exit from the intervertebral foramen. By means of frequent anastomoses, they form arched loops with each other, and give off roots to the *nerv. sympatheticus*.

1. Posterior branches, *rami dorsales*, smaller than the anterior, turn round between *lig. colli costae extern.* and *intern.*, backwards, and divide into an external and internal branch.
   a. *Rami externi*, turn outwards:
      a. Those of the seven superior, smaller, pass out between the transverse processes; pass between *m. longissim.* and *sacro-lumbalis*, give branches to them, to *cervical. descend.* and *transversal.*, to *levatores costarum*, and the over-lying skin.
   b. Those of the five inferior are larger, perforate the tendons of *serratus posticus* and *latissimus dorsi*, and terminate below in the skin.

b. *Rami interni*, are larger in the seven superior dorsal nerves; pass upon *m. multifid. spinae*, inwards and downwards towards the transverse processes, give branches to *m. multifid.*, *semi-spinal. cervicis* and *dorsi*, *mm. interspinales*, perforate the superficial muscles, and spread out, as the two are associated together, externally in the skin of the back.

2. The anterior branches, *nervi intercostales*, pass between the ribs before the *lig. colli costae intern.*, traverse, below the *vasa infracostalis*, the *sulcus costalis*, between *mm. intercostales externi* and *interni*, forwards and outwards, and divide in the middle between *vertebrae* and *sternum* into an internal and external branch. The anterior branch of the first dorsal nerve assists in forming the *plex. brachialis*, as its superior branch passes upwards behind *art.*
maxillaris to the eighth cervical nerve; its inferior branch traverses as intercostal nerve along the first rib.

a. Ramī interni s. profundī continue to pass in the direction of the trunk, along the inferior borders of the ribs as far as the middle line of the chest and abdomen.

α. The thoracic (r. thoracici interni), these are the branches of the second to the seventh intercostal nerves, which give small branches to the mm. intercostales and triangularis sterni (of the third to the seventh), perforate at the outer border of the sternum the mm. intercostal. and pectoralis major, are again reflected outwards, supplying the mammary gland and skin, and unite as internal cutaneous nerves of the chest with the external.

β. The abdominal branches (r. abdominales interni); these are, the branches of the eighth to the twelfth intercostal nerves, are larger, give branches to the mm. intercostales, pass behind the cartilages of the short ribs, and traverse between mm. obliquus intern. and transversus abdom. to and in the sheath of m. rectus, supplying the muscles and skin of the anterior abdominal walls.

b. Ramī externi s. laterales perforate (the twelfth excepted) the m. intercostal. extern. from behind forwards, then pass forth on the lateral walls of the chest and abdomen, and divide immediately into an anterior and posterior branch.

α. The thoracic branches (r. thoracici externi), that is, the second to the seventh branch, passing forth between the digitations of m. serratus ant. major. Their anterior branches are reflected inwards, and ramify in the skin of the thorax. Their posterior branches, backwards upon n. latissimus dorsi, give filaments to it, and terminate in the skin of the back. The posterior branch [intercosto-humeral] of the second and third n. intercostal. goes to the skin of the upper arm, and forms the posterior cutaneous nerves of the superior third of this region of the upper extremity [Nn. Wrisbergii].

β. The abdominal branches (rami abdominales extern.), that is, the eighth to the twelfth branch, passing out between the digitations of m. obliquus extern. Their anterior branches are reflected inwards, give a branch to m. obliq. extern., and ramify in the skin of the lower part of the anterior abdominal parietes. Their posterior branches pass backwards to the skin of the lumbar region.
662. III. The lumbar, abdominal nerves, \textit{Nervi lumbales},
(eight pairs.)

The first passes out between the twelfth dorsal and first lumbar vertebra, the fifth between the fifth abdominal and the sacrum. Their roots lie closer together, belong to the cauda equina, and pass tolerably far downwards in the \textit{canal. spinalis}; they are not united, like the earlier spinal nerves, by means of interposed filaments. The \textit{ganglia} of the lower are situated in the \textit{canalis spinalis}. The trunk divides, soon after its exit from the intervertebral foramen, into an anterior and posterior branch.

The anterior branches increase at the origin from the first to the fifth, unite by means of two or several filaments with \textit{n. sympathetic}, pass through \textit{m. psoas major}, and associate in loops before the transverse processes of the abdominal vertebrae, the four superior of which form \textit{plex. lumbalis}, while the fifth belongs to the \textit{plex. sacralis}.

2. The posterior branches decrease in size from the first to the fifth, are soon reflected backwards between the transverse processes and their muscles, and divide into:

a. \textit{Internal} branches. They pass in the groove on the basis of the transverse process to \textit{m. multifidus} and \textit{interspinales}. The fifth branch unites with the first \textit{n. sacralis}.

b. \textit{External} branches. They are larger, go to \textit{mm. intertransversarii} and \textit{sacro-lumbalis}. The three first distribute \textit{nn. cutanei superiores [lumbo-gluteal]} to the gluteal region.

663. \textit{Plexus lumbalis}.

The lumbar plexus is formed by the loops of the second, third, fourth, and a small branch of the first abdominal nerve, and is situated on the sides of the bodies of the lumbar vertebrae between the transverse processes and the fasciculi of \textit{psoas major}. Three secondary and three principal branches pass off from it, the former of which belong to the first and second lumbar nerves as \textit{nn. abdominales}, and pass between \textit{m. psoas} and \textit{iliacus} on one side and the \textit{peritoneum} on the other, to the crural arch; the latter supply the inferior extremity.

664. a. The secondary branches, abdominal branches.

1. \textit{N. ilio-hypogastricus} arises from the first lumbar nerve, perforates the \textit{psoas}, passes outwards before \textit{m. quadrat. lumbar}. downwards towards the \textit{crista ilei}, penetrates \textit{m. transvers. abdom.}, passes, between \textit{m. transversus} and \textit{obliquus internus}, along the
crista ilei, and terminates in the skin over the abdominal ring and 
mons Veneris, or passes through the inguinal canal. It supplies 
the above-mentioned muscles.

2. N. ileo-inguinalis arises from the first lumbar nerve or the 
first loop, perforates m. psoas farther forwards, and the m. trans-
versus in the neighbourhood of spina ilei anterior super., after 
that the obliq. intern., and passes over the spermatic cord (or the 
round ligament), through the abdominal ring to the skin of the 
pubic region (mons Veneris) and the anterior external part of the 
scrotum (or the labia externa), sometimes even to the thigh.

3. N. genito-cruralis arises from the second lumbar nerve, or 
the second loop, perforates the psoas close in front, passes down-
wards, forwards and outwards upon its anterior surface, and 
divides in the inguinal region into an internal and external 
branch.

a. Ram. externus s. lumbo-inguinalis, passes off obliquely, 
from the psoas to the m. iliacus outwards, and passes upon 
this with an external branch to the spina anter. super., per-
forates the inferior border of the abdominal muscles, and 
supplies the skin of the outer superior part of the thigh; 
with an internal, upon or outside the art. cruralis, through 
the femoral ring to the skin of the anterior superior part of 
the thigh.

b. Ram. internus s. n. spermaticus externus [s. ileo-inguinal] 
runs through the femoral ring on the inner side of v. cruralis, 
with an external branch which terminates in the inguinal 
glands over Poupart's ligament and the skin; with an inter-
nal branch through the inguinal canal upon the spermatic 
cord (or lig. uteri rotund.) into the tunica vaginalis propria 
to m. cremaster, testicle, tunica dartos, and skin of the scro-
tum (or to mons Veneris and the anterior extremities of the 
labia).

665. b. The principal branches, femoral.

4. N. cutaneus femoris anterior externus [s. inguino-cutaneus], 
arises from the second loop, perforates the psoas, passes down upon 
m. iliacus underneath its aponeurosis; behind art. circumflexa 
ilei at the outer extremity of lig. Poupartii through a short sheath, 
here perforates the fascia cruralis, and descends on the outer side 
of the thigh as far as the knee. Connexions: with the two rami 
of the genito-cruralis (plexiform). Branches: to the skin over 
trochanter major, and internally in front.

5. N. cruralis, the middle and largest branch of the lumbar
plexus, arises, especially, from the second, third, and fourth lumbar nerves, passes rather obliquely downwards, outwards and forwards, behind m. psoas, then before m. iliacus, behind lig. Poupartii upon the anterior surface of the thigh, where it immediately divides into two principal branches. Situation: in the fossa iliaca; in the fossa between psoas and iliacus covered by the fascia iliaca on the external border of the psoas; behind the lig. Poupartii; separated from the art. cruralis by its sheath and the tendon of psoas, below the femoral ring. Branches: to m. psoas and iliacus pectineus (?) and the following:

1. \( N. \) cutaneus femoris anterior internus comes off at Poupart's ligament, and descends as far as the outer surface of the knee. It gives branches to m. sartorius and supplies the skin of the outer surface in the centre, and that of the anterior and internal in the lower third of the thigh.

2. \( N. \) cutaneus femoris anterior medius arises from the anterior and internal principal trunk, descends in the lower third of the thigh outwards, and terminates above and outside the patella.

3. \( N. \) patellaris arises next to the last on the outside, below lig. Poupartii, supplies the skin on the internal and anterior part of the lower extremity of the thigh, and turns over the patella to the anterior part of the superior extremity of the leg.

By anastomoses between the external cutaneous nerves, loops and superficialplexuses arise upon the inferior part of the patella.

4. Rami musculares for: tensor fasciae (sometimes [?]), for vastus externus (from three to four), internus (one), m. sartorius, several, superficial and deep, which, perforating the muscle, pass to the skin on the inner side of the knee; for rectus femoris and cruralis.

5. Nervo. saphenus magnus, the principal branch of n. cruralis, passes as far as the middle of the thigh on the outer side of art. cruralis above the passage of the last through m. adductor magnus, and divides into an internal and a larger external branch.

   a. Ram. internus passes over art. cruralis, behind m. sartorius, then perforates it and passes on the internal surface of the knee-joint to the anterior of the shin-bone to ramify in a radiating form in the skin over its upper third. A branch passes backwards to the middle of the thigh.

   b. Ramus externus is larger, passes over the art. cruralis
downwards and inwards, comes forth, after being more deeply seated, from between \textit{m. gracilis} and \textit{sartor.,} and descends on the internal and anterior part of the leg, with the \textit{ven. saphena;} it supplies the skin of the inner part of the popliteal region, of the calf, of the inner malleolus and back of the foot.

6. \textit{Nervus obturatorius,} arises especially from the fourth lumbar nerve, passes downwards posterior and internal to \textit{m. psoas} with the \textit{vasa obturatoria} close to the lateral parietes of the pelvis, and enters the foramen in the \textit{membrana obturatoria} above the artery, where it divides for the supply of the \textit{mm. obturatorii [only externus} and sends a few filaments to the hip-joint].

a. \textit{Ram. anterior} is larger, passes forth between \textit{adductor brevis} and \textit{longus,} supplies these, the \textit{gracilis,} the skin on the internal anterior region of the middle of the thigh, and, united with \textit{n. cutan. fem. intern.,} the inner side of the calf [and knee—hence pains in this region in incipient disease of hip-joint].

b. \textit{Ram. posterior} perforates, and supplies the \textit{adductor longus} and \textit{brevis,} and ramifies in the \textit{magnus} as far as the knee.

666. IV. The Sacral Nerves, \textit{Nervi sacrales,}

(eight pairs).

They arise (except the fifth) side by side from the inferior enlargement of the spinal cord. Their roots descend, almost vertically, in the \textit{canal. spinalis}, inside of which, even, the ganglia of the posterior roots are situated. The trunks of the united roots are therefore longer than those of the lumbar nerves. They divide soon after their exit from the sacral foramina, into their anterior and posterior branches.

a. The \textit{anterior} branches decrease in thickness from the second to the fifth, pass out through the \textit{foramina sacralia antt.,} but the last between the inferior piece and the cornua of the sacrum unite with \textit{n. sympatheticus,} and give branches to \textit{m. pyriformis} and \textit{coccygeus.} The first to the fourth give branches to the plexus in the depth of the pelvis, and form the \textit{plexus ischiadicus} with the fifth lumbar nerve. The fifth unites with the fourth and the coccygeal nerve, and goes directly into the skin of the anal region.

b. The \textit{posterior} branches are less developed, the third most. They pass forth through the \textit{foram. sacral. posteriores,} unite with each other, with the anterior branches, and with the last lumbar and coccygeal nerves, and pass as the \textit{posterior cutaneo}neous nerves of the gluteal region; \textit{nn. clunium posteriores (3)}
Plexus sacralis s. ischiadicus,
formed of the first, second and third sacral nerves, and of branches of the fourth and fifth abdominal [lumbar] nerves; is situated in a direction downwards and outwards towards the inferior extremity of the incisura ischiadica major before the m. pyriformis; before it, the vasa hypogastrica, which separate it from the peritoneum and rectum. It is connected above with the lumbar plexus [by lumbo-sacral nerve], in front with the hypogastric plexus; below it continues into the n. ischiadicus, and with the smaller portion of the muscular nerves of the gluteus, the posterior region of the thigh, and into the pudendal nerves.

1. The secondary branches.
   a. Nn. haemorrhoidales medii and vesicales inferiores, are three or four twigs of the anterior branches of the third sacral nerves, they give branches to plexus hypogastricus (see n. sympathetic), pass to the rectum and above the vesiculae seminales to the neck of the bladder, in the female as far as the vagina.
   b. Nn. haemorrhoidales inferiores, the terminal filaments of the, anterior branches of the fourth sacral nerve. This last gives branches to plex. hypogastricus, the prostata, vagina, m. levator ani and coccygeus.

1. N. gluteus superior, arises from the loops of the third and fourth lumbar with the first sacral nerve, passes above m. pyriformis with art. glutaea through the incisura ischiad. major, anastomoses with the ischiadic nerve, and divides immediately into two or three principal branches, the largest of which passes in a curve to the outer part of the thigh, between gluteus medius and minimus; it supplies the glutæi [g. med. and min.] and skin [?] the tensor fasciae, and in the pelvis, the pyriformis.

2. N. gluteus inferior, arises from the loops of the fourth and fifth lumbar, and first and second sacral nerves, passes out below m. pyriform. with art. ischiadica from incisura major on the internal surface of gluteus maximus; ramifies in it and in the skin, and unites with the ischiadic nerve.

3. N. cutaneus femoris posterior communis, arises from the first and second loop of the sacral nerves, passes out under m. pyriform. through incisura major with art. ischiadica and downwards between tuber ischii and trochanter major, dividing into several branches:
   a. Nn. cutanei clunium inferiores are reflected around the inferior border of gluteus maximus, supplying the skin of trochanter major and the lower part of the gluteal region.
b. *Nn. scrotales s. labiales* are reflected beneath the *m. glutaeus maximus* inwards, and terminate in the skin of the internal superior part of the scrotum or *labia maj.*, sometimes also in the *perinaeum*.

c. *Nn. cutanei femoris posteriores*, for the skin of the posterior and inner part of the thigh as far as the posterior and outer part of the popliteal region, whence filaments extend downwards to the outer and interior region of the calf.

4. *N. pudendus s. spermaticus communis* arises (variably) from the flat cord of the associated sacral nerves, immediately passes in the depth between *lig. spinoso-sacrum* and *sacro-ischiadicum* on the inner side of *art. pudenda* under *m. levator ani*, and divides into:

a. *Ramus inferior s. N. perinaei*, corresponds to the *art. pudenda* (with the exception of *art. dorsalis penis*), passes, above this, from behind forwards, then between *m. obturator intern.* and *membr. obturat.* with a curve upwards, and terminates with a superficial branch (with *art. transv. perin.*), taking a course, obliquely inwards and forwards, to the lower part of the scrotum and the penis, with a deep branch to the anterior part of *sphincter ani*, to the *bulbo-cavernos.* and *bulbus urethrae* (in the female to *sphincter vaginae*, the *labia* and *mons Veneris*).

b. *Ramus superior s. n. dorsalis penis* (*n. clitoridis* of the female), passes in a curve (with *art. pudenda*), at first close to the inner surface of the *tuber ischii*, then upwards between *levator ani* and *obturator internus*, and beneath *symphysis pubis* (surrounded by the veins), upon the dorsum of the penis in the middle line, and more superficial than *art. dorsalis*; it divides into two branches, the internal deeper of which goes to the glans, the external cutaneous ramifications on the sides of the penis, and forms a plexus which supplies the skin of the three superior fourths of the organ.

The nerve of the *clitoris* is finer and smaller, but takes precisely the same course.

5. *N. haemorrhoidalis infimus* arises, frequently, from *n. pudendus*, passes, more internally than this, between *lig. tuberoso- and spinoso-sacrum*, under the *levator ani*, in the fat, divides and passes to the posterior part of the *sphincter ani* and the neighbouring skin.

6. *N. ischiadicus*, the largest nerve of the body, arises from the third and fourth lumbar, and the first, second and third sacral nerves, passes out from the *incisura ischiadica major* below *n. pyriformis*, flattened, descends between *tuber ischii* and *trochanter*. 
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major, close upon the rotator muscles, covered by glutaeus maximus, directly to the posterior surface of the thigh. It here lies enveloped in fat, and accompanied by no [large] vessel, before the long head of \( m. \) biceps and before \( m. \) semitendinosus, then in the fossa between the two; behind \( m. \) adductor magnus. [Above gemellus sup. it gives off a branch which, passing behind the two gemelli and obturator intern., is lost in quadratus femoris.]

Distribution. At the breadth of three to four fingers above the knee-joint (the commencement of the popliteal space); even before or after its exit from the pelvis it divides into two principal branches. Branches; superior: to \( m. \) biceps, semitendinosus, -membranosus, adductor magnus; inferior: to caput breve bicipitis, to the fat of the knee-joint, to the outer side of the patella.

1. \( N. \) peroneus s. fibularis s. poplitæus externus, the smaller external branch, descends on the external side of biceps, obliquely outwards through the popliteal region, then behind condylus extern. femoris and tibiae, between the tendons of the biceps and the outer head of gastrocnemius; outwards and rather forwards, behind the superior attachment of \( m. \) soleus to the capitulum fibulae, where it divides into one of two superficial and deep branches. Branches: to biceps and knee-joint (see \( n. \) ischiadic.); farther:

a. Posterior cutaneous branches, \( rr. \) cutanei cruris peronæi posteriores.

1. \( N. \) cutan. medius internus, descends under the fascia in the middle of the posterior surface of the calf as far as the inferior extremity of the leg.

2. \( N. \) cutan. medius externus s. communicans fibularis passes along the outer half of the calf and the tendo Achillis, then under the external malleolus to the back of the foot, supplies the skin on its outer half, the dorsal surface of the outer side of the fifth, and the collateral surfaces of the fourth and fifth toes; and unites with \( n. \) communicans tibialis (which see).

3. \( N. \) cutaneus externus, supplies the skin of the outer border from the superior to the inferior extremity of the leg.

\( \beta. \) The superficial terminal branches of \( n. \) peronæus.

4. Ramus superficialis externus s. \( N. \) cutaneus dorsi pedis medius, passes on the outer side of the fibula, gives branches to gastrocnemius extern., peroneus tertius, extensor hallucis longus; betakes itself to the middle of the anterior surface of the leg, perforates the fascia, supplies the skin of this part and about the external malleolus; divides dichotomously on
the dorsum of the foot, and supplies with an *internal* arched branch the skin of this region, as far as the root of the great toe; with an *external* branch the collateral surfaces of the third and fourth toes.

5. *Ramus superficialis internus s. N. cutaneus dorsi pedis intern.* supplies the mm. peronei, passes over the ankle joint inwards, towards the internal malleolus, supplies the skin on the internal border of the dorsum pedis and bifurcates. Its *internal* branch supplies the inner surface of the *great*, and the collateral surfaces of the same and the second toe; its *external* branch the collateral surfaces of the second and third toes.

γ. The deeper terminal or muscular branch.

6. *N. tibialis anticus* winds round the capitulum fibulae, forwards, descends on the anterior surface of lig. inteross. outside and before art. tibialis antica, between m. extensor digitor. longus communis, hallucis and tibialis anticus, gives branches to these muscles, passes under lig. cruciatum, upon the dorsum pedis, into the sheath of extensor halluc. and bifurcates.

\[a. \text{Ramus internus,} \text{ continuation of the trunk,} \text{ passes under art. metatarsea (pedicea?) directly forwards,} \text{ between first and second os metatarsi, unites with the fifth,} \text{ and supplies, accordingly, the dorsal side of the collateral surfaces of the} \text{ first and second toes.}\]

\[b. \text{Ramus externus} \text{ passes transversely outwards, close upon the tarsus,} \text{ under extens. brevis halluc. and digitor. communis,} \text{ and supplies them.}\]

\[b. \text{N. tibialis s. peroneus internus,} \text{ descends as the continuation of n. ischiadicus, vertically through the popliteal space,} \text{ between the heads of the gastrocnemius, then on the posterior surface of the tibia,} \text{ covered by m. soleus,} \text{ and on the internal border of tendo Achillis,} \text{ behind and under the internal malleolus, where it bifurcates.} \text{ Situation: in the popliteal space,} \text{ on the posterior and outer side of vena poplitea,} \text{ covered only by the fascia;} \text{ as far as tendon Achillis,} \text{ by mm. gastrocnemius and soleus,} \text{ on the outer side of art. tibialis postica; behind and below the malleolus,} \text{ covered by the fascia, in a sheath with the vasa tibialia (and behind them),} \text{ behind the tendons of m. tibialis posticus and flexor. commun. digit longus.}\]

Branches: for the posterior part of the knee-joint, for *m. popli-
teus, the muscles of the calf; m. tibialis postic. and flexor hallucis longus. Farther:

1. N. communicans tibialis s. cutaneus longus (s. saphenus externus), descends behind the popliteal space and the calf; then curves under the external malleolus and unites with n. communic. fibularis, as:
N. dorsalis extern. digiti 5, on the outer border of the foot and to the fifth toe (see before).

2. N. cutaneus plantaris arises in the centre of the leg, perforates the fascia on the tendo Achillis, and passes to the skin of the heel and the sole.

3. N. plantaris internus, arises under proc. internus calcanei, passes over m. abductor hallucis, and between this and flex. digit. commun. brevis, and bifurcates. Its internal smaller branch passes on the inner border of the sole to the great toe, supplying the skin and mm. flexor and abductor brevis. Its external branch bifurcates, supplies the skin, mm. lumbricales [only two] and interossei [?] and the joints, as well as the collateral plantar surfaces of the first and second, the second and third, the third and fourth toes.

4. N. plantaris externus, is stronger, passes forwards between caro quadrata and flexor. digitor. comm. brevis to the outer border of the foot, gives branches to these muscles, and abduct. brevis digit. 5. Its superficial branch supplies the collateral surfaces of the fourth and fifth, and the outer surface of the fifth toe. Its deeper branch passes in a curve to the arcus arter. plantaris, inwards and forwards, and supplies the adductor halluc. flex. digiti 5, and interossei.

668. V. The Coccygeal Nerves, Nervi coccygei, (one or two pairs),

arise from the conus medullaris with a single root which descends in the filium terminale, enlarges at the point of the sheath of dura mater; passes out and descends with two branches on the middle ligament of the sheath to the inferior extremity of the sacrum. The anterior branch is the larger, passes out between the cornu and the superior part of the first piece of the coccyx, forwards, unites with n. sympatheticus (see ganglion coccygeum); and with the anterior branch of the fifth sacral nerve.

The posterior branch passes immediately backwards, and unites with the posterior branch of the fifth sacral nerve.
[Nerves of the Lower Extremity from the Lumbar Plexus.

Anterior crural nerve — supplying the flexors of the hip, sartorius, and the extensors of the knee joint.

Obturator nerve — the obturator extern., the adductors and gracilis.

Lumbo-Sacral.

Superior gluteal — gluteus med. and min. and tensor vaginae femoris.

Cutaneous branches

Sacral.

Internal pudic — the skin over these muscles.

Inferior gluteal — gluteus maximus and skin of pudendal and posterior femoral regions.

Branches

Branches — Viscera in pelvis.

Muscular branches — the flexors of the knee.

External popliteal — the peroneal muscles, the flexor of foot and extensors of toes.

Internal popliteal (posterior tibial) — the extensors of foot and long flexors of toes.

Internal plantar

External plantar — short flexors of toes.

Cutaneous branches — the flex. acc., interossei, adductor hallucis, trans. pedis and fl. min. digit.

[The skin over these muscles.]

669. The Sympathetic Nerve,

Nervus sympathetic s. gangliosus,

This is a string (connecting cord) of from twenty-four to twenty-five interrupted ganglia, found upon the lateral and anterior surfaces of the vertebral column, before the transverse processes of the vertebrae, which forms plexuses on the different organs by means of branches which pass off laterally from the ganglia. It receives its roots from the brain, but in great measure from the spinal cord, as filaments pass from each spinal nerve to the corresponding ganglion, remaining here with the already existing plexus, or continuing, after a longer or shorter course, from the connecting cord into the lateral branches. [Filaments also arise within the ganglia.] The ganglia correspond, generally, to the intervertebral spaces, and are in close relation, by means of connecting filaments, with all the other ganglia of the body, like a chain. The connecting cords of the two sides are associated before the os coccyx in the ganglion coccigeum.
A. The ganglionic chain, central portion,
is divided into the cranial, cervical, thoracic, abdominal, and pelvic portions.


The cervical portion consists of three (or four) ganglia connected
together by means of the trunk, is situated upon the anterior sur-
face of mm. rectus cap. antic. major and longus colli, surrounded
by loose uniting tissue, behind carotis interna and communis, v.
vertebralis and n. vagus (on their inner side).

The trunk between the ganglia is white, thinner or thicker,
sometimes knotty and divided, descends vertically to the second
ganglion, behind art. thyreoid. inferior, or directly to the third

671. 1. Ganglion cervicale suprimum s. magnum is spindle-
shaped, fusiform, flattened, rather concave on the inner surface;
gray, even; half to one inch long, one to six lines broad, one to
three lines thick; sometimes fissured at the inferior extremity,
and constricted (double ?). Position: generally before the proc.
transvers. of the second to the fourth cervical vert., before mm.
rectus cap. antic. major and longus capitis, posterior and internal
to carotis interna, n. vagus, and hypoglossus; ten to twelve lines
below the introitus canal. carotici. It receives its principal roots
from the three first cervical nerves, some also from the fourth and
fifth. These enter into its posterior side, are reflected, and then
pass into the rami and the cord of the cervical portion. The branches
are:

a. Ramus ascendens, passes off from the superior extremity, and
divides into an anterior and posterior branch, which together form
the cranial portion of the n. sympathetic.

1. N. jugularis (r. posterior) ascends from the superior poste-
rior part to the foram. jugulare, and gives filaments to:
gangl. petrosum glossopharyngei; gangl. jugulare vagi;
to nerv. hypoglossus. The last, generally, enter the gangl.
cervic. suprimum in an isolated manner, and do not properly
go to the hypogloss., but come from it.

2. N. caroticus (ram. anterior), ascends on the posterior and
internal surface of carotis interna, forming delicate plexuses,
and divides on the first curvature, close beneath canal caroti-
cus, into an external and internal branch, which pass toge-
ther on the outer and inner side of carotis, ascending in the
canal to the plexus cavernosus. In the canal arise:
a. *N. carotico-tympanicus inferior*, from the external branch, passes through a little canal on the posterior outer wall of *can. carotic.* into the *tympanum* for the *nerv. Jacobsonii* (see *n. glosso-pharyngeus*).

b. *N. Vidianus profundus* (*s. petrosus prof. major*), passes through *can. Vidianus*, with *n. Vid. superficial*, to the gangl. Meckelii (see *trigeminus*), after it has received the superior connecting branches with the *plex. tympanicus*.

*N. petrosus profundus minor.* This passes out between *can. caroticus* and the osseous *tuba Eustachii*.

c. Connecting branches with *m. abducens*; commonly, three wind round the second curvature of the *carotis* outwards, and pass into the *sinus cavernosus*, to *nerv. abducens*, where this crosses the *carotis*.

672. *Plexus cavernosus,* is situated below and on the inner side of carotis, at its entrance into the *sinus cavernosus*, is gray, perforated by arteries, and gives numerous branches, which form a plexus, partly about the carotis and its branches, and partly pass to other nerves. Branches:

1. For *n. oculo-motorius.* A twig passes, constantly, between *n. oculo-motor.* and *ophthalmicus* (*n. quinti*) through fissura orbital. super. to the longer (or shorter) root of ganglion ciliare. Others pass close over *n. abducens* to *n. oculo-motorius*.

2. For *n. trigeminus.* They pass over the third curvature of *carotis* from within outwards, and advance, partly into the internal portion of gangl. Gasseri, partly into *n. ophthalamicus*. Several rr. *recurrentes* pass backwards to the *tentorium cerebelli*.

3. For *n. abducens*. They pass on the internal inferior side of *n. abducens* below the last curvature of the carotid; sometimes to *n. trochlearis*.

4. For *n. opticus* and gangl. *spheno-palatinum*. Some filaments go on the inner side of *nerv. abducens* from the superior anterior part of *plex. cavernosus*, but only reach as far as the sheath of the optic nerve, and appear to anastomose with filaments of the gangl. spheno-pal. (Valentin.)

5. *Ramuli sphenoidales* (four to six) pass inwards to the *dura mater* around the *hypophysis* (but probably not into this), and into the *sinus sphenoidalis*.

6. *Ramuli ad carotidem cerebralem* pass on the inner side of *n. abducens*, on the sigmoidal superior curvature of the *carotis* to *plex. n. mollium*. 
THE NERVES.

b. *Ramu descendens* is the connecting cord of the *n. sympathicus* itself (see above). From it connecting filaments pass off to *n. cardiacus* and *laryngeus superior*.

c. Anterior branches of *ganglion cervicale* I.

1. *Nervi molles* (*s. carotidis externae*), arise singly or with a common trunk (*truncus n. mollium*) from the anterior surface of the ganglion, are soft, thin, and reddish, descend forwards, entwine round both carotids, and form *plexuses* round all the rami of *carotis externa*.

    *Plexus nervorum mollium* are as numerous as the branches passing off from the *carotis extern.*; also, *pl. thyreoideus, lingualis,* &c. Above the point of division of the large arteries they commonly form *ganglia*; thus *ganglion intercaroticum* in the angle between *carotis interna* and *externa*. The following nerves have a distinct share in these plexuses; *n. hypoglossus, vagus, glossopharyngeus, facialis*, and *trigeminus*. From the *plexus facialis* a filament passes, as a soft root, to the *ganglium intermaxilleum*; from *pi. maxillaris internus*, with *art. meningea media* to *ganglion oticum*.

2. *N. cardiacus superior* *s. longus*, arises from the inferior extremity of the *ganglion*, or below this even from the trunk, enlarged by the laryngeal branch of the *vagus*; passes on the inner side of *n. sympathicus* before *m. longus colli*, behind *carotis communis*, in front, over *art. thyreoidea* (on the right side close to *trachea*, on the left before *esophagus*), enters the chest behind *art. subclavia*, and passes with the *carotis*, (on the left) and *truncus anonymus* (on the right side) to the *aorta*, in the coats of which it is, partly, lost, sending filaments on to the *posterior cardiac* and *pulmonary* plexus. It unites with: *nn. molles, vagus*, and its *recurrent* branch, and gives filaments to the *thyroid gland, m. sterno-, hyo-thyroid, constrictor pharyng. inferior*. It sometimes forms two ganglia.

    a. *Gangl. cardiacum superius*, small, close under *art. thyroidei* inferius.

    b. *Gangl. cardiacum inferius*, *s. Wrisbergi*, larger, in the thorax (upon the right side, where the nerve is generally stronger).

673. 2. *Ganglion cervicale medium*, roundish, elliptical, smaller than the superior cervical ganglion, is larger in one instance than in another, but almost always present; it is placed on the trunk of *n. sympathicus*, between the *superior* and *inferior* cervical gan-
glion on the art. thyreoid inf., receiving ramuli from the fifth and sixth, or fifth to the seventh cervical nerves, and the principal filaments of plex. thyroideus inferior (is not to be confounded with the ganglionic enlargement before the fourth and fifth cervical vertebrae; this is often wanting). Between it and the inferior cervical we find, almost always, small ganglia interposed.

a. Plexus thyroideus inferior, passes from the cervical portion, form plexuses around the art. thyr. inf., gives branches to the thyroid gland, and receives those of: the plexus of the cardiac nerves in the inferior part of the neck, from n. recursens, and the trunk of the vagus. In it lies before or behind art. thyreoid. infer. a gangl. thyroideum inferius.

b. N. cardiacus medius, arises from or below the gangl. c. medium, passes downwards and inwards behind the carotis, form plexus around this (forming in the thorax the gangl. cardiac. medium), and enter along it the posterior cardiac plexus; it unites with: plex. thyroideus infer., with branches from gangl. infim. c. and n. vagus.

674. 3. Ganglion cervicale infimun s. stellatum, flat, roundish, or three to four cornered, rarely double, sometimes blended with the first thoracic ganglion, lying before the root of proc. transv. of the seventh cervical vert., or on the neck of the first rib, higher or lower upon the art. vertebral, behind art. subclavia. Its roots come from the sixth and seventh, also from fourth, fifth, and eighth cervical nerves. Its branches are:

a. N. cardiacus infimus, half a line thick, passes downwards and inwards, with the trunk of the vagus, and then on the arcus aortae to the inferior cardiac plexus; it is sometimes wanting upon the right side, forms united with n. card. medius, the thick (crassus) cardiac nerves. Connexions: with plex. vertebral., subclav., laryng. infer. and vagus.

b. Branches (three) for art. vertebralis, ascending on this in the canal. vertebral., surrounding it like a plexus, and anastomosing with the cervical nerves.

c. Branches (two) for art. subclavia, forming loops about it, and sinking into the first thoracic ganglion.

d. The trunk of n. sympath., between the lowest cervical and first thoracic ganglion, divides and descends before and behind art. subclavia.

675. II. Pars thoracica n. sympathici.

The thoracic portion descends along the vertebral column (from
the first to the third ganglion, upon the heads of the ribs, then more externally), through the thorax, and divided, between the external and middle crus of the diaphragm, into the abdomen. Before it is covered by the pleura; behind it pass the vasa and nerv. intercost.; close to that of the right side the v. azygos. Its ganglia:

Ganglia thoracica (eleven to twelve) are flat, generally triangular, with the apex directed outwards, and they are applied to the outer side of the trunk. The two first and the twelfth are the most developed, but less so than the cervical ganglia. The first is covered, partly, by art. subclavia and vertebral. They contain a single or threefold root from the intercostal nerves, and give branches: to the cardiac, pulmonary, esophageal, and aortic plexuses, for the bodies of the vertebrae and the intercostal spaces. Lastly:

The roots to the nervi splanchnici, the visceral branches.

676. III. Pars lumbalis n. sympathici.

The lumbar portion descends on the sides of the bodies of the lumbar vertebrae internal to the m. psoas, and unites above and below by means of transverse cords with the one of the other side. The trunk is single as well as double and triple. Its ganglia:

Ganglia lumbalia (four to five) are small, flat, and elongated, frequently blending one with another, so that only two or three appear to be present (as in the neck); grayish-red, like the rest of the ganglia, and lying on the left behind aorta abdominalis, on the right behind v. cava. Their single, double, triple or five-fold roots, from the anterior branches of the lumbar nerves, are very long, and pass into them, around the bodies of the vertebrae, under m. psoas. Branches:

To aorta abdominalis, artt. lumbales, hypogastrica, and the plexuses of the same names, n. renalis infer., poster., and filaments between n. renalis and spermaticus.

677. IV. Pars sacralis et coccygeus.

The pelvic portion descends, divided into two larger filaments, on the anterior surface of the sacrum, to the inner side of foram. sacralia anteriora. Its trunk is very delicate, approaches more and more the farther it descends to that of the other side, and unites by means of transverse filaments with it, and the plexus about the art. sacralis media, and terminates with the gangl. coccygeum. Its ganglia:
Ganglia sacralia (four to five, or six) are very variable in situation, shape, and number, the superior generally the thicker; they lie close to the exit of the anterior roots of the sacral nerves, from which they receive two thick roots. 

Branches:

To art. hypogastrica and their branches, rectum and pelvic plexus.

Plexus sacralis medius commences even upon the fourth lumbar vertebra, descends on the anterior surface of the sacrum, becomes larger as far as the fourth piece of the sacrum, and forms four to five ganglionic circles about the art. sacralis media, becomes more delicate on the coccyx, and terminates in the

Ganglion coccygeum.

An azygos, small ganglion, in which the most external filaments of the n. sympathici of the two sides blend together. It is situated upon the anterior surface of the coccyx, unites with the coccygeal nerves, and gives several minute filaments to the apex of the os coccyx.

B. Visceral branches and plexuses.

679. a. Rami splanchnici (s. pars thoracica).

1. Nerv. splanchnicus supremus, is not constant, it arises from the cardiac plexus, and receives roots from the first to the sixth thoracic ganglia. Its course varies, sinking into the vagus, or with the aorta into the abdomen to the plexus mesaraicus superior and renalis.

2. N. splanchnicus major, arises with many roots from the fifth to the eleventh or all the thoracic ganglia, descends along the vertebral bodies, becomes flattened, passes between the external or internal and middle crus of the diaphragm (or through hiatus aorti.) in great measure to the gang. semilunare of its own side. The right sends a portion of its fibres, to the left, towards the spleen; the left towards the right, so that they cross.

3. N. splanchnicus minor, arises from the eleventh or twelfth thoracic ganglion or higher, passes outwards close to 2, sometimes united with it, into the lower part of plex. celiacus, often also into plex. renalis.

4. N. splanchnicus inferior s. renalis posterior, arises from the twelfth thoracic ganglion, anastomoses with 3, and passes to plex. celiacus, renalis, and supra-renalis.
The *nn. splanchnici* are white, the *plexus*, into which they enter gray.

b. Plexuses in the abdomen.

1. *Plexus solaris* (caliaci s. mesenterici) comprehends the great plexus of nerves on the aorta, from the origin of *art. caliaca* and *mesaraica superius* as far as the commencement of the renal arteries, lying behind the peritoneum, deeply, behind the *regio epigastrica*, and forming very large ganglia, from which numerous branches, interlacing with each other, pass off, and which anastomose with *n. vagus* and *phrenicus*, with other branches of the *sympathicus*, a less number with the lumbar nerves. The principal mass of them forms the two:

1. *Ganglia semilunaria* (s. magna caliaca s. cerebrum abdominale), two reddish, bridge-like masses of ganglion, which are situated on the inner sides of the supra-renal capsules. Into these ganglia the *white nn. splanchnici major* and *minor* betake themselves; from them *gray branches* pass out, as:

   1. *Rami phrenici*, uniting with posterior branches of *n. phrenicus* and forming *plexus* about the *art. phrenicae inferr.* on the right and left, entering into the fleshy portion of the diaphragm, and connecting themselves with the hepatic and suprarenal *plexus*.

2. *Rami suprarenales* (eight to sixteen) form, particularly upon the posterior surface of the suprarenal capsules, *plexus suprarenales*, which are connected with *n. phrenicus*, *vagus*, and with the *renal plexus*.

3. *Rami hepatici*, arise from the two large ganglia and that part of the *plexus solaris* which lies transversely over the *art. hepatica* before the aorta; and forms:
   a. *Plexus arteriosus hepaticus s. dexter*, on the hepatic artery and *ductus hepaticus* within the liver; where it anastomoses with the
   b. *Plexus venosus*. From this plexuses go to the gall bladder (also from *a*), *ductus cysticus*, and *choledochus*, which are in connexion with those of the *pancreas*, *duodenum*, and stomach.

4. *Rami gastrici* (white) form, especially upon the *art. coronar. ventric. sinistra*, a *plexus* (*plex. curvatur. minor*), anastomoses with the branches of *n. vagus* (which see) lying before it, *pancreatic, splenic*, and *hepatic* plexuses; forming a coronet around the *port. pylorica*.

5. *Rami lienales*, forming the *plex. lienalis* on the splenic
artery for the spleen, and giving branches to the pancreas and fundus ventriculi.

2. *Plexus mesentericus superior*, a dense plexus of whitish-gray nerves at the origin of art. mesent. super., contains on the left side a large ganglion, which is connected with gangl. cæliacum. Before it lies the pancreas, and it receives the plex. pancreaticus, as well as the intestines to which the branches of art. mesent. sup. go, supporting the plexus.

II. *Plexus intermesentericus aortæ* (s. aorticus abdominalis), lies between art. mesenterica superior and inferior, forms ganglia, and unites with the mesenteric, renal, inferior caval and spermatic plexus, and sends branches to the sciatic and vesical plexus.

III. *Plexus mesentericus inferior*, accompanies the arteries of the same name and its branches; unites in the meso-rectum with the sciatic plexus.

IV. *Plexus renales*, are situated before and behind the renal vessels; are superior, middle, and inferior, forming small ganglia, and are connected with the principal ganglia (see above). In the kidneys the nerves pass with the arteries, give filaments to the renal calyces, and twine around the straight urinary canaliculi.

V. *Plexus venaæ cavae inferiores*, are but slightly developed, arise especially from pl. intermesentericus, connected with renal, spermatic, and hepatic plexus.

681. C. The Pelvic Plexus.

I. *Plexus divisionis aortæ abdominalis*, a superior and inferior. The superior lies under the origin of art. mesenterica inferior, passing a little to the left; its right portion passes upon art. hypogastric. dexter, the left on the art. hæmorrh. intern. to the pl. hæmorrh. intern. The inferior is more delicate, lies between the two art. iliaca, and goes into the plex. hypogastrici.

II. *Plexus hæmorrhoidalis superior s. S. romani*, lies between the two layers of the superior (sigmoid flexure) meso-rectum, is in connexion with the nerves of the vas deferens, and especially of the left ureter.

III. *Plexus hypogastrici*, a superior azygos and two inferior lateral.

1. *Plexus h. impar*, goes on the right side of the art. iliaca, passing off from the plexus at the place of division of the aorta, and enters right and left the

2. *Plexus h. laterales*. These descend on the artt. hypogastr.; form long plexuses, and are surrounded by a ligamentous mass. They are in connexion, below, with
IV. *Plexus haemorrhoidales inferiores*, a right and a left, connected with the superior plexus of the rectum, receiving branches from the sacral nerves.

V. *Plexus vesicales*, ascend partly at the sides of the urinary bladder, partly horizontally forwards to the *collum vesicae* and to the *prostata* (*plex. prostatici*). Filaments pass off from it to the *vesiculae seminales*, *vasa deferentia*, and form *plex. spermatici*, which are connected above with the *renal plexus*, and continue into the *plexus testicularis*.

VI. *Plexus cavernosi*, arise especially in the *pl. prostatici* and from branches of the sacral nerves, perforate the fibrous mass about *isthmus* and *bulbus urethrae*, and partly cross, as the one enters into the right, the other into the left spongy body.

In the female, instead of branches for prostate, vas deferens, &c., there are corresponding filaments for *uterus* and *vagina*, *ovarium* and *tuba*.

The posterior and lateral *plexus uterini* arise, generally, from *plex. hypogastr.*, the anterior on the contrary, generally, from the anterior branches of the third and fourth sacral nerves. They entwine about the *veins* and enter into the substance of the uterus.
TOPOGRAPHICAL ANATOMY.
LITERATURE.


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TOPOGRAPHICAL SURVEY OF THE MORE IMPORTANT REGIONS OF THE BODY.

The Head.


683. 2. Regio temporalis, temples, is bounded, anteriorly, by proc. orbital. of frontal bone; behind, by the root of proc. zygomatic. and meatus auditorius; below, by zygomatic arch; above, by linea temporalis (semicircular). Thickness := 12" (before and below); = 6" (above and behind.) Parts: 1. Skin (behind beset with hair). 2. Fibro-cellular tissue containing fat, with art. temporalis, which divides into frontal and parietal branches at a distance of 15" above the zygoma, 4" from the external auditory meatus. 3. M. attollens auriculæ and fasc. superficialis. 4. Loose fibro-cellular tissue. 5. Fascia temporalis, between the two layers of which below, a triangular space with fat and art. temporal. med. 6. M. temporalis; anteriorly fat, vasa et nerva temporal. profundi. 7. Periosteum and bones,—pars squamosa temporal., os parietal., frontal., ala magna sphenoid., os zygomatic. 8. Art. meningea media; two fingers' breadth removed (and above) from proc. orbitalis oss. zygomat. 9. Dura mater, &c.

684. 3. Aural region (see Organon auditus).

685. 4. Regio-mastoidea, is bounded, in front, by the groove between the cartilage of the ear and proc. mastoid.; behind and above, by the curved line at which the growth of hair terminates:
below, by the apex of proc. mastoid. Parts: 1. Closely-applied external skin and fatless fibro-cellular tissue. 2. M. retrahens auriculae, occipital., sterno-mastoid., below the last m. splenius. 3. The anterior (auricular) vessels, nerves, and lymphatic glands in the groove behind the ear, below m. retrahens; behind, below the skin, vasa et. nn. mastoidei. 4. Periosteum and bones—pars mastoid. of temporal bone, the posterior inferior angle of parietal, and a little way from occipital bone; for. mastoid., sulcus lateralis (a small portion); sutur. mastoid. and squamosa; cellul. mastoideae. 5. Dura mater with (a portion of) the sinus lateralis, and tentor. cerebelli.

In the new-born infant—the posterior lateral fontanelle.

[Dissection. 1. An incision from the root of the nose to the external occipital protuberance, in the middle line. 2. In front, an incision from the root of the nose extending outwards along the eyebrows to the anterior extremity of the zygoma. 3. Behind, an incision from the external occipital protuberance transversely outwards to the apex of the proc. mastoideus. The section should be carried through the skin and subjacent fibro-cellular tissue, which are then to be reflected outwards towards the ear, with very great care. Trans.]

5. Nasal region, Reg. nasalis.

Interior of the nose. The opening of the lacrymal canal—surrounded by a fold of mucous membrane—lies behind a projection of the proc. nasalis of the upper jaw, an inch behind the anterior nasal openings, on the external nasal wall. The inferior turbinate bone is distant two lines from the floor of the nasal cavity. [This varies considerably.]

The opening of the Eustachian tube is found in the middle of the side wall of the posterior nasal opening, equally as far removed from the anterior, as the incisor teeth from the uvula.

6. The Mouth, Cavitas oris.

(See before, "Cavities of the Face.")

a. Arch of the palate. Parts: 1. Mucous membrane (firmly connected to a fibrous cellular tissue) with nn. palatini posterr. 2. Vasa et. nn. palatini medii at the internal part of the alveolus. 3. Vasa et. nn. alveolares behind and infraorbitales before, on the external part of the alveolus. 4. Palate and superior maxillary bones.

b. Soft palate—velum pendulum palati—extended transversely across, behind the arch of the palate, four-sided, five lines high, is on both sides covered with mucous membrane which anteriorly
passes upon the vault of the palate, behind upon the choanae, is bounded at the sides by the palate, and terminates in the palatine arches; in the centre of the inferior surface—the uvula. Parts: from before backwards: 1. Anterior mucous membrane. 2. Layer of mucous glands. 3. Fibrous fascia of mm. tenores palati with the insertions of glosso- and pharyngo-palatini. 4. Levatores palati. 5. Layer of glands with azygos [levator] uvulae. 6. Posterior mucous membrane.


The lymphatics pass into the submaxillary glands [lymphatic].

[Dissection. The pharynx and upper portion of the oesophagus, the larynx and upper rings of the trachea with the surrounding soft parts, the bones of the face, and the anterior half of those of the cranium, are to be removed from the subject. The section of the bones of the basis cranii must be made posterior to the roots of the styloid processes of the temporal bones, and through the basilar portion of the occipital, between the origins of the superior and middle constrictor muscles of the pharynx, before, and the insertion of the rectus anticus major muscle, behind. After dissecting the pharyngeal muscles by removing the cellular tissue about them, a vertical division of them should be made through the raphe in the middle line behind. The posterior wall of the pharynx being now turned aside, the parts described under 5. and 6. a, b, c, may be examined after inspection and removal of the mucous membrane. Trans.]

d. Malar region, reg. malaris. Over the malar bone the skin is very delicate and rich in blood-vessels; under it fibres orbicul. palpebr.; under these the zygomatici; behind, art. transv. faciei; below, rami zygomat. n. facialis—Pars masseterica. 1. Skin and much fat. 2. The anterior border of parotis and rami buco-ales n. facial., ductus Stenonianus, behind from 8 to 9′′′, in front 4′′′ below the zygomatic bone (with art. transv. fac. on its superior margin), its opening in the region of the first and second molar teeth, 4′′′ before the masseter m. 3. M. masseter. 4. Lower jaw; in the incisura sigmoid: the deep vessels and nerves of the
masseter. 5. Below, n. lingualis, ram. mylohyoid., n. dental. infer., m. pterygoid. internus; above, between the last and maxilla super.: art. maxillar. intern., nn. dental. infer. and temporal. super., lig. laterale internum, which separates the prece-
ding from ram. lingualis n. trigemini.

[Dissection. 1. Carry an incision through the skin, only, from the inner
gle of the eyelids along the lower border of the orbit to the outer angle of
the lids, thence parallel with the zygoma to its temporal root. 2. An inci-
sion from the inner angle of the eyelids to the commissure of the lip, then to
the anterior border of the masseter muscle upon the inferior maxillary bone,
and thence parallel with the lower edge of the horizontal ramus of this bone
to its angle. Reflect the skin towards the sterno-cleido-mast. m., and dissect
the parts 1, 2, and 3.

Dissect away carefully the parotid gland, leaving it attached by its duct.

Now, saw through the temporal root of the zygoma and the malar bone,
divide the fascia attached to the zygoma above, and reflect it, together with
the masseter muscle, carefully, downwards. The parts, 4., will be exposed,
the vessels and nerves close to the posterior border of the temporal muscle.
Detach the masseter from its insertion, and leave it suspended by its nerve.
The insertion of the temporal muscle (the coronoid process of the lower jaw)
is now to beawn through, and, with the muscle, turned upwards. The
pterygoid muscles are exposed, and the parts, 5., may be dissected. Two
incisions are required to remove the coronoid process; one, vertical, parallel
with the posterior border of the ascending ramus, and passing through the
centre of the incisura sigmoidalis; the other, transverse, and parallel with
the border of the alveolus. The two incisions should meet in about the cen-
tre of the ascending ramus. Trans.]

Pars intermaxillaris—the anterior portion of the cheek; be-
tween the upper and lower jaws.

e. Floor of the mouth. The tongue with the frenulum, on the
sides of which, close beneath the tongue the openings of the ductus
Wharton., at the sides of the tongue artt. ranine, and more exter-
nally vence ranine. Mm. mylohyoid. shuts in the cavity of the
mouth; below it the anterior belly of biventer, the skin.

[Dissection. To examine these parts and their relations accurately, it is
necessary, after removing the skin and displaying the soft parts, to make a
vertical section of the lower jaw, on the outer side of, not through, the sym-
physis; in fact, between the lower incisor teeth and first cuspidatus. Then,
dividing the mucous membrane of the mouth at its attachment to the lower
jaw, the tongue may be drawn forwards, and the anatomy of this region stu-
died. A bristle may be passed through the duct (Wharton’s) of the submax-
illary gland. The openings of the sublingual glands by the sides of the
tongue should also be examined. Trans.]
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688. 7. Cavity of the Gullet (s. Pharynx).

The entrance to the larynx lies in the anterior part of the pharynx, below the isthmus faucium.

[Dissection: see under 6. above, after c. Trans.]

639. 8. Orbital region, regio orbitalis.

a. Eyebrows. About the inner third of the superior margin of the orbit the n. frontalis passes out, besides the artery.

At the internal angle of the eyelid: 1. Most delicate skin. 2. Venous plexus. 3. Lig. palpebr. intern. 4. Lacrymal sac, which is separated externally by a fibrous layer from the caruncula, below the last, and rather externally, the thin roof of the antrum Highmori, and the origin of m. obl. inferior.

690. 9. Zygomatic fossa, Fossa zygomatica,

below the temples, above the masseter, external to the orbits, internal to the parotis. The superficial portion is connected with the deep (fossa sphen-o-maxillaris) by fissura pterygo-maxillaris; that with the orbita by fiss. orbitalis inferior. It is formed by the:
a. Sphenoid; b. posterior part of sup. maxillary; c. palate; d. condyle of infer. maxillary; e. a portion of the temporal; and f. ethmoid bone.

Parts; below the zygoma and the insertion of m. temporalis:
1. Vasa temporalia masseteric. 2. M. Pterygoid extern. with art. maxillar. intern. between its two portions, and plex. ven. pterygoid. 3. Below the insertion of m. pteryg. extern. internally n. lingualis, in the centre n. dental. infer., externally temporal superficialis. In the fossa sphen-o-maxillaris from above to below; (v. ophthalmica, n. ophthalmic., oculomotor., pathetic., abducens in the fissura. orbit. superior); n. maxillar. super. from behind forwards; ganglion Meckelii on the outer side of foram. spheno-pala-tinum.

[Dissection. As described in the second part, under b, d. Trans.]

691. 10. Parotid region, Regio parotidea,

is bounded, anteriorly, by the posterior border of ram. maxillar. infer.; behind, by proc. mastoid. and meatus auditor. extern.; above, by zygoma; below, by the angle of the lower jaw, and a
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horizontal line backwards; internally, by proc. styloideus, lig. stylo-maxillar.,—hyoideum. The parotis occupies nearly the whole of this space, and is all round enclosed in fascia. Parts from without inwards: 1. Skin, slightly hairy (behind the beard of the cheek). 2. Close areolar tissue, having little fat, with branches of n. auricular, from plex. cervicalis. 3. Lymphatic glands. 4. Parotis; from it upwards: art., ven. temp., rr. temporal. n. maxill. infer.; behind: art. auricular, post., and rr. auricul. n. facial. and plexus cervical. Inside the parotis: 1. behind, n. facialis, 6'' deep; in front its branches ½'' deep. 2. V. parotideae. 3. deeper, carotis externa, close to the proc. styloid.

[Dissection. As described in the first part, under 6, d. Trans.]

The Trunk.


a. Supra hyoideal, reg. supra-hyoidea, lies between lower jaw and hyoid bone, forms the floor of the mouth.

In the middle line (submental region) lie: 1. skin (in the male hairy) with a thicker or thinner layer of fat. 2. Mm. platysmam. with superficial nerves of the plex. cervical. and branches of art. mentalis. 3. Ventr. anter. m. digastric. 4. Deep branches of art. submentalis. 5. Mm. mylohyoidei. 6. Mm. geniohyoidei. 7. Genio-glossi. 8. In front and above: glandula sublingual., with ductus Whartonian. and the mucous membrane of the mouth; below and behind, the tongue. Laterally, we find over the m. platysmam. the following parts: 1. Layer of fasc. cervical. 2. Plexus of art. and ven. submental. (facialis), the vasa lymphat. facial., the n. mylo-hyoid. (dental. infer.), branches of facialis and superficial branches of plexus cervicalis; between them gland. submaxillar. and lymphatic glands. 3. M. mylohyoideus. 4. Above and before, gland. sublingual., duct. Wharton. (above), n. lingual. and art. sublingual. (below the glands), then beneath the mucous membrane below and behind: 1. N. hypogloss., and ven. lingual, close to the great cornua of the hyoid bone. 2. M. stylo-, hyoglossus. 3. Art. lingual. and n. glosso-pharyngeus and tongue.

Ven. facialis passes upon the external, art. facialis on the internal side of the gland. submaxillaris; art. submental. below it on the inferior border of the lower jaw; n. mylohyoideus still deeper.

b. Infrahyoid region, reg. infrahyoidea. s. interstitium jugulare, a triangle the base of which is formed by the os hyoides, the
sides by the internal borders of the *musculi sterno-mastoidei*, and the apex by the first piece of the sternum.

1. The central portion consists, above, of the *reg. laryngea* (larynx); the centre, of the *reg. thyreoidea* (thyroid cartilage and thy. gland); below, of the *fossa supra-sterinalis* s, jugulum, tracheal fossa.

2. Superior lateral portion, *trigonum cervicale superius*, is a triangular fossa, bounded, above, by the posterior belly of digastricus, in front, by the superior belly of omohyoideus, behind, by the anterior border of *sterno-mastoid.*, and above passing into the *reg. parotidea*. Below lies the *sterno-mast.*, close to and before the trachea.

Position of the parts: 1. Skin and loose fibro-cellular tissue, with little fat. 2. Above, *fascia cervicalis* and *mm. platysmam.*; below, in the jugulum, a space between the anterior and middle layer of the *fasc. cervicalis*, which sends a process externally into the *reg. supraclavicularis* behind the *m. sterno-mast.*, and contains in the middle line a descending branch of *ven. thyreoid. inf.* (frequently); some lymphatic glands; laterally, the *ven. jugularis anterior*. 3. *Mm. sterno-hyoides*, above, *m. omohyoideus*. 4. *Mm. thyro-hyoides*, branches of *n. hypogloss* and *mm. sterno-thyroidei*. 5. Thyroid gland, with the deep layer of *fasc. cervicalis*, which is attached to the posterior surface of the sternum and larynx. 6. *Plexus venosus thyreoidus*, and, near the sternum, *v. subclavia sinistra* and *truncus anonymus* (but the last rests entirely beneath this region, as it ascends obliquely from left to right). In the angle between the two: 7. The trachea. 8. Pharynx above; below and to the right, *n. recurrens dexter*; below and to the left, *oesophagus*, and on its anterior surface, *n. recurrens sinistra*, and a transverse branch of *art. thyreoid. inf.*. 9. Loose fibro-cellular tissue; under that *mm. longi colli*, and the fifth to the seventh cervical vertebræ.


693. Lateral surfaces of the Neck, *Reg. supraclavicularis*.

1. *Reg. sterno-mastoidea*. The *sterno-cleido-mast.* is covered by a loose fibro-cellular tissue, in which the *ven. jugular. externa* descends from before backwards. It covers:
a. Below (the *m. omohyoideus*): 1. Loose fibro-cellular tissue, wherein is a branch of *ven. jugul. extern.* (anter.) 2. The deep layer of *fasc. cervical.* and *m. omohyoideus.* 3. The external border of *m. sterno-hyoid.* and *thyreoideus.* 4. The junction of *vv. jugular* intern. and extern. behind *articul. sterno-cleidoidea* (in the angle the duct thoracicus opens). 5. *N. phrenicus* outside (close to *scalenus antic. m.*), 1" distant from *n. vagus* (close to *carotis commun.*); between the two, *n. sympathetic.* 6. Right, the superior extremity of *truncus anonymus* (carotis and *art. subclav. dextra*); left, *carotis comm.*, *art. subclav. sinistra.* 7. Right, *n. recurrens*; left, ductus thorac., the superior extremity of the pleura. 8. *M. longus colli* and vertebral column. The carotis lies 1" removed from the anterior border of *m. sterno-cleido-mast.*; the right rather nearer.


2. *Trigonum cervical inferius,* supraclavicular fossa, a triangle, the base of which is formed by the claviculae (the first rib), the sides by the anterior border of *m. cucullaris* and the posterior of *sterno-cleido-mast,* and which is divided by the post. belly of *m. omohyoideus* into an inferior smaller, and a superior larger triangle.


Posterior surface of the neck, nape, cervix.

*Dissection.* 1. An incision should be made in the middle line, through the skin only, from the chin to the sternum. 2. From the mastoid process to the acromion. 3. From the mastoid process to the centre of the upper border of the sternum.

Two triangular flaps of skin are thus formed, attached by their bases, the one, above, to the horizontal ramus of the lower jaw; the other, below, to the
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clavicle. These are to be reflected upwards and downwards. The *platysma myoides* is to be dissected, the course of the external jugular vein examined, and the muscle divided transversely and reflected. The parts above described occupying the various regions, the boundaries of which should be accurately defined, may be now exposed and dissected in succession. Trans.]

694. Chest, Thorax.


c. Behind the ribs: 1. Fibro-cellular tissue (and *mm. infracostales*). 2. *Vasa mammar. interna*, above, two lines from the border of the sternum, below, before *m. triangular. sterni*. 3. Pleura. (The chest should not be opened upon the right side below the fourth, upon the left below the third intercostal space (reckoning from below), if it is wished to avoid injury to the diaphragm).


695. Cavity of the Thorax.

1. *Regio mediastini*, is bounded in *front* by the sternum, *behind* by the vertebrae, *above* by the neck, *below* by the diaphragm, *right
and left by pleura and the lungs. Directed towards the left and downwards, this space is broad above, and especially below, in the centre very narrow, also X-shaped. In the centre at the posterior third lie the roots of the lungs.

a. Inferior half corresponds to the inferior of the sternum. Parts:
1. Loose, fibro-cellular containing adipose tissue.
2. Anterior part of the pericardium.
3. Heart, origin of the great arteries, termination of *ven. cava super.*
4. *Vv. pulmonales*; and post. part of pericardium.
5. Lymphatic glands and esophagus (in the central line) surrounded by *plex. nerv. asophag.*
6. *Aorta descend.* to the left; *ven. azygos* to the right; *duct. thorac.* in the centre and behind.
7. Fibro-cellular containing adipose tissue, in which are *nn. splanchnici, artt.* and *vv. intercostales.*
8. Dorsal vertebrae.

b. Superior half, behind the superior half of the sternum. Parts:
1. Loose fibro-cellular tissue, containing adipose (thymus gland) with small branches of mammary artery.
2. Above: *v. subclavia sinistra*; most superior part of the pericardium, below.
3. *Truncus anonym.* and *v. cava superior,* in front; termination of *art. pulmonalis,* *lig. arteriosum,* *arcus aortae* (with *n. recurrens*);
4. *carotis* and *art. subclavia sinistra* (with *n. vagus* and *phrenicus*) to the right; curve of *ven. azygos* (with *n. vagus* and *phrenicus.*) to the right.
5. *Esophagus,* behind *bronchus sinistra.*
7. Loose *fibro-cellular tissue* with the superior intercostal vessels.
8. Extremity of *m. long. coli.*

c. Roots of the lungs, above the centre and in the posterior third. Parts:
1. The *pulmonary veins,* two on a side.
2. *Ramus art. pulmonal.*
3. *Bronchus,* covered before by *plex. pulmonal. anter.,* behind by *n. vagus* and *plex. pulmon. posterior.* They divide the anterior from the posterior mediastinum and *n. phrenic.* from *vagus.*
2. Lateral parts. The lungs invested by the pleura pulmonalis.

696. *Abdomen, Venter.*

1. *Reg. epigastrica,* extends from the termination of the *sternum* and the *eighth rib* as far as the inferior border of the *twelfth,* and to about the breadth of two fingers above the navel. A central and two lateral portions are described.

a. *Epigastrium, scrobiculus cordis,* gastric fossa, that is, the triangular, central part between *sternum* and the cartilages of the six last ribs. Behind the delicate, sensitive skin, the *fasc. superficial.*
with the cutaneous branches of sixth to eighth nerv. intercostal.; proc. ensiform., lineal alba, m. rectus in its sheath; vasa mamma-ria; laterally, m. transversus and pars costal. diaphragma. The following parts are met with:

1. The left lobe of the liver; 2. the cardia; 3. pars pylorica of stomach; 4. the small omentum and a part of the large; 5. the second and third portions of duodenum; 6. Pancreas surrounded by lymphatic glands, with truncus coeliacus; 7. the large vessels, crura diaphragmat.; first and second lumbar vertebrae.

b. Hypochondrium dextrum, contains the costal portion of the diaphragm and lig. suspensorium hepatis, is filled up by the liver. The fundus of the gall bladder corresponds to the cartilage of the ninth rib. We find therein: 1. Flexura coli dextra. 2. The first portion of duodenum and cap. pancreat. 3. Before the foram. Winslow.: art. hepatica in front [to the left]; ductus hepatic., cystic. and commencement of choledochus in the centre [to the right]; ven. porta [between the two], and termination of n. vagus dexter behind. The right lobe of the liver rests against the right kidney and supra-renal capsules above and behind.

c. Hypochondrium sinistrum, contains the fundus ventriculi; above and before a small process of the left lobe of the liver; behind and to the left the spleen with lig. gastro-splenicum, between the anterior lamina of which the vasa brevia, between the posterior the vasa lienalia and the cauda pancreatis. Behind the stomach and below the spleen: the superior extremity of colon. ascend., the left kidney, and caps. supra-renales.

Both regg. hypochondr. present. 1. A thick skin. 2. Fibro-cellular containing adipose tissue, cutaneous veins and branches of the inferior nn. intercostales. 3. A thin aponeurosis and fascia superficial. 4. Mm. obliq. extern. and latissim. dorsi. 5. Costae spurie with mm. intercostales. 6. Diaphragm; on the inferior surface of which (abdominal cavity) the peritoneum; on the superior surface (thoracic cavity) pleura costalis and phrenica.

697. 2. Regio mesogastica. This is the part below the last ribs and above the hip bones; distinguished in the centre as regio umbilicalis, at the sides regg. lumbales, loins. The abdominal wall is here thick; the peritoneum is firmly attached in the proximity of the navel to the linea alba, in which openings for vessels are found, especially above the navel. The abdominal wall in the region of the loins consists of, 1. Skin. 2. Areolar tissue (fasc. superficial.) in a thick layer between m. obliq. extern. and longissim. dorsi; passing, below the twelfth rib, into the areolar tissue of the
thorax. 3. M. obliq. externus; behind a small piece of latissim. dorsi. 4. Fasc. lumbo-dorsalis. 5. M. obliq. internus, covered before by m. obliq. extern. 6. Areolar tissue, with branches of vasa circumflexa ilei and n. ileo-hypogastric. 7. M. transversus. In the centre of the space between navel and spina ilei ant. supe- rior, one is equally far removed from artt. epigastrica, circumflexa ilei, and lumbales.

In the abdomen are situated: 1. The great omentum. 2. Colon transversum (separated from the reg. epigastrica by mesocolon transvers.); the small intestines. 3. Mesenterium. At the sides, behind some of the convolutions of the small intestines: 1. Colon ascend. and descendens. 2. Kidneys and ureters in a considerable quantity of adipose tissue.

698. 3. Lumbar regions, regio lumbalis, lie right and left of the fine lumbar vertebrae, present in the centre a groove (with proc. spinosi) formed by the projecting mm. ileo-lumbalis and longiss. dorsi; are bounded below by crista iliaca and spina poste- rior. Parts: 1. Skin. 2. Condensed areolar tissue. 3. Fasc. lumbo-dorsal. (posterior layer). 4. M. ileo-lumbar, and longissim. dorsi. 5. Fasc. lumbo-dorsal. (anterior layer). 6. M. quadratus lumb., which forms the most posterior portion of the abdominal walls. On the convex anterior surfaces of the lumbar vertebrae: 1. Crura diaphragmaticis; right; ven. cava; left, aorta; externally, nerv. sympathetic; above, the commencement of duct. tho- racicus and of ven. azygos. 2. Lymphatic glands and areolar tissue, which are connected with those of the mesenterium. Late- rally: m. psoas; plexus lumbalis; and 2 to 3' below the last rib, the kidneys, in adipose tissue. To reach the abdominal aorta it is not necessary to open the peritoneum; between m. psoas, quad- ratus lumborum, and peritoneum we find areolar with abundance of adipose tissue.

699. 4. Inferior abdominal region, regio hypogastrica, extends from a transverse line, between the two spine ilei, as far down- wards as the bones of the pubes.

Parts: 1. Skin (with pubic hairs). 2. Areolar tissue (fasc. su- perfic.) over the pubes, thick and rich in adipose tissue, with art. epigastric. superf. 3. M. pyramidalis, rectus in its sheath; lig. triangulare. 4. Mm. obliq. and transv. 5. Fasc. transv., be- longing to the inferior fourth of m. rectus, immediately adjacent to which is the peritoneum. 6. Art. and ven. epigastrica; Urachus; artt. umbilicales and the superior third of the urinary bladder. 7.
Peritoneum. In the abdominal cavity: the small intestines, covered by the great omentum.

Lateral parts, inguinal regions, regg. inguinales (see next page). Iliac fossa, fossa iliaca interna, between the vertebral column, the crista ili and the crural arch are covered by m. iliacus and psoas. Between them m. cruralis passes; transversely behind the psoas, art. ileo-lumbalis; before it, n. genito-cruralis; external to it, n. inguino-cutaneus; close to the crista iliaca, the art. circumflexa ilei.

Vasa iliaca commun. and hypogastrica are covered by laminated areolar tissue (fasc. propria), and by:

1. Fasc. iliaca. Upon this lie: art. iliaca, in the direction of a line between the navel and the centre of the crural arch, on the anterior and outer side of the vein. 2. Peritoneum. 3. Cecum on the right, sigmoid flexure of colon on the left, &c., as far as the external skin. The fascia iliaca envelopes the psoas above by its attachment to the vertebral column, and proceeds below the crural arch towards the trochanter minor, uniting with the fascia lata, (and thus forms the passage which the pus takes in psoas abscess.)

699. bis. Regio inguinalis, Inguinal region, includes the parts which lie the breadth of two fingers above, and the breadth of three fingers below, the bend of the thigh, plica inguinalis.

In the upper part, close above lig. Fallopie, lie behind the skin:

1. Layers of fascia superf., cutaneous veins between them.
2. V. superfic. abdom., \( \frac{1}{2} \) to \( \frac{3}{4} '' \) distant from annul. abdom.; external to it, art. epigastrica superficialis.
3. Lig. Fallopie and the inferior portion of the tendon of m. obliq. extern.; with annul. abdom. (1\( \frac{1}{2} '' \) removed from the symphys. pubis), and canalis inguinalis, which contains the spermatic cord or lig. uteri rotund., art. sperm. extern., ram. intern. of nerv. spermat. extern. and nerv. ilco-inguinalis.
4. Behind the inguinal canal: fasciculi of m. obliq. intern. and transversus.
5. Fascia transversalis forms, two inches distant from the spina iliaca anter. super., the annulus inguinalis (intern.).
6. Fascia propria (areolar tissue between fasc. transversal. and peritoneum), with vasa epigastrica (internas), one fourth to half an inch distant from the internal boundary of annul. inguin. (intern.).
7. Peritoneum with its folds, and fovea inguinal. externa and interna.

At the inferior part, below lig. Fallopie, lie behind the skin:
1. Layers of fasc. superf. with cutaneous veins, ram. extern. nerv. sperm. externi, ven. saphena magna (and superfic. abdominis), which last opens one inch below lig. Fallop. into the vena cruralis, surrounded by superficial inguinal glands, outside n. cutan. femor. anter. externus.

2. Superficial layer of fascia lata, which forms proc. falciform. and fovea ovalis.

3. Vena cruralis, behind fovea ovalis; externally art. cruralis behind the outer part of proc. falciform.; on the outer side of the artery, nerv. cruralis in its sheath.

4. Upwards towards lig. Fallopiae: the crural canal and crural ring in the centre between spina ilei anter. super. and symphysis pubis, internal to and below the internal abdominal ring.

5. Vasa cruralia, surrounded by the deep inguinal glands, enclosed by the vagina vasorum, separated from nerv. cruralis by the deep layer of fascia lata; internally, close to the vessels, the thin prolongation of fascia transversalis (septum crurale, Cloquet), and lig. Gimbernati; externally m. psoas iliacus with nerv. cruralis in its sheath.

6. Eminentia ileo-pectinea, and ram. horizontal. oss. pubis above; m. pectineus below; behind, the deep layer of fascia lata, covers the vasa obturatoria, at their exit from the pelvis.

The triangular space between lig. Fallopiae, ram. horizontal. pubis and os ilium filled up internally by lig. Gimbernati, in the centre by the vasa cruralia and nerv. cruralis, externally, by the inferior part of m. psoas iliacus (between spina ilei anter. infer. and eminent. ileo-pectin.)

(Dissection. Above Poupart's ligament. 1. Make an incision through the skin only, transverse to the axis of the body, from the anterior superior spinous process of the ilium to the mesian line; from the termination of this, continue:

2. A vertical incision to the symphysis pubis. Reflect the skin towards the thigh, as far as Poupart's ligament. Examine the layers of superficial fascia. Reflect them, making incisions, as before, in the same direction. Clear away, after observing it, the external spermatic fascia, and make the boundaries of the external abdominal ring distinct. Through this, in the male, the spermatic cord, in the female, the round ligament, will be seen to pass; the incision may be extended downwards, following the course of these organs. An incision should now be made through the tendon of the external abdominal oblique muscle only, in a direction corresponding with No. 1, above, and the tendon reflected towards the thigh, the fibres connecting it with the subjacent tendons, and the tendon of the muscle of the opposite side
(the decussating fibres), being carefully divided. Examine next the free muscular edge of the internal oblique and transversalis muscles, and their conjoined tendons, as well as the fibres of the cremaster muscle in the male. From the junction of the outer with the middle third of Poupart's ligament carry an incision vertically upwards, parallel with the linea alba, dividing and reflecting inwards in succession, and outwards, the muscular fibres of internal oblique and transversalis muscles. The muscular fibres must be detached from the outer third of Poupart's ligament. From the commencement of the vertical incision the fibres may be separated in the direction of their fasciculi, namely, towards linea semilunaris. The fascia transversalis will now be exposed, the spermatic cord (or round ligament) resting upon its pubic portion, and lost in the internal abdominal ring, the external or iliac portion attached to Poupart's ligament. The fascia spermatica interna is to be examined, and then removed, to display more clearly the margins of the ring. Next push upwards and backwards the peritonaem, and observe the course of the spermatic vessels, the vas deferens, and the relations of the external iliac and internal epigastric arteries. The fascia iliaca and its attachments may likewise be studied.

Below Poupart's ligament. 1. Make an incision from the anterior and superior spinous process of the ilium to the centre of the thigh, the direction being inwards; in fact, parallel with the course of the fibres of the Sartorius muscle.

2. An incision from the spine of the pubes, downwards, to the termination of the last. Reflect the skin, only, upwards. Fat and fibro-cellular tissue forming more or less a superficial fascia, which encloses small arteries and veins, lymphatics, and their glands above, and the saphena vein below, may be reflected upwards. The fascia lata will be exposed, and immediately below the point at which the saphena vein is lost to view, by entering the sheath of the femoral vessels, it divides into an internal pubic and an external iliac portion. The handle of the scalpel may be passed under the falciform process of the latter, and upon raising it, the sheath of the femoral vessels is seen. The lymphatic vessels may be seen passing under Poupart's, and close to the outer border of Gimbernat's ligament, on the inside of the femoral vein, to the outer side of which is the femoral artery, each enclosed in separate fascial canals, the most internal being called the crural ring. To demonstrate this, make a small longitudinal incision through the anterior surface of the sheath, parallel to and over the centre of each vessel; then, with the handle of the scalpel passed along the sides of vessels, raise them from their fibrous canals. A considerable quantity of adipose tissue will be found surrounding the lymphatics below and at their entrance into the crural ring. Dividing carefully across, or detaching the posterior surface of Poupart's ligament from the anterior of the sheath of the femoral vessels (septum crurale), the connexion between this sheath and the pubic portion of fascia transversalis will be displayed. Trans.]
Pelvis.

700. I. Pubic region, regio pubis (see parts of generation).

Cavity of the small pelvis. Behind the symphysis pubis:
1. Urinary bladder. 2. Vas deferens and ureter upon both sides (they cross each other). 3. Fossa recto-vesicalis in the male, vesico-uterina in the female. 4. In the female: Uterus, vagina, and broad ligaments (they divide the pelvis into an anterior and a posterior half); behind that fossa recto-uterina. 5. Behind and to the left, rectum, fixed above by meso-rectum, below by loose areolar tissue.

701. II. Perineal region, R. perinæi,
closes the pelvic outlet, is bounded behind by the coccyx, on the side by ligg. sacro-ischiatica, tuber and ram. ascendens ischiī, in part, by ligg. pubicum inferius; below, by the external skin, above, by the peritoneum. It is oval, passes forwards towards the root of the penis (or the commissura poster. labor. pudend.), and is divided by a transverse line extending between the two tuberosities of the ischia, into the anterior, proper perineal, and into the anal region.

1. Reg. analis, region of the anus.
   b. Behind the anus: skin, condensed areolar tissue, containing adipose, posterior extremity of sphincter ani, fascia perin., mm. levatores in the raphe, fascia perin. superior, fat and areolar tissue, coccyx, and sacrum.

2. Reg. perinealis s.uro-genitalis, the anterior triangular part of the perineum, between the pubic arch and a transverse line between the two tubera ischiī.
   a. In the male: 1. Skin, wrinkled, thin, hairy. 2. Loose laminated areolar tissue with adipose, which continues on to the scrotum. 3. Fascia superficialis with the vasa and nn. perinæi superfic. (in the direction of tuber ischiī of the one to the spina pubis of the other side.) M. bulbo-cavernos. in the centre, transvers. and ischio-cavernosi on the sides. 5. Bulbus urethrae in the centre, corp. cavernos. on the sides; in the triangular space between the two, two or three lines from the ram. ascend. ischiī, crosses art. transvers. perinæi; 4. and 5. lie in a sheath formed of fasc. superfic. and profunda s. media. 6. Lig. perinæale; it is perforated by bulb. urethrae and vasa, nn. dorsal. penis (between corp. cavernos. and
ram. descend. pubis). 7. Between fascia perinei and pelvis lie from before to behind:

a. Pars membranacea urethrae with Cowper’s glands and invested behind by mm. bulbo-cavernosus.

b. Prostata, pars prostat. urethrae and collum vesicae, attached above by lig. pubo-prostaticum (six to eight lines behind the symphysis pubis, two or three above the anus).

c. Vesiculae seminales, and vasa deferentia between them, and crossing with the inferior extremity of the ureters. In the triangular space between them the fundus vesicae rests upon the rectum; between the last the neck of the bladder, prostatic and membranous portion of the urethrae, a triangular space also exists (which is taken advantage of in Lithotomy).


b. In the female the proper perineum, that is, the region between the labia. majora and orific. ani. is shorter (fifteen lines long), but broader than in the male. Fascia perinei, very strong; the muscles are the same, only instead of bulbo-cavernosus the constrictor vaginae.

The urethra (one to an inch and a half long, before, four to six lines, behind, three lines broad), passes backwards beneath the pubic arch on the anterior surface of the vagina curved rather upwards. Its orifice lies a quarter of an inch below the clitoris.

The vagina (four inches long, one inch broad) curved, ascends, backwards, between urethra, bladder, and rectum; between their openings and that of the last a triangular space exists (the base of which lies below, since the vagina and rectum lie close upon one another, fifteen lines above the orific. ani.), in which adipose as well as areolar tissue, fibres of mm. transvers., sphincter, levator ani, constrictor vaginae, and the vasa transvers. perinei are found. To their sides fascia pelvis is firmly attached.

The triangular space of the vestibule between the clitoris and the orificium urethrae is taken advantage of in Lithotomy; in it we find: 1. The mucous membrane. 2. Very vascular areolar tissue in the centre, the roots of the clitoris covered by the mm. ischio-cavern. and the anterior extremity of sphincter vaginae on the sides. 3. Fascia perinei (with the art. transvers. perinei) perforated by the urethra. 4. Vg. dorsales clitorid., collum vesicae and ligg. pubo-vesicalia. 5. The inferior portion of the anterior wall of the bladder.
The urinary bladder lies, in the female, higher over the perinæum, than in the male.

The orificium ani is broader, and is placed more posteriorly (behind a transverse line between the tuber ischiæ) than in the male.

[Dissection. 1. Of the male perinæum.

The subject should be tied up, as in the operation for lithotomy. The bony boundaries of the perinæal region must then be carefully recognised.

Incisions through the skin: 1. A vertical incision is to be made in the raphé from the arch of the pubes, which may be felt, or from the junction of the skin of the perinæum with that of the scrotum, to the anterior verge of the anus. 2. Transverse incisions, one on either side from the termination of the last to the outer sides of the tubera ischiæ. The two triangular flaps thus formed are to be reflected outwards over the thighs, and there fastened. 3. From the anterior verge of the anus carry two incisions, one on either side, around the opening, backwards, until they meet at the posterior verge in the middle line behind; from this point continue directly downwards to the coccyx. These two likewise triangular flaps are to be reflected over the thighs, and there secured. The sphincter ani is now to be dissected, and after examining the posterior portion of the superficial fascia, the ischiorectal fossæ of either side may be cleaned out.

Continuing the dissection of the perinæum, make an incision in the middle line as before indicated, from the arch of the pubes, in front, to the anterior extremity of anus, behind, having previously reflected the superficial anterior fibres of the sphincter ani, or even dividing them also in the centre. Now, carefully dissecting the superficial fascia away from its posterior or deeper connexions, examine its relations with the deep perinæal fascia behind. Having done this, divide the junctions between them, and reflect the layers of the superficial fascia on either side, observing their attachments to the anterior borders of the rami of the ischia and pubes.

Care must be taken of the perinæal vessels and nerves which traverse this fascia. The muscles of the perinæum may now be dissected.

The accelerator urinæ should be detached from the deep fascia behind, for it does not arise from it, but is merely applied to its anterior surface. With a little care and dexterity, the handle of the scalpel may be gradually passed between the muscle and the spongy body which it surrounds. The tubular character of the muscle is then clearly demonstrated. The posterior portion of the corp. spongiosum and urethra may even be divided transversely, and then withdrawn from the muscular tube.

2. Of the female perinæum.

The vertical incision should be carried to the anterior commissure of the vagina, and then round the borders of its mouth, meeting at the posterior commissure, terminating in front of the anns. With this variation excepted, as in the male. Trans.]
702. Axillary cavity, *fovea axillaris*, Axilla,
is triangular; its base directed towards the chest, its apex towards
the inner side of the upper arm, its anterior wall is formed by *m.
pectoralis major*, *minor*, and the anterior portion of the *deltoides*;
its posterior wall by *m. latissimus dorsi*, *teres major*, and *subscapularis*;
the inner wall by *m. serratus magnus* and the chest; the
external wall by *m. biceps, coraco-brachial.* upper arm (the upper-
most part). The blunt apex forms a triangular opening, which is
in connexion with the *reg. supraclavicularis*; formed in front by the
*clavicula*, behind by the superior border of *reg. scapularis*, inter-
ternally and below by the first rib.

703. *Fossa infraclavicularis,*
is the name given to a triangular excavation on the anterior wall
of the axilla, through which we pass to the apex of that fossa. It
is bounded externally by the *head* of the humerus; internally, by
*proc. coracoid.* above, by *clavicula* and acromion; and arises from
the fissure between *m. deltoideus* and *pectoralis major*. Before it
pass *vena cephalica* and *art. acromialis*. Behind that *vasa* and
*nn. thoracici externi*; *m. pectoralis minor* and *fasc. coraco-clavi-
cularis*, *m. subclavius*. Beneath the hairy and thin skin at the base
of the axilla, which is largely supplied with sebaceous follicles, a
loose adipose areolar tissue is found, some superficial lymphatic
glands, *fasc. brachialis* (between *m. pectoral. maj.* and *latissim.
dorsi*), branches of *vasa axillaris*. and the *v. axillaris*, deep lym-
phatic glands, *vena* and *art. axillaris*, the trunks of nerves, lami-
nated areolar tissue, and the shoulder joint.

*Art. axillaris* passes: a. between the first rib and the superior
border of *m. pectoral. minor*, on the outer side of *v. axillaris*, on the
inner of the inferior branch of *plex. nerv. brachialis* and *proc. cora-
coid.* supported upon *m. intercostal. I.*, the second rib, and *m. serrat.
antic. major.*; b. behind *pectoralis minor*, covered by the two roots
of the *n. medianus* before, closer to the humerus; c. from the infe-
rior external border of *m. pectoral. minor*, as far as to the inferior
limit of the *axilla*, behind *v. axillar.* internal to and behind *nerv.
medianus*, *m. coraco-brachial*, *cap. breve bicip.* and *os humeri*;
before *nerv. ulnaris*, before and internal to *n. radialis and axillaris.*
Behind it, *plex. lymphaticus*, tendons of *subscapularis*, *m. latissim.
dorsi*. The direction of *art. ven. axillaris*, and the *plex. brachialis*,
is oblique from above and within, to below and without (from the
anterior internal angle of the axilla to its external).
On the costal parietes pass; art. mammae externa (in front), n. thoracic. poster. (behind) and nn. cutanei brachii.

On the posterior wall of the axilla: a branch of art. scapular. commun., a nerv. infrascapular., and lymphatics.

The largest number of lymphatic glands lie at the internal anterior angle above the mm. pectorales, and close to the axillary border of the scapula.

The Extremities.

704. Plica cubiti, bend of the elbow,

is the angle in the anterior region of the elbow, which the articular ends of the upper and forearm form with one another. We there find under the skin and fascia, which above passes into the f. brachii, below into the vagina cubiti, the fossa cubiti, a triangular depression bounded externally by m. supinator longus, internally by pronator teres, at the base by the tendon of the biceps, and m. brachialis internus (above), the origin of flexores commun. digit. and supinat. brevis (below). Position of the parts in the fossa cubiti:


705. Fossa poplitea, bend of the knee,

a rhomboidal shaped space on the posterior (flexion) side of the knee, is formed below by the two heads of m. gastrocnemius, the inner of which is the longer, and partly covered by the tendon of semimembranosus; the external superior side by the biceps, the internal by the belly of semimembranosus, then by the tendons of the last-named muscle, the semitendinosus, gracilis, and sartorius.

Position of the parts: 1. Skin thin, smooth, and very extensible. 2. Fibro-cellular tissue with adipose, in which cutaneous veins and the terminal branches of nerv. cutaneus femor. poster. magn. and nerv. cutan. post. medius. 3. Fascia lata; forming, with a superficial layer, an arch over the fossa, covers with a deep layer the limits and the floor of it; surrounding also, besides lymphatic glands, fibro-cellular and adipose tissue, the vessels and nerves.

a. Art. poplitea, passes pretty nearly in the centre of the fossa,
is entirely covered above by *ven. poplitea*, fibro-cellular tissue, fascia, and skin, at the lowest part by *m. gastrocnem.*, and the obliquely passing *m. plantaris*.

b. *Ven. poplitea*, firmly adherent to the posterior external side of the artery.

c. *Nerv. tibialis*, to the posterior external side of the vein, passing away obliquely behind it to the inner side.
DISTRIBUTION OF THE ARTERIES AND NERVES OF THE

Fingers.

**Art. volares.**

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<thead>
<tr>
<th>Art. radial. pollicis arises from ram. dorsal., or volar. art. radial.</th>
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<td>dig. medii</td>
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<td>annularis</td>
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<td>auricularis</td>
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| arcus volar. sublimis united with branches of arcus volaris profundus |

**Nervi volares.**

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<td>radial. auricularis</td>
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| from ram. superfic. nerv. mediani. |

Toes.

**Art. plantares.**

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<th>Art. tibial. hallucis arises from art. plantar. int.</th>
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<td>tibial. and fibul. dig. II.</td>
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| arise from arcus plantaris, formed by art. plantar. extern. and art. intern. and art. interossee (between the tibial. art.). |

| Branches of art. tibialis postica. |

**Nervi plantares.**

<table>
<thead>
<tr>
<th>Nerv. tibial. hallucis from ram. intern. nerv. plant. int.</th>
</tr>
</thead>
<tbody>
<tr>
<td>fibularis</td>
</tr>
<tr>
<td>tibial. dig. II.</td>
</tr>
<tr>
<td>fibularis</td>
</tr>
<tr>
<td>tibialis dig. III.</td>
</tr>
<tr>
<td>fibularis</td>
</tr>
<tr>
<td>tibialis dig. IV.</td>
</tr>
<tr>
<td>fibularis</td>
</tr>
<tr>
<td>tibialis dig. V.</td>
</tr>
</tbody>
</table>

| from ram. extern. nerv. plant. int. |

| from nerv. plant. extern. |

| Branches of nerv. tibialis. |
### Fingers.

**Art. Dorsales.**

<table>
<thead>
<tr>
<th>Art. radialis pollicis</th>
<th>Art. tibialis hallucis</th>
</tr>
</thead>
<tbody>
<tr>
<td>- ulnaris</td>
<td>- fibularis</td>
</tr>
<tr>
<td>- radialis indicis</td>
<td>- tibialis dig. II.</td>
</tr>
<tr>
<td>- ulnaris</td>
<td>- fibularis</td>
</tr>
<tr>
<td>- radialis dig. medi.</td>
<td>- tibialis dig. III.</td>
</tr>
<tr>
<td>- ulnaris</td>
<td>- tibialis dig. IV.</td>
</tr>
<tr>
<td>- radialis annul.</td>
<td>- fibularis</td>
</tr>
<tr>
<td>- ulnaris</td>
<td>- tibialis dig. V.</td>
</tr>
<tr>
<td>- radialis dig. min.</td>
<td>- fibularis</td>
</tr>
<tr>
<td>- ulnaris</td>
<td></td>
</tr>
</tbody>
</table>

**Nervi dorsales.**

<table>
<thead>
<tr>
<th>Nerv. radialis pollicis from ram. superf. anter. nerv. radialis.</th>
<th>Nerv. tibialis hallucis from nerv. dorsal. ped. intern.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- ulnaris</td>
<td>- fibularis</td>
</tr>
<tr>
<td>- radialis indicis</td>
<td>- tibialis dig. II.</td>
</tr>
<tr>
<td>- ulnaris</td>
<td>- fibularis</td>
</tr>
<tr>
<td>- radialis dig. medi.</td>
<td>- tibialis dig. III.</td>
</tr>
<tr>
<td>- ulnaris</td>
<td>- fibularis</td>
</tr>
<tr>
<td>- radialis annul.</td>
<td>- tibialis dig. IV.</td>
</tr>
<tr>
<td>- ulnaris</td>
<td>- fibularis</td>
</tr>
<tr>
<td>- radialis dig. min.</td>
<td>- tibialis dig. V.</td>
</tr>
<tr>
<td>- ulnaris</td>
<td>- fibularis</td>
</tr>
</tbody>
</table>

### Toes.

**Artt. Dorsales.**

<table>
<thead>
<tr>
<th>Art. tibialis hallucis</th>
<th>from art. inteross. dorsal. I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- fibularis</td>
<td>- from arcus tarseus dorsalis, formed by art. metatarsals, united with art. tarsae externa.</td>
</tr>
<tr>
<td>- tibialis dig. II.</td>
<td></td>
</tr>
<tr>
<td>- fibularis</td>
<td></td>
</tr>
<tr>
<td>- tibialis dig. III.</td>
<td></td>
</tr>
<tr>
<td>- fibularis</td>
<td></td>
</tr>
<tr>
<td>- tibialis dig. IV.</td>
<td></td>
</tr>
<tr>
<td>- fibularis</td>
<td></td>
</tr>
<tr>
<td>- tibialis dig. V.</td>
<td></td>
</tr>
<tr>
<td>- fibularis</td>
<td></td>
</tr>
</tbody>
</table>

**Nerri dorsales.**

<table>
<thead>
<tr>
<th>Nerv. tibialis hallucis from nerv. dorsal. ped. externus, receiving branches from nerv. tibialis.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- fibularis</td>
</tr>
<tr>
<td>- tibialis dig. II.</td>
</tr>
<tr>
<td>- fibularis</td>
</tr>
<tr>
<td>- tibialis dig. III.</td>
</tr>
<tr>
<td>- fibularis</td>
</tr>
<tr>
<td>- tibialis dig. IV.</td>
</tr>
<tr>
<td>- fibularis</td>
</tr>
<tr>
<td>- tibialis dig. V.</td>
</tr>
</tbody>
</table>
d. Nerv. peronaeus, on the inner side of m. biceps, covered only by fascia, on the posterior surface of condyl. extern. femor. to the outer side of condyl. extern. tibiae, as far as behind capitul. fibulae.

The two nerves (c and d) receive the art. and vein in the centre between them.


Situation of the Viscera, relative Position of the Organs in the Three Great Cavities.

708. Cranial Cavity.

After removing the cranial bones we directly come to

1. Dura mater, from the internal surface of which the following processes pass between the recesses of the brain:

1. Proc. falciformis major, s. falx cerebri. Its superior convex border extends from foram. caecum and crista galli of ethmoid bone along the crista frontal., interna, beneath the central line of the cranial arch as far as protuberant. occipital. interna; containing the sinus longitudinal. superior. Its inferior concave border is extended freely between the two hemispheres of the cerebrum, close above the corp. callosum in the scissura longitudinal. cerebri; it contains the sinus longit. inferior.

2. Tentorium cerebelli; lies over the fossa cranii inferior, transversely between the lobes of the cerebrum and the superior surface of the cerebellum, below the falx cerebri and above the falx cerebelli. In the middle line passes sinus quartus [straight or horizontal sinus]. Its external convex border is attached to the lineae cruciatae transversae occipitis, the angulus super. oss. petrosi, as far as the proc. clinoides poster.; contains sinus transvers. and petrosi superiores. Its free, internal, concave border reaches as far as the corp. quadrigemina, splenium corp. callosum and pons Varolii.

3. Process, falciformis minor s. falx cerebelli lies in the incisura cerebelli poster., between the hemisphær. cerebelli, behind tuber valvul. and pyramis vermis, beneath the centre of the Tentorium, and extends along the crista occipital. interna from the protuberantia as far as foram. magnum; containing, at the posterior attached border, sinus occipitalis posterior.

4. Process. spuriæ durae matris are visible after the brain is removed from the skull.

a. Roof of the sella turcica, stretched between proc. clinoid.
THE EXTREMITIES.

anter. and poster., covers the fossa pro gland. pituitar., presenting in the middle a foramen for infundibul. and sin. circular Ridley.

b. Between the apex of the petrous and the ala parva of sphenoid bone, the superior external wall of sin. cavernos., and farther outwards the sin. ophthalmicus is formed.

c. Tubular sheaths for vessels and nerves penetrate the foramina of the basis cranii.

5. Sinus; are found between the layers of the dura mater.

a. Sinus transversi in the sulcus transvers., at the posterior border of tentorium cerebelli. Into it open

1. Sinus longitud. super.; passing along the convex border of falk cerebri.; opens into the right sin. transv. on the protuberantia occipit. interna.

2. Sinus quartus; [straight] passes into the centre of tentorium, from before backwards; receiving where tentorium and falk cerebri unite,

Vena magna Galeni, which, arising by the confluence of vv. cerebrales interneæ, pass into plexus choroid. 3.

Its posterior extremity enters the left sinus. transversus (s. torcular. Herophili).

3. Sinus longitud. inferior, on the concave border of falk cerebri., passes into sinus quartus.

4. Sinus petrosus superior, in the sulcus petrosus on the superior angle of pars. petrosa; unites sinus cavernos. with transversus.

5. Sinus petrosus infer., between the apex of pars petrosa and the clivus; opens at the foram. jugulare into the sinus transversus.

b. Sinus occipitalis posterior passes on the crista occipit. interna, from the torcular Herophili downwards to the sinus circular. foram. magni, which lies upon the posterior boundary of foram. magn., and is connected with the so-called sin. occipit. ant. s. basilar. upon the clivus and the fossa pro medulla oblongata.

c. Sinus cavernosi passes on both sides of sella turcica between the apex of petrous and ala parva of sphenoid bone. Into it discharge,

1. Sinus circularis Ridleyi; surrounding the hypophysis cerebri.

2. Sinus sphenoparietales s. ophthalmici (ant. extremity of sin. cavernosi); at the inferior extremity of fiss. orbitalis superior.

3. Sinus petrosi antiores.; between pars squamosa and petrosa of temporal bone (often wanting).

II. Arachnoidea, surrounded by the Dura, it surrounds the pia
mater; it is extended like a bridge across all the depressions, and over all the sulci of the brain.

III. Pia mater, slightly attached to the free surface of the brain, and entering into all its sulci, depressions and cavities, it closes the fourth ventricle at the fissur. transv. cerebali, [abnormally] and the third ventricle even at the foram. Bichat. in the fiss. transv. cerebri.

709. IV. Cerebrum, great brain. Its superior convex surface looks towards the cranial vault, and is divided into two hemispheres by the

Scissura longitudinalis, which penetrates as far as corpus callosum, in front, before the genu corpor. callosi, and between the anterior cerebral lobes to the base of the skull; behind, posterior to splenium corp. callosum, and between the posterior cerebral lobes to the cerebellum, and receives the falx cerebri.

Anterior cerebral lobes. Their inferior surfaces lie upon the fossa cranii anterior; their internal surfaces meet together; behind they are separated from the middle lobes by the fossa Sylvii. On the inferior surface, towards their inner border, the sulcus tractus olfactorii is seen, at the posterior termination of which, close before substantia perfor. media, lie the corp. mammillaria.

Middle cerebral lobes are indistinctly bounded behind by margo petrosus of petrous bone, and they occupy the fossae cranii medie. Posterior cerebral lobes occupy the space in the fossae occipitales superiores. Between them and the cerebellum the fissura transv. cerebri leads to splen. corp. callos., corp. quadrigem., ventricul. 3., and laterales.

710. V. Cerebellum, lesser brain, fills up the fossae occipitales inferiores, is divided by the horse-shoe-shaped incisura poster., at the posterior border and falx cerebelli, into two hemispheres, by a deep transverse groove, sulcus horizontalis Reilii, into a superior and inferior half, united in the middle line by the vermis [proc. vermis]. The vallecula on the inferior surface of the vermis receives anteriorly the pons Varolii, behind the medulla oblongata. Between the last and the cerebellum the fissura transversa cerebelli leads into the fourth ventricle. The superior surface of the cerebellum is separated from the posterior lobes of the cerebrum by the tentorium.

711. VI. Basis encephali. We find in the middle line from behind to before,
1. Medulla oblongata. upon the pars basilar. occipitis, between the hemispharia cerebelli, behind pons Varolii. In its middle line:
   a. Fissura long. anterior; on the side of this:
   b. Corp. pyramidalia. Next to these the olivary bodies, and most posteriorly and externally the corp. restiformia.
2. Pons Varolii, upon the clivus, behind the crura cerebri, between the crura cerebelli ad pontem.
3. Substantia perforata media, between crura cerebri.
4. Corp. mammillaria, above proc. clinoidei posteriores, between crura cerebri.
5. Tuber cinereum, between the anterior extremities of tractus optici, elongating itself forwards and downwards in the infundibulum to the hypophysis in the sella turcica.
6. Chiasma nerv. opticorum, upon the proc. clinoidei medii, between the two laminae cribrose, which lie before the crura cerebri at the commencement of fossae Sylvii, and the posterior extremity of sulcus tractus olfactorius. On the sides of the base are situated,
   1. Fossa Sylvii, with the insula of Reil, and the operculum.
   2. Crura s. pedunculi cerebri, behind the tractus opticus, before pons Varolii.
   3. Tractus opticus, behind lamina cribrosa, before crus cerebri, winding round them.
   4. Gyrus hippocampi, externally close to crus cerebri, forms in front the uncus.

712. VII. Cerebral nerves.

1. Olfactorius, appears at the internal extremity of fossa Sylvii and lamina cribrosa, passes in the sulcus tractus olfactorius on the inferior surface of the anterior cerebral lobes, enlarges (bulbus cinereus) upon the cribriform plate of the ethmoid bone, and quits the cranial cavity with a double series of filaments.
2. Opticus, appears at the anterior border of chiasma, passes through foram. opticum, where it lies above and internal to art. ophthalm., into the orbit, where it is situated on the outside and below it.
3. Oculo-motorius, appears on the inside of the pedunc. cerebri, passes through a fissure of the dura mater, approaching proc. clinoid. post., into the sinus cavernosus, along the superior wall, outside the carotis interna; enters the orbit through fissura orbital. superior.
4. Trochlearis, appears at the anterior lateral border of pons Varolii, before the crus cerebelli ad pontem, perforates the dura mater behind proc. clinoid. post., passes in a canal formed by it above the apex of the petrous bone, between the superior and outer wall of sinus cavernosus, to the fiss. orbital. super., and into the orbit.

5. Trigeminus, appears at the anterior lateral border of pons Varolii, before the crura cerebelli ad pontem, external to trochlearis, penetrates the anterior border of tentorium close above the apex of the petrous bone, and there forms the ganglion Gasseri, from the inferior border of which its first, second, and a portion of its third division pass off.

Ramus I. passes through fissura orb. superior.
— II. through foram. rotundum.
— III. through foram. ovale out of the skull.

6. Abducens, appears between the posterior border of pons Varolii and the corp. pyramid., enters through the fissure of the dura mater, on the clivus, into the sinus cavernos., and passes, when in this, on the outer side of the carotis to the fiss. orbital. superior.

7. Facialis, appears at the posterior lateral border of pons Varolii, between crus cerebelli ad pont. and corp. restiforme, passes in a sulcus of the acusticus; and enters, by the meatus auditor. intern., into the canal Fallopie.

8. Acusticus, appears externally close to the last, passes to meatus auditor. intern. between corp. olivare, floccul., and crus cerebelli ad pontem.

9 and 10. Glosso-pharyngeus and vagus, appear below the posterior border of pons Varolii, between corp. olivare and restiforme, they pass out through foram. jugulare [post. lacerated foramen].

11. Accessorius Willisii, passes through for. magnum into the cranium, and leaves it through foram. jugulare [post. lacerated foramen].

12. Hypoglossus, appears between corp. olivare and pyramid., passes out through foram. condyloid. anterius.

713. VIII. Arteries [see § 552, and 554.]

1. Carotis cerebralis, enters the sinus cavernosus at the apex of the petrous bone, surrounded by plexus carotic. intern., lies upon the outer inferior side of the sinus. penetrates it behind foram. opticum, gives off art. ophthalmica, and divides into the three following arteries:

a. Art. corpor. callos. [ant. cerebral], lies at its commencement before the chiasma above n. opticus, then in the scissura longitudinal.
SITUS VISCERUM.

b. *Art. fossae Sylvii* [middle cerebral], commences below the *lamina cribrosa*, then in *fossa Sylvii*.

c. *Art. choroidea*, external to *crus cerebri*, below *tractus opticus*, enters the *cornu descend.* of the lateral ventricle.

2. *Circulus arteriosus Willisii*, above and close to the *sella turcica*, surrounds the *chiasma*, *tuber cinereum* and *corp. mammillaria*.

3. *Art. vertebralis*, enters into the cranial cavity at the posterior lateral part of *foram. magn.* lies at first on the side of, then obliquely before the *medulla oblongata*. The two vessels unite and pass as *basilaris* upon the *clivus*.

a. *Art. basilaris* gives off: *art. auditorice internae, cerebelli inferiores* and *superiores*, and divides at the *proc. clinoid. post.* into the two *artt. profunda cerebri* [posterior cerebral], which pass around the *crura cerebri* to the posterior cerebral lobes.

714. Thorax [compare § 695.]

After removing the sternum we arrive at the pleura with the lungs laterally, in the centre the *cavum mediastini antici*, the *pericardium* with the *heart*, and the *cavum mediastin. postic.* with *trachea, aosophagus*, vascular and nervous trunks.

715. I. Pleurae. Each pleural sac is united to the lateral thoracic parietes as *pleura costalis*. The right lies obliquely from above to below, and from right to left, so that above it reaches as far as the right border of *manubrium sterni*, below to the centre of *corp. sterni*. The left attaches itself to the left border of the *manubrium*, below to the external extremity of the sixth and seventh rib cartilage.

From these points the *pleura costalis* turns backwards on either side to the lateral regions of the pericardium and the roots of the lungs as *mediastinum anticum*.

Each *pleura costalis* goes backwards to the front of the heads of the ribs and to the sides of the vertebral bodies, and hence turns forwards to the lateral surfaces of the pericardium and to the roots of the lungs as *mediastin. posticum*.

Below, the pleura is united with the convex surfaces of the diaphragm, *pleura phrenica*; posteriorly and at the sides it extends to the last ribs.

*Ligamentum pulmonis*, extends from the *pleura phrenica* to the posterior border of the inferior lobe of the lungs, and here passes over into the

*Pleura pulmonalis*, which invests the entire surface of the lungs,
forming between the lobes *ligg. interlobularia*, and at the roots of the lungs covering the parts entering and passing out.

716. II. Lungs. Each of the two lungs rests with the concave basis upon the convex surface of the diaphragm. The rounded apex reaches about one inch above the first rib. Their convex external surface is turned towards the concavity of the ribs, and shows on the right lung two *incisurae interlobulares* passing from behind forwards, on the left one *incis. interlobular.*, so that the former is divided into three, the latter into two lobes.

717. III. Pericardium, extends from the point of junction of the sixth and seventh rib cartilage with the sternum of the right side: a rhomboidal piece of its anterior surface looks freely into the *cav. mediast. anticum*. It envelopes

718. IV. The Heart, the posterior inferior surface of which rests upon the diaphragm, the basis of which lies to the right, above and behind as high as the sixth dorsal vertebra, the apex to the left, in front and below, behind the anterior extremity of the cartilage of the sixth and seventh left ribs. *Sulcus longitudinalis, transversus. Ventriculi, atria and auriculae cordis* (see Heart, § 527.) Besides the coronary veins, there open into the heart:

1. *Vena cava superior*, formed by the junction of the two *anonyma* [ven. brachio-cephalicae] behind the first and second right costal cartilages, passes before *art. pulmonal. dextra*, to the right and rather behind the commencement of the *Aorta*, into the *atrium dextrum*.

   a. *V. anonyma dextra* [right brachio-cephalic] lies perpendicularly before the first [right] costal cartilage, before and internal to *nerv. phrenic. dexter* and *art. mamm. intern. dextra*.

   b. *V. anonym. sinistra* [left brachio-ceph.] horizontal behind the *manubrium*, close above *arcus aorta*, before *art. anonyma, carotis and subclavia sinistra*.

3. *V. cava inferior*, passes through *foramen quadrilaterum* of the diaphragm from the *ventral* into the *thoracic* cavity, and immediately into the *pericardium*, where it turns forwards and to the left, and before the eighth and ninth dorsal vertebra sinks into *atrium dextrum*.

3. *Venas pulmonales*, pass forth with two trunks from the root of each lung, lie behind and below the other large blood-vessels of the heart and behind the *bronchi*, advancing towards those of the opposite side, and opening into the *atrium sinistrum*.

From the heart arise, besides the coronary arteries,
1. Arteria pulmonalis, which lie the most anterior of all the vascular trunks. Origin: ventriculus dexter, behind auric. sinistra, covering the origin of the aorta. Divides on an elevation with the third dorsal vertebra. The left trunk passes obliquely backwards over vv. pulmonal. sinistr., before aorta descend., and bronchus sinister with two branches to the left lung. The right branch below arcus aortae, before bronchus dexter, behind aorta ascendens with three branches to the right lung. From the angle of division the lig. arteriosum (duct. art. Botalli) passes to the concavity of arcus aortae, internal to nerv. vagus sinister.

2. Aorta, arises from the left ventricle, ascends behind art. pulmonalis as aorta ascendens from left to right, lying there between art. pulmon. (to the left) and v. cava sup. (to the right), forms on an elevation with the second intercostal space the arcus aortae, which passes from right to left and from before backwards into the cav. mediast. post.; and downwards as far as the fourth dorsal vertebra. Here it descends as aorta descend. close to the left side of the vertebral column, first close, then behind the asophagus, and passes through hiat. aortic. in the region of the twelfth dorsal vertebra into the abdomen.

From its convexity arise

a. Art. anonyma [art. brachio-cephalic.], lying the farthest to the right and in front, behind manubrium sterni, before trachea; divides into carot. commun. and subclav. dextra.

b. Carotis comm. sinistra, at the commencement before, then to the left of trachea and asophagus, behind manubrium, ven. brach. ceph. sinistra, and m. sterno-hyoides.

c. Subclavia sinistra, the farthest to the left and behind, before the termination of m. longus colli.

1. Mammaria interna, arises from the ant. inf. surface of subclavia, turns, at the commencement, forwards, then downwards, passes inwards between two veins, before the pleura on the inner surface of (one to seven) costal cartilages as far as proc. ensiform., where it bifurcates into its two terminal branches, ram. musculo-phrenic. and epigastricus.

719. V. Vena azygos and hemiazygos (v. conjugatae) pass along on either side between crus extern. and med. diaphrag. into the cavum mediast. post., passing close to the bodies of the dorsal vertebrae as high as the eighth, where they unite in the ven. azygos. This passes upwards to the right of the aorta and the ductus
thoracicus as high as the third and fourth dorsal vertebrae, curves around bronch. dexter and art. pulmon. forwards to the posterior wall of ven. cava sup., in which it terminates.

720. VI. Ductus thoracicus passes through hiat. aortic., lying between aorta thoracica. and ven. azygos before the bodies of the vertebrae; goes to the left, in the region of the fifth and sixth dorsal vertebrae behind the oesophagus and the termination of arc. aorta, and opens in the angle between ven. jugular, interna, and subclavia sinistra.

721. VII. Trachea, behind the manubr. sterni, ven. anonyma, and carotis sinistra, it divides before the third dorsal vertebra, close behind arcus aortae, into the two bronchi. Bronch. dexter [the largest] lies behind v. cava super., passes away under the curve of v. azygos; bronch. sinister [the longest and most oblique] under the arch of the aorta to the lungs. Both lie behind the art. and above the v. pulmonales.

722. VIII. Oesophagus passes behind the trachea and rather to the left of it, into the cav. mediastin. post.; lying, at the commencement, more in the central line, and to the right of the aorta; lastly to the left and before aorta and duct. thoracici., and enters, upon a plane with the ninth dorsal vertebra, the abdominal cavity through for. oesophageum.

723. IX. Nerves.

1. Nerv. vagus, passes down and close to carotis, rather external to it, before art. subclavia and behind ven. anonyma obliquely into cav. mediast. anticum.

a. N. recurrens dexter, passes off from it, and around the art. subclavia dext. backwards to the larynx: sinister likewise around the arcus aortae. Both ascend behind the carotis in the groove between trachea and oesophagus.

b. Nn. pulmonales.

The vagus then turns into the cav. mediast. post., passes obliquely inwards behind the bronchi to the oesophagus (the left on its anterior, the right upon its posterior surface), and are lost through for. oesophageum of the abdominal cavity.

2. Pars thoracica nerv. sympathici, lies on the outside of cav. mediastin. post. behind the pleura costalis, close to the vertebral bodies, before the proc. transv. and heads of the ribs. Ganglia thoracici (eleven to twelve) between, upon, or before the heads of the ribs.

a. Splanchnicus major, arises from six to ten ganglia
thorac., entering the abdominal cavity between crus med. and intern. diaphragm.

b. Splanchnicus minor, arises from nine to ten ganglia, perforates the crus medium. Both lie more anterior and internal than the trunk of sympathicus, before the vasa intercostal.; upon the left side, close to the aorta; upon the right, close to ven. azygos.

3. Nervus phrenicus, enters the cav. mediastin. antic., on either side behind the outer portion of artic. sterno-clavicularis before art. subcl. and behind v. subcl., on the outer side of art. mammaria interna, contiguous to the pericardium; the right passes more anteriorly before v. cava super., the left curved around the apex of the heart to the diaphragm.

724. Abdominal Cavity.

1. Within the peritoneum (Infra peritoneum).

1. Liver, situated in the hypochondr. dextr., extending on the left as far as into epigastrium. The convex surface in the concavity of the diaphragm, directed upwards and forwards; the concave surface downwards and backwards.

Lobulus dexter covers the superior part of the right kidney (impressio renalis), the flexura coli dextra (impressio colica), farther to the left and before the duoden., pylorus, lig. hepatico-renal and duodenale; foram. Winslowii.

Lobulus sinister lies upon the small omentum and the cardia; lob. Spigelii in the curvatura minor.

Posterior superior border is obtuse, and unites with the diaphragm.

Inferior anterior border is acute, and directed downwards.

On the inferior surface: Fossa longitudinal. dextra with the gall bladder—fundus below, collum directed towards fossa transv.; passes into ductus cysticus, which joins with duct. hepaticus, at an acute angle to form the duct. choledoch., which opens into the posterior wall of pars descend, duodeni. At the posterior part lies ven. cava inferior.

Fossa longitudinal. sinistra with lig. teres (ven. umbilical.) before duct. ven. Arantii behind.

Fossa transversa presents: v. portae and art. hepat. (vessels entering), duct. hepat. (passing out) surrounded by capsul. Glissonii, in the lig. hepatico-duodenale.

a. Ven. portae, and to the right before it art. hepatica.

b. Ductus hepaticus before v. portae, between art. hepat. (to the left) and duct. cystic. (to the right).
c. Duct. choledochus to the right, and rather before the ven. porta, behind duodenum.

2. Spleen, situated in hypochondr. sinistra. Its thick superior extremity on the diaphragm, the thin inferior extremity above flex. coli sinistra. External surface towards the concavity of the last ribs and pars cost. of diaphragm. Internal concave surface bounded by fund. ventriculi, presents hilus.

3. Pancreas, behind the stomach, in the reg. epigastr., before the large vascular trunks and the vertebral column. The head in the curve of the duodenum, the tail towards the spleen. The duct (duct. Wirsungianus) opens into pars. descend. duodeni.

4. Stomach in reg. epigastrica and hypochondr. sinistra. Curvat. major below, minor above; anterior wall behind the abdominal parietes; posterior before pancreas, aorta; cardia to the left and above, beneath for. asophageum; behind proc. xiphoideus, in the scrobiculo cordis, and the extremity of the left lobe of liver; pylorus to the right, behind the lobul. quadratus. Fundus in the reg. hypochondr. sinistra, united to the spleen.

5. Duodenum. First portion, pars horizontal. super. proceeding from the pylorus to the right, curves below the right lobe of the liver. Second portion, pars. descend., before the right kidney to the region of the third lumbar vertebra. Second curve. Third portion, p. horizontal. infer. passes off to the left, then between the layers of the mesentery into the jejunum.

6. Jejunum two-fifths, and ileum, three-fifths, traverse regg. umbilical., hypogast., iliaca, even into the depth of the pelvis (in the excavat. recto-uterina and vesico-uter.), passing in the reg. iliac. dex. into the large intestines.

7. Cecum; with proc. vermiform, behind and external in reg. iliac. dextra, upon m. iliacus dexter.

8. Colon, ascendens, transvers., descendens with sigmoid flexure passes by the side of the last lumbar vertebra into the rectum.

9. Peritoneum, extends from the umbilicus upwards on the internal surface of the abdominal parietes to the diaphragm, forming in this way, as it surrounds the lig. teres, the lig. suspensor. hepatis.

From the concavity of the diaphragm it descends to the obtuse border of the liver as lig. coronar. hepatis, which at the sides passes over into the anterior layer of ligg. triangularia; covering the convexity of the liver it turns over the acute border to the inferior surface which it also covers as far as lobulus Spigelii, and completes laterally the ligg. triangularia. From the fossa transv. it goes to the flexur. coli. dextra. and right kidney (lig. hepatico-colicum and -renale) farther, to the curvat. minor. (lig. hep. gastric.
SITUS VISERUM.

s. omentum minus), and to the duodenum (as lig. hepatico-duodenale, which is continued to the right kidney as lig. duodeno-renale). On the left side it descends from the diaphragm to the anterior wall of the stomach and the spleen (lig. phrenico-gastric, and one layer of lig. phrenico-lienale), covers the anterior surface of the stomach, descends as one layer of the great omentum [turns upon itself], and ascends as the fourth layer, covering the colon transversum, as mesocolon transversum, passes to the [inferior] border of pancreas, and attaches itself to the posterior abdominal parietes.

Foramen Winslowii is a space between ven. cava and v. portalum below the tubercul. caudatum of the liver. Through this the saccus epiploicus is tucked in. The anterior layer covers lobulus Spigelii, forms the posterior layer of lig. gastro-hepatic. (small omentum), covers the posterior surface of the stomach, descends as second layer of great omentum, and as third layer again ascends, covering [the transv. colon] the anterior surface of the pancreas, and turning back at the lobul. Spigelii.

Mesenterium. The root of the mesentery extends from the second lumbar vertebra to the symphys.-sacro-ilac. dextrum. Between its two layers are found the convolutions of the small intestines. From the symph. sacro-ilac., the peritoneum is continued upon the cecum, proc. vermiform., colon, and rectum.

In the male it passes from the anterior surface of the rectum to the posterior of the urinary bladder, since it forms the excavat. recto-vesicalis, and on both sides the plicae semilunares Douglasii, covers the lateral two-thirds of the posterior surface of the bladder, invests laterally the lig. vesica lateralia, and above the lig. vesica suspensor., and then again ascends to the posterior surface of the anterior abdominal parietes.

In the female it forms the excavatio-recto-uterinum, plic. Dougl., lig. uteri lata, plicae and excav. vesico-uterinae, passes upon the bladder, and so on.

Uterus lies in great part covered by peritoneum, above the vagina, between bladder and rectum, with the fundus in the entrance to the pelvis.

Tuba Fallopiae lies at the entrance to the pelvis, before and above the ovary, at the side of the uterus; its external extremity projects freely into the abdominal cavity.

Ovarium, between the layers of the broad ligament, over the round ligament, on the side of fundus uteri, and united with it by lig. ovarii.

Lig. uteri rotundum, below the tuba and the ovarium, on the lateral borders of the uterus.
II. Outside the peritoneum,
in the abdominal and pelvic cavities are situated: the capsule 
supra renales, the urinary organs, internal organs of generation,
the rectum; the superior portion of the duodenum, the great ves-
sels and nerves.

1. Caps. sup. renales, situated in the reg. hypochondriaca on
the posterior abdominal walls, upon the upper border of the kid-
ney, below the diaphragm, the right behind the liver, the left be-
hind fundus ventriculi.

2 Urinary organs, viz. kidneys, ureters, bladder.

a. Kidneys. They are placed in the reg. lumbalis, before m.
quadradus lumborum and the eleventh and twelfth ribs, close to
the first and third lumbar vertebrae, behind the peritoneum; the
right kidney behind lobul. dexter, duodenum, and colon ascendens;
the left behind the inferior extremity of the spleen, cauda pancreat.
and colon descendens.

The internal border with the hilus, rests upon the pars lumbal.
of diaphragm and m. psoas. In the hilus lie, from before back-
wards, vena, arteria, pelvis renalis.

b. Ureter, descends obliquely inwards from the pelvis of the
kidney, with a sigmoidal curve; before, m. psoas and vasa iliaca;
behind, the vasa spermatica, which descend obliquely outwards,
and cross it; it passes between rectum and psoas into the pelvic
cavity, and to the posterior wall and lateral parts of the fundus
vesica. Here it lies in the male, at first on the side, then be-
tween the rectum and urinary bladder, behind vas deferens; in
the female, close to collum uteri, below lig. uteri rotund., then
between bladder and vagina.

c. Urinary bladder; it lies in reg. pubis, between the pubic
bones and the rectum or uterus:

1. Corpus vesica, behind the symphysis pubis, before the
rectum or uterus, touching laterally the side walls of the
pelvis.

2. Vertex, projects upwards as far as the superior border
of symphysis pubis, or, even above this, covered behind by
peritoneum.

3. Fundus, situated anteriorly upon the perineum, above the
vesiculce seminalis. and vasa deferent., behind upon the inferior
portion of rectum (in the male); upon the anterior wall of
vagina (in the female).

4. Collum (in the male surrounded by the prostate), lies over
the anterior part of perineum (the vagina in female), close
behind the lower border of symphysis.
3. Internal organs of generation.

a. Prostata surrounds the collum vesicæ and the commencement of the urethra, situated close before the vesicul. seminal. and vasa deferent., above the perinaem and the lower extremity of rectum; its anterior pointed extremity behind and below the lig. arcuatum.

b. Vesicule seminales are placed close together, behind and above the prostata, between rectum and fundus vesicæ, before and external to the ureters and vasa deferentia.

c. Vas deferens, passes on either side through the internal inguinal ring into the abdominal cavity, bends round art. epigastrica and over vasa cruralia backwards, inwards, and downwards, lying at first at the side, then on the fundus of the urinary bladder, before the ureter, and internal to the vesic. seminal. of its own side.

d. Vagina, between rectum and bladder, below the fundus vesicæ and urethra, in the axis of the lesser pelvis.

4. Rectum: it lies on the posterior wall of the pelvis from the promontorium down to the end of the coccyx; in women, behind uterus and vagina; in men, behind and below the prostate, bladder, vesiculae seminales, and vasa deferentia. Its most superior portion is covered in front, and laterally by the peritoneum.

5. Vessels:

a. Aorta abdominalis descends through hiatus aorticus into the abdomen, lies close to the anterior surface of the lumbar vertebrae (as far as the cartilage between the fourth and fifth), to the left of ven. cava infer., behind the cardia, caput pancreat., third portion of duodenum, radix mesenterii. Its branches:

1. Phrenicæ infer. and cæliaca, arise close under hiatus aorticus.
2. Lumbares I., mesenterica super., arise before the twelfth dorsal vertebra.
3. Supra renales, renales, spermaticæ intern. Lumbares II., before the second lumbar.
4. Lumbares III., arise before the third lumbar.
5. Mesenterica inferior, between third and fourth lumbar.
6. Lumbares IV., before the fourth lumbar.
7. Sacra media and i liace, between fourth and fifth lumbar.

b. Artt. iliace communes descend obliquely from the place of division of the aorta outwards and backwards behind the ureters, on the inner side of m. psoas, as far as symphys. sacro-iliaca. The left lies immediately before the vena iliaca sinistra on the outside, the right goes first over v. iliaca sinist., and then passes to the inner side of v. iliaca dextra. Their branches:
1. Hypogastrica [iliac intern.], lies close before symphys. sacro-iliaca, at the side of the posterior wall of the small pelvis.

2. Iliaca externa lies in the great pelvis, between vena iliacca (internally) and nerv. cruralis (externally,) before fasc. ilica and psoas, passing under the crural arch.

c. Vena cava inferior, arises rather below the division of the aorta, ascends on its right side, inclines rather to the right and forwards, and passes behind the pancreas, before the right crus of the diaphragm into the fossa pro ven. cava of the liver, between lobulus dexter and Spigelii; hence through foram. quadrilaterum into the thorax. Its branches:

Vv. iliacce communes, pass on the right side of the corresponding arteries; the left longer, behind the origin of art. iliaca dextra, before art. sacra media.

1. V. hypogastrica, lies behind its artery.

2. V. iliaca externa, on the inner side of the artery.

d. Vena azygos arises before the second and third lumbar vertebra (on the right) by the junction of branches of v. iliaca, renalis, and cava infer. with the lumbalis ascend., passes between the centre and external right crus diaphragm. (or through hiatus aortic.) into the thorax.

e. Vena hemiazygos, arises on the left, and takes a course like ven. azygos.

d. Ductus thoracicus, formed by two trunci lumbales and one lymphatic. intestinal., arises before the first and second lumbar vertebra to the right of and behind aorta abdominal., close to art. mesenter. super. (or renal. dextra), passes through hiatus aorticus into the thorax.

6. Nerves:

a. Plexus lumbalis; lies in and behind m. psoas, before m. quadrat. lumborum. Its continuation: nerv. cruralis lies in the groove between m. psoas and iliaca, under fasc. iliaca, at first behind; then on the outer side of art. iliaca.

b. Plexus sacralis s. ischiadicus lies behind art. hypogastrica, ischiadica, and pudenda, before n. pyriformis at the inferior extremity of incisura ischiadica major.

c. N. sympathetic. The lumbar portion lies on the sides of the bodies of the lumbar vertebrae, the gangl. lumbalia dextra behind aorta, the gangl. lumb. sinist. behind v. cava. The sacral portion—close before the os sacrum; the (four) gangl. sacralia at the inner edge of foramina sacral. anteriores. Gangl. coccygeum, the termination of n. sympathetic on the anterior surface of the sacrum.
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