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THE

ANATOMY

OF

THE HORSE,

EMBRACING THE

STRUCTURE OF THE FOOT.

BY

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> "Anatomy may be esteemed the very basis of medicine and surgery. Without a knowledge of anatomy, we feel ourselves incompetent to treat the most common surgical case. And in the majority of instances in which a member of our profession has disgraced himself, it may be traced to his ignorance of this foundation of his art."—*Carmichael's Lectures.*

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PREFACE.

AMONG the modern veterinary works published in our own country, that there should not be one exclusively devoted to the science of anatomy, will not appear altogether so surprising when we come to consider the opportunities of place and circumstance required to cultivate this study; the unwearied assiduity and labour incumbent upon any chance of success; and, after all, the probable unprofitableness of such a work in the book-mart: for (to echo the sentiments of Sir Charles Bell, our highly distinguished physiologist) *the public really do not comprehend the importance of anatomy as a science.*

In the composition of the present work (parts of which have already made their appearance in 'The Veterinarian,') the VETERINARY LECTURES, formerly published by the Author, have been freely drafted from: at the same time, the old matter has undergone much revision, correction, and emendation, and has been altogether fresh cast — has been, in fact, arranged in a *systematic* form: a plan, the Author is induced to hope, that may tend much to facilitate the progress of the student. On points obscured by any doubt or mystery, the Author has consulted the most eminent continental veterinary authorities; above all others, the work of M. Girard, Director of the Veterinary School at Paris. And in framing his nomenclature in accordance with that in use among human anatomists, the Author has availed himself of the products of the labours of his own countryman, the clever and indefatigable Stubbs. To Mr. Bean, also, who aided him in the dissection of the nerves; and likewise to Mr. Smith, for an account of the ear, the Author begs to kindly acknowledge his obligations.

That many, very many discoveries, and most important and valuable ones too, yet remain to be made through anatomical research, no one conversant in the science will pretend to gainsay; and that they, in the progress of time, will come to light, and redound amply to the credit of those who may elicit them, is no less the firm persuasion than the fervent hope of the Author of the work herewith offered to the profession.

Regent's Park Barracks;
October, 1832.

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INTRODUCTION.

In all ages have medical philosophers regarded a knowledge of anatomy as requisite to the attainment of the science of medicine; but in no age, we may venture to assert, has the truth of this opinion shone upon the mind with brighter light than at the present time. In this, our own day, we may look around and seem to trace the success of each one eminent in the healing art to his anatomical acquirements: at least we may safely affirm, that not one of our present medical *distingués* could have gained the same ground without a knowledge of anatomy; and he would appear to have reached the highest station who has had the wisdom and foresight to make that science the foundation of his other professional pursuits.

However much lack of knowledge and respectability on the part of its practitioners may have disparaged it, the Veterinary Art itself must claim kindred with human medicine, anatomy and physiology being their common parents. Both sciences spring from the same source, and must be attained by a like course of study. The surgeon has lived to the day to be convinced, that no so sure road to reputation and distinction lies open to him as the broad and accessible one through the dissecting-room; and the day *will* come (should it have not yet arrived) when the Veterinary Surgeon will discover that the same path is the only one which even he can rationally pursue. The age of grooms and farriers is on the decline; and the day fast approaching, when science must and will assert the same sway over the veterinary profession as she so triumphantly exercises at the present day over the medical world at large.

After this encomium on anatomy, it comes very natural to inquire what we learn or profit by the science. A short and pithy answer (though it might be deemed an unsatisfactory one) may be given to this question, by repeating, that no really useful medical learning can be acquired without it. A professor of medicine with a mind unfurnished with anatomy and physiology, is precisely in the situation of a mechanic who undertakes to repair a deranged or broken machine without any acquaintance whatever with its mechanism or operations: both such persons are empirics, and worse than empirics—impostors in their professions: either of them *perchance* may do good; but there is ever much to be apprehended that they may be working some irreparable mischief. We hear of "wonderful cures" being performed by persons having no pretensions whatever—indeed possessing none—to medical science; and in this hit-or-miss manner of proceeding, it cannot be denied that some valuable discoveries have been made: could we, however, but set against these discoveries, brilliant as some of them may have turned out to be, a true catalogue of the failures attendant upon the experiments in which they had their origin, we are sorely afraid the picture would exhibit a complexion which even the discoverers themselves could not regard without mingled dissatisfaction and remorse.

Plain and obvious as this necessity for fundamental knowledge must appear to every reflecting mind, yet there are gentlemen—men of education—enough to be found who commit their horses, in disease as in health, entirely to the care of their *grooms!* or, who call to their aid the blacksmith or bell-hanger, rather than put faith in a man who is, or ought to be, even under every disadvantage, alone qualified to comprehend the nature and cause of disease. It was once so with human medicine: science has, however dispelled the gloom in that quarter; and will as certainly, in the progress of time, in like manner enlighten our own clouded and sunless regions.

Want of education among its members, literary as well as medical, has done more real injury to the cause of veterinary science than any one individual agent besides. Superiority in knowledge is the only effective weapon we possess, with which we are able successfully to combat our opponents: without that, we may exhibit the shadow, but hold not the substance of pre-eminence over those who have for ages had possession of the practice of that art, of which we come before the public, not merely as practical but as scientific professors.

By learning anatomy, we become acquainted with the situation, form, connection, and structure of every part of the body. Its action or use is taught us by the science of physiology. From which we proceed to the third natural link in the chain of fundamental medical knowledge,—pathology, or the doctrine of disease. Anatomy prepares the mind for, while it excites it to, the study of physiology; a science no less admired for the sublimity of its dogmas, than ardently pursued for its fruitful and valuable products. To conclude, let us once more repeat, that anatomy forms the groundwork of physiology; and that he who possesses a knowledge of both sciences combined, holds in his hand the key to all rational practice, as well in medicine as in surgery, be it human or be it veterinary.

The science of anatomy admits of division into *general*, and *particular* or *descriptive* anatomy.

General Anatomy treats of the several elementary parts or simple tissues into which the organs or complicated parts of the body are resolvable: developing their different properties—mechanical, chemical, and vital; and at the same time exposing their various modes of association, by which is constituted *organization;* the phrase "organization" being used by anatomists to imply perfection or adaptation of structure to its end, design, or function.

Particular or Descriptive Anatomy views parts and organs, entire—as we find them: taking cognizance of the *form* and *structure* of each; and noting its *relations*, such as situation, direction, position, dimensions, connection, &c. In fact, it is the object of the work before us.

Anatomy may also be said to be *particular* when its inquiries become confined to any one individual species of animals; in which sense many subdivisions may be made of it, though they all become conveniently reduced to three, viz., *human, veterinary*, and *comparative anatomy.*

HUMAN ANATOMY restricts its investigations to the human species.

VETERINARY ANATOMY, though perhaps strictly applicable (in accordance with its derivation) to beasts of *burthen*, is, at the present day, understood to comprehend all *domesticated* animals; or, at least, such of them as come more immediately into our domestic service.

COMPARATIVE ANATOMY extends its view over the whole animal creation, but derives its name from a reciprocal *comparison* of them, or from a comparison of them individually with man as a standard; and acquires importance from the mutual illustrations it affords in structure and function.

The study of anatomy, more, perhaps, than that of most other sciences, will be found to be facilitated by systematic arrangement; and the nearer approach this makes to the end we have in view in such study (which is, primarily, physiology), the greater seem to turn out the advantages therefrom resulting. For this reason, in the work before us, a *physiological* systematization has been preferred; by which, parts and organs co-operating to one common end or purpose, will be found classed together in the same system. Co-operation in function, however, so far from indicating identity of structure, is in many instances effected by organs of structures the most dissimilar; while, on the other hand, similarity of texture pervades many parts belonging to different physiological systems: two facts that may be adduced as forming some objection to the classification here adopted. But, we conceive, they are both overruled by the insight which the present plan gives us into physiology; the object, let it never be forgotten, we have in view in prosecuting anatomy. The following table exhibits the

PLAN OF THE WORK.

SECTION.	SYSTEM.		CONTAINED PARTS.
I.	Osseous		Bones; Ligaments; Joints.
II.	Muscular		Muscles; Tendons; Bursæ Mucosæ.
III.	Circulatory		Blood; Blood-vessels; Heart.
IV.	Respiratory		Larynx; Trachea; Lungs.
V.	Digestive		Mouth; Tongue; Salivary Glands; Pharynx; Œsophagus; Stomach; Intestines; Liver; Spleen; Pancreas.
VI.	Absorbent		Absorbents; Absorbent Glands.
VII.	Urinary		Kidneys; Renal Capsules; Ureters; Bladder.
VIII.	Generative	Male	Testicles; Vasa Deferentia; Vesiculæ Seminales; Penis.
		Female	Vulva; Clitoris; Meatus Urinarius. Vagina; Uterus; Fallopian Tubes; Fimbriæ; Ovaries.
IX.	Nervous		Brain; Spinal Marrow; Nerves; Ganglia.
X.	Sensitive		Nose; Eye; Ear.
XI.	Tegumental		Skin; Hair; Cellular Membrane; Fat.
XII.	Plantar		Feet.

Conformably to this plan, the BONES come first under consideration; they it is that, being of a nature, hard, firm, and inflexible in themselves, form the framework of the animal structure;—that constitute the walls of defence and pillars of support to the other parts of the body. *The skeleton presents a beautiful illustration of this; it exhibits almost a perfect* outline of the living animal:

"How changed! and yet how like!"

It forms altogether an inimitable piece of mechanism, serving the united purposes of protection, support, and locomotion. The cranium affords an asylum for the delicate organs of sensation; the thorax, a place of security for the vitally important ones of respiration; while the four legs, after the manner of the four columns of a building, support the body, resting upon the feet as their pedestals. Form and strength are likewise fundamentally derived from the osseous fabric. The dimensions and proportions of parts must necessarily be regulated by the bony frame, and their powers also must be greatly dependent upon the nature of this foundation: a fact that has not escaped the observation even of those but little acquainted with the science of anatomy, as we may gather from the trite remark, that such a horse possesses "plenty of bone."

Superadded to all this, the bones are the agents, though but *passive* ones, of locomotion; the *active* or moving powers being the next order of parts—the muscles. And when we come to examine into the different forms and proportionate magnitude of the bones; the curious and admirable methods by which they are fitted and adapted to each other; and the singular advantages they, in their relative situations and positions, present to the moving powers, the muscles; we cannot fail to be struck less with the beauty of the structure of the skeleton, than persuaded of what paramount importance a knowledge of it must be to him who is setting out in the study of anatomy.

Compared with other living substances, bone possesses so little animal or vital material in its composition, that hardly any difference is perceptible in its aspect either in life or death: altogether, it is found to bear considerable analogy to inorganized matter; not undergoing that rapid spontaneous decomposition, after the departure of life, to which other parts of the body are subject, but enduring for ages without losing even its original shape.

During the earlier periods of fœtal existence, we find no bone whatever in the body—nothing but pieces of gristle or *cartilage*, assuming the forms of the bones into which they become at various periods afterwards converted: cartilage being a firm, solid, flexible substance, intermediate in its degree of hardness between bone and flesh, and serving many useful purposes in the animal economy, for which bone would be too stiff, unyielding, and brittle, and other material too soft and unsubstantial. For this reason it is employed in the temporary place of bone, in the fœtus; and for the same reason, in some parts—in the ears, nose, windpipe, &c.—is continued as a substitute for it during life.

No less than two hundred and thirty-eight bones are found to be required to complete the fabric of the skeleton; which (in order for them to admit of elasticity and motion) are linked and joined one to another by curious, highly ingenious methods of connection, that come, indiscriminately, under the general denomination of *joints.* Such, however, is the variety observable among the joints, that anatomists have found it necessary to make some sort of classification of them. The most natural and convenient one seems to be that which arranges them in three classes: *First,* into *membranous joints,* formed for elasticity only, such as those of the cranium and face. *Secondly,* into *cartilago-ligamentous joints,* designed both for elasticity and motion; such as the connection existing between the splint and cannon bones; between the bones of the pelvis; and between the vertebræ of the spine, and the ribs and the breast-bone. *Lastly,* into *capsular joints,* the most perfect but the most complicated description of articulation, and the one intended solely for the purpose of motion, simple or compound, according as the necessities of the parts themselves may require. In the construction of this kind of joint we find, first, the ends of the bones forming it to be nicely shaped and fitted to each other; secondly, the adjusted extremities of the bones to be covered with cartilage, to render them smooth and polished like ivory; thirdly, a capsule of a membranous nature attached around and investing these cartilaginous ends; fourthly, lateral and other ligamentous chords, running from one bone to the other, to strengthen the connection; fifthly, a fluid resembling the white of egg, exuded from the internal surface of the capsule, for the purpose of lubricating the cartilaginous ends, and preserving them from friction. Although such is the general composition of this third kind of joint, we find it varied in every particular instance to suit the intentions of nature: exciting our admiration no less for its inimitable beauty or construction than for its wonderful power and effect.

Ending our account of the passive mechanism of locomotion, we come to consider the active powers or means by which the machine is set in motion. Little, perhaps, would that person imagine, who contemplated simply the dead body, that *muscle* or flesh possessed such capability; much less would he suppose its power to be of that wonderful nature which experience has taught us that it is. Even the anatomist himself discovers nothing in the structure of a muscle to account for such properties; but is compelled, after the most tedious and elaborate research, to ascribe them to something he cannot explain, dependent upon the presence and exercise of the vital energy. Only by calling in this mysterious power to his aid, can he pretend to offer any reason why a piece of flesh that would of itself be torn asunder by the weight of a few ounces, should, in a living state, be capable of lifting and sustaining a hundred or more pounds!

A muscle, anatomically examined, is found to consist simply of a congeries of longitudinal fibres, disposed in packets or bundles, severally encased in cellular membrane, and by the same material connected altogether into one solid body. These fibres have, superficially viewed, the appearance of being single and indivisible: through microscopic aid, however, we learn, that not only are the packets made up of bundles of fibres of smaller and finer mould, but that even their component fibres are themselves packets of similar composition; in which way we become continually foiled and disappointed in our researches after the ultimate or original fibre, whereunto no investigator has hitherto arrived.

Though muscles ordinarily are red, colour is not essential to them: it is entirely dependent on the blood contained in their vessels, some being naturally white or colourless, like what we find them in almost all fish, and many birds. In general, muscles possess bulk correspondent to their power, and are so shaped and positioned as to have full effect in regard to the function they have to perform; while in their situations they confer upon the body beauty of outline, combined with exquisite symmetry of form. In number we compute them at about three hundred and twelve. And when we come to reflect that most of them are susceptible of varied action, and to calculate to what extent these actions may be multiplied by different combinations, we shall not feel so much surprise at the endless multiplicity and diversity manifested in the motions of the body. From what has been said, therefore, it appears that the muscles are the active or essential agents of locomotion; the bones, the passive part of the apparatus: the two chief ends of locomotion being, to enable the animal to obtain food, and avoid such objects as may seem anywise offensive or detrimental to him.

With few exceptions, muscles are distributed over the body in *pairs*, or fellows, there being an equal number of correspondent magnitude and power ranged on either side. And their positions and attachments are such as to enable them to act as antagonists one to another, either direct or indirect, singly or in combination: the grand secret furnishing us with the explanation of the vast variety of motion, internal as well as external, of which the body is capable.

The generality of muscles are furnished with what are called *tendons* or sinews; which being composed of a material mechanically stronger than the flesh itself, but much less bulky, serve the useful purpose of connecting the muscles to the part to be moved, without at the same time proving an incumbrance from their volume. In texture they are dense, tough, and fibrous; and in aspect have a glistening blueish-white hue, forming a beautiful contrast with the florid red of the fleshy portion of the muscle.

There is yet another part belonging to the muscular apparatus; one that answers the same purpose that the synovia or joint-oil does in the interior of a joint: in the same manner as that serves to prevent friction between bones, the *bursæ mucosæ*, which likewise contain synovia, obviate similar inconvenience arising between tendons, or between tendons and bones.

From the organs of support and locomotion, we proceed to those concerned in the circulation of the blood over the animal machine. These consist of the *heart*, the *arteries*, and the *veins*. The heart in its situation in the middle of the cavity of the thorax, operates after the manner of a forcing pump, throwing blood into the trunks of the arteries, through whose manifold ramifications it is conducted over every part of the body, to be afterwards conveyed back again by the veins. In this manner are executed the important functions of *nutrition*, *growth*, and *secretion*. Blood is to the animal what sap is to the vegetable: it nourishes the body; supplies new materials for its growth and repair; and, at the same time, becomes the vehicle for the removal of the old and worn-out matters; besides furnishing the various secretions, such as bile, urine, semen, perspiration, &c., which, by a process alike wonderful and mysterious, are elaborated in organs constructed especially for the purpose, through the extreme ramifications of the arterial system. Above all, blood is the medium through which the spirit of life itself is eliminated and diffused over the body: every part owing its vitality and susceptibility of action to a continual fresh supply of this fluid.

These important purposes served by the blood, necessarily tending to a consumption as well of its material quantity as of its vital principle, it became necessary that means should be provided in the animal economy for the replenishment of both these losses. Accordingly, we find one system of parts formed for the supply of fresh blood; another for the purpose of the vivification of the fluid. This latter function is performed by the RESPIRATORY SYSTEM. The lungs, constituting that system, are two bulky bodies, in structure bearing much resemblance to a honeycomb, through whose cells a large proportion of the blood is conducted by the pulmonary vessels at every round of the circulation, in order that it may be exposed to atmospheric air, and from its influence derive those vital properties that render it fit for the support of heat and life in every part through which it has subsequently to circulate; experience proving to us, that deprivation of blood to a part is followed first by the loss of heat, and ultimately of its vitality. In what this extraordinary influence of the air upon the blood consists, we are only vaguely informed: in truth, we know but very little more for certain concerning it than the palpable change of colour the blood undergoes, from a very dark to a birght scarlet red.

To make up for the expenditure in the quantity of blood, we find a number of organs provided, comprehended under the head of the DIGESTIVE SYSTEM; the ultimate object of whose combined operation is, the transmutation of the food into a fluid fit for becoming blood. The organs concerned in the process of digestion are—the *mouth*, in which the food is broken down and masticated by the teeth, and at the same time mixed with saliva; the *pharynx*, which receives the food from the mouth, and by the act of deglutition transmits it to the *œsophagus*, the tube that conducts it into the *stomach*. Within the stomach, the food becomes converted into a uniform homogeneous mass, termed *chyme*; and thus becomes prepared for its further passage into the *intestines*, in which, from the admixture of *bile* coming from the liver, and *pancreatic juice* from the pancreas, a further change takes place in the alimentary mass, attended by a spontaneous separation of it into such parts as are veritably nutritious, and such as are excrementitious, or only fit for being ejected out of the body. The nutritious particles assume the appearance of a milky juice, to which anatomists have given the name of *chyle*; and the process by which it is produced is denominated *chylification*.

This brings us to the consideration of the ABSORBENT SYSTEM: the absorbent vessels being the conductors of the chyle from the cavity of the intestines into the veins, in which it becomes mingled with the general mass of blood. Independently of this, however, the absorbents are employed in removing old, decayed, or worn-out parts of the body, at the time that the arteries are restoring the loss by the deposition of new material; so that, in point of fact, the body is undergoing a continual repair, or rather renovation, and thus is maintained in perpetual vigour and aptitude for action.

The old worn-out material, together with other matters conveyed into the circulation, having now become useless and excrementitious, we find a channel for their expulsion in the URINARY SYSTEM. This includes the kidneys and the bladder; the former being organs of secretion—by which is meant, organs having the power, by an action peculiar to themselves, of separating a substance or fluid from the blood altogether different from the blood itself, and which either answers some important purpose in the animal economy, or becomes the medium for the ejection of useless or excrementitious matters; the latter, simply a reservoir for the urine, containing it until convenience may suit for its discharge.

In order for the animal machine, thus constituted, to be set in action, the NERVOUS SYSTEM becomes necessary; that system which is the source of all sensation, as well as of all motion, and by which the animal is signally elevated beyond the vegetable creation. Sir Charles Bell, who has thrown such splendid new light upon this department of anatomy, arranges the nervous system in four classes: First, comprising nerves of sensation; second, nerves of voluntary motion; third, nerves of respiratory motion; fourth, nerves of the sympathetic system, by which are regulated the functions of nutrition, growth, and decay, and whatever is directly necessary to animal existence. The simplest form of nervous system is found to consist in a central ganglion, with a single nerve attached to it; and is exhibited in animals whose organs of motion are found to be imperfect. But should the creature possess organs of progression, and be endowed with organs of sense in addition, then nerves and ganglia are superadded, and a sensorium or brain is formed, which becomes at once the seat and source of all motion and sensation, the throne of reason, and grand focus of every intellectual faculty. In this manner—

> "Nature, in her productions slow, aspires
> By just degrees to reach perfection's height."

Intimately in structure connected with, and in function entirely dependent upon, the nervous system, is the SENSITIVE SYSTEM; comprehending the *nose*, the *eye*, and the *ear*. Were it not for the nerves interpassing between these organs and the brain, we could neither smell, nor see, nor hear; and in proportion as these senses in different animals are acute, so we find the nervous structures of their individual organs to be more or less developed. The nerves belonging to the sensitive organs are not included in the foregoing classes: possessing the peculiar faculties of taking cognizance of odour, light, and sound, they differ as much from the nerves of common sensation as Sir Charles Bell has demonstrated the latter to do from those of motion.

Exclusively of the nervous influence, the anatomical mechanism of the several organs included in the sensitive system, is no less wonderfully than admirably adapted to those ends which, in each of them, it is designed to answer; and rises far more beyond all human art and contrivance than it is possible for the mind of man to conceive. That the hound should be able, with fatal fidelity to his prey, to pursue the evanescent odour of footsteps, is owing to a faculty possessed by the nose; but one equally inexplicable to us, with the extraordinary telescopic and microscopic powers possessed by the eye, or the finer and more delicate sense inhabiting the ear.

The term of life of every animal being limited to a more or less distant period, according to its kind, it became necessary, in order to guard against annihilation, to make provision for the procreation of the species. In the higher classes of animals, generation is effected by concurrence of the sexes, the organs for the purpose being different in them respectively, though reciprocally adapted to the same end; but in some animals of a lower grade, the sexes are found combined in the same individual, and generation takes place without any copulative act whatever. In the animals by which we are surrounded in common life, we find a male and female sex; and these are distinguished, in an anatomical point of view, by the possession of organs of a totally different character. In the male we have the *testicles*, which secrete the peculiar fluid from the blood, known by the name of *semen*; and the *penis*, an organ formed for the conveyance and transmission of the semen into the womb of the female; besides seminal ducts and reservoirs to contain the fluid until it is wanted. In the female we find a *vagina* or canal leading into the *uterus* or womb; attached to the horns of which by two serpentine *tubes*, called the *Fallopian*, are two oval bodies, smaller than the testicles in the male, named the *ovaries*, or female testicles, in which it is now ascertained the germ or first rudiments of the forthcoming fœtus are generated. The organs of the female are set in action by the stimulus of excitation they receive from the seminal fluid of the male; and the result of a long, tedious, and myterious process is, a fœtus—a prototype of its parents.

Covering all and clothing all, we have the skin with its coat of hair; which two parts, along with the cellular membrane and fat, we have ranged in a SYSTEM we have denominated the TEGUMENTAL. The cellular membrane itself may be regarded in the light of an *internal* covering to the body; for it clothes or lines the inner surface of the skin, being the medium of connection between the common integuments and the parts subjacent. The fat likewise is much intermingled with the cellular membrane, and answers the purpose of a covering; as well as that of filling up vacuities and interstices, and giving a degree of rotundity and beauty to the form which the animal would much lack without it.

Lastly, comes under our notice the SYSTEM to which we have prefixed the epithet of PLANTAR; meaning thereby to denote, that it embraces the four feet—the pedestals upon which repose and move the four limbs or columns of support. Though plain and unobtrusive in their outward aspect, the feet will be found to exhibit an internal mechanism worthy of the study and meditation of a medical philosopher of the highest pretensions: indeed, we are hardly going beyond our warranty in asserting, that in no part of any animal shall we find a structure exhibiting more beauty of design than is displayed in the anatomy of the horse's foot. In addition to this consideration, however, we, as veterinarians, are enjoined, by an imperative duty consequent upon its importance in a pathological point of view, to examine this part with more than ordinary solicitude; thereby, not only that we may obtain a more correct insight into the nature of its diseases, but be enabled to exercise a scientific control over the mechanical operations of the farrier.

THE
ANATOMY OF THE HORSE.

SECTION I.

OSSEOUS SYSTEM.

OF THE SKELETON.

THE SKELETON is the simple, jointed, bony frame, divested of the soft parts and dried. There are two kinds—

1. *The natural skeleton* is that in which the bones remain attached to each other by their natural connections, denominated *ligaments.*

2. *The artificial skeleton* is made by separating the bones from all their connections, by macerating or boiling, and afterwards joining them again in their natural order and relative position, by wire or other means, so as to imitate as nearly as possible the natural one; over which it possesses the advantages of cleanliness, distinctiveness, and more or less artificial mobility of the joints.

Construction. Leaving the head and neck out of consideration, the entire frame will be found to come with sufficient proximity within the limits of a square, formed by drawing perpendiculars, touching the extreme parts before and behind, from a horizontal line level with the surface of the ground, to another parallel to it touching the summits of the back. A line extended perpendicularly through the middle of this square, divides the frame into two nearly equal parts, and falls upon the ground (represented by the inferior horizontal line) equidistant from the four points of tread; a line drawn in the horizontal direction through its middle, includes the trunk within the upper division of the square, the space formed by the limbs, as well as the limbs themselves, within the lower section. The limbs represent four columns supporting the body, the bones composing which, though many of them are obliquely placed, are found, on taking the aggregate of their directions, to maintain their bearing in lines parallel to the common centre of gravity, which may be said to be represented by the perpendicular line extended through the middle of the square: the angular position of these bones renders their motions more extensive and facile, at the same time that they, so placed, present convenient and powerful levers for the operation of the muscles. Furthermore, the bones forming the limbs are, superiorly, lengthy and few in number; whereas, below the fetlock, they are small, and consist of several pieces: the rationale of which is, that the long bones are well adapted for extent of motion; the short ones, for resistance and multiplicity of movements. The head and neck operate as a burden, in addition to half of the trunk, upon the fore limbs; although the hind limbs appear the greatest and most capable of resistance: this apparent incongruity is removed when we come to learn that the latter constitute the powerful engines of progression.

Of the multiplicity and variety of pieces or distinct bones of which the skeleton is composed, most are found to be double, or to exist in pairs; such are the ribs, most of the bones of the head, and all those of the limbs: there are, however, several single bones; and these may be regarded as the key-stones of the fabric, being in reality the media through which the two lateral halves of the skeleton (composed of the bones in pairs) are united together into one entire structure. In this arrangement, the symmetry of the whole is preserved most completely, even as completely as if every bone had had a fellow; since both sides or longitudinal halves of the single bones exactly correspond.

The bones so far influence and determine the form of the soft parts that in very many (perhaps the majority of) instances, the animal is recognised in the appearance of the skeleton; in other examples, however, this is not so remarkable; in all the resemblance can be traced only in certain parts. In general, the head, chest, and legs—below the knees and hocks present striking outlines of the same parts in the living animal; whereas, the neck, loins, arms, and haunches, have few or no points of similitude.

Division. THE SKELETON is composed of 238 bones, and is divided into *trunk, head,* and *extremities.*

THE TRUNK is subdivided into *spine, thorax,* and *pelvis.*

THE HEAD comprises the *cranium* and the *face.*

THE EXTREMITIES are four in number: two *fore* and two *hind.*

TABULAR ENUMERATION OF THE BONES.

TRUNK.

SPINE.	
Cervical Vertebræ	7
Dorsal Vertebræ	18
Lumbar Vertebræ	5
Total	30

THORAX.	
Sternum	1
Ribs, 18 on each side	36
Total	37

PELVIS.	
Ossa Innominata	2
Sacrum	1
Coccygeal Bones, varying from 13 to 18	15
Total	18

HEAD.

CRANIUM.		
	Frontal Bone	1
	Parietal Bones—*pair*	2
	Occipital Bone	1
	Temporal Bones—*two pairs*	4
	Ethmoidal Bone	1
	Sphenoidal Bone	1
		10
Bones of the Ear.	Malleus Incus Stapes Obiculare	4
Total		14

FACE.			
Upper Jaw.	Nasal Bones Superior Maxillary Bones Inferior Maxillary Bones Malar Bones Lachrymal Bones Palatine Bones Superior Turbinated Bones Inferior Turbinated Bones	Pairs.	16
	Vomer—*single*		1
	Lower Jaw		1
			18
	Teeth		40
	Os Hyoides		1
	Total		59

EXTREMITIES.

FORE.		
Scapula Humerus	*Shoulder Bones*	2
Radius Ulna	*Arm Bones.*	2
Bones of the Knee. 1st. Row: Scaphoid, Lunar, Cuneiform, Trapezeum; 2d Row: Pisiform, Trapezoid, Os Magnum, Unciform		8
Large Metacarpal Bone 2 Small Metacarpal Bones	Leg Bones.	3
Sesamoid Bones—*Fetlock*		2
Pastern Bone		1
Coronet Bone		1
Coffin Navicular	*Foot Bones*	2
Total		21

HIND.		
Femur—*Haunch Bone*		1
Patella—*Stifle Bone*		1
Tibia Fibula	*Thigh Bones*	2
Astragalus Os Calcis Cuboid Bone 3 Cuneiform Bones	*Hock Bones*	6
The bones below the hock correspond in name and number to those below the knee, *viz.*		9
Total		19

CERTAIN TERMS used in descriptive anatomy may require some explanation.

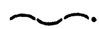
The anatomist views the body in the erect position; the limbs preserving, in the direction of the tendency of the weight, perpendicular lines in respect to the trunk, and parallel lines in regard to the correspondent fore and hind feet, and also in the transverse direction, in relation to one foot to its fellow; the head and neck maintaining their natural degrees of elevation and curvature; the tail erect. In this position the anatomist assumes, to aid him in his descriptions, that an imaginary plane extends through the body, bisecting it into lateral halves; this is continued through the neck and head, and descends between the legs. The correlative terms, *superior* and *inferior, anterior* and *posterior,* require no elucidation, unless it be in regard to the head and neck: the line bounding the superior regions is considered to extend from the tip of the coccyx over the occiput to the upper lip; that forming the inferior boundary, from the lower lip, along the under jaw, down the neck, and along the belly, with some interruption in the croup, to the extremity of the tail. The adoption of the compounds of these terms, leads to still further accuracy in description: such are *antero-superior, antero-inferior, supero-anterior, infero-anterior,* &c. Antero-superior denotes the anterior compartment of the superior region; *supero-anterior,* the superior compartment of the anterior region; and so on. *Inner* and *outer* express relation to the bisecting plane, running through the middle, *median* or *mesian,* region: but the componnds *mesio-superior, mesio-posterior,* &c., have no reference whatever to the middle regions: they simply imply the middle compartments of the superior and posterior regions. According to this arrangement, every distinct part, the head, neck, shoulder, quarter, arm, thigh, &c., is divided, by imaginary lines, into five regions:—superior, inferior, anterior, posterior, and middle; each of which is subdivisible into three minor compartments: *e. g.,* the superior region is distinguishable, if required, into antero-superior, mesio-superior, and postero-superior; the anterior into supero-anterior, mesio-anterior, and infero-anterior; and so with the others. Without this explanation the anatomical detail, to follow, might prove perplexing or even unintelligible: by such preparation, the labour of the anatomist is abridged and facilitated; the progress of the student smoothed and accelerated.

OF THE TRUNK.

The trunk *comprehends the vertebral chain, the thorax, and* the pelvis.

I.—THE VERTEBRAL CHAIN.

Also called the spine, vulgarly the back-bone, reaches from the occiput to the sacrum, constituting the bony structure of the neck, back, and loins, and consists of thirty separate pieces, denominated *vertebræ,* which are classed, in accordance with the part they enter into the formation of, into cervical, dorsal, and lumbar.

Configuration. It bears altogether a resemblance to an S, providing the letter be reversed, turned in the horizontal direction, and an additional curve given to it; thus, . Proceeding from the vertex with more or less crest-like curve, it sinks into a bend in the opposite direction at the posterior part of the neck; from this, in the back, it at first gradually rises, but shortly afterwards pursues the horizontal line, or even dips a little: in the loins, however, it rises very perceptibly, forming an arch of considerable extent, which, posteriorly, is completed by the declivity of the coccyx.

OF THE VERTEBRÆ IN GENERAL.

Conformation. The vertebræ bear a common resemblance, one to another, manifested by the following general characters. Every vertebra is in form symmetrical, and presents middle and lateral divisions. 1st. The middle consists of the body, a cylindrical solid part, having a convex surface anteriorly, a concave one posteriorly, and both roughened by the implantation of the intervertebral substances; the arch, extended transversely from the sides over the body, so as to include its superior surface; and this surmounted by the spinous process; lastly, the vertebral, spinal, or medullary hole. 2d. The sides present two transverse processes, jutting outward; four articulatory processes, two anterior and two posterior, having smooth surfaces for articulation with those of the vertebræ next to them; four notches, the excavations between the arch and the body, constituting, by apposition, with others in the contiguous vertebræ, the holes of conjugation.

CERVICAL VERTEBRÆ.

Larger than the others, and differ more remarkably in their individual conformation.—In *number,* seven; and named according to their numerical order, beginning from the head: the first, however, has got the designation of atlas, and the second, of axis or vertebra dentata.—In *figure*, quadrangular. Body, oblong; anterior surface of it, smooth, convex, heart-shaped, apex turned downwards; posterior surface, correspondently concave. The vertebral hole is larger than in the other classes, and semi-oval in figure. Two spinous processes; the crest or superior one is bifid, cleft and divergent posteriorly, united at a sharp angle anteriorly; the inferior (the additional) spinous process is curved like an S reversed and inclined ∽; being convex and prominent posteriorly, sharp-edged and curved upwards anteriorly. The transverse processes are very broad, but short, arise from the body as well as the arch, are bifid, presenting four projecting ends, two forwards, two backwards, and are each perforated by a foramen; which transmits the vertebral artery and vein. The articular processes are large, directed horizontally forwards and backwards, and present broad surfaces for articulation; those on the anterior looking upwards and inwards, those of the posterior downwards and outwards. The notches are found between the articular processes and the body.

DORSAL VERTEBRÆ.

Volume, less than that of either of the other classes.—*Number*, eighteen; (in some instances nineteen;) distinguished by their numerical order, counting from the neck backwards. Body small, short, thick, and semi-circular; flattened superiorly, prominent and edged inferiorly; anteriorly, smooth, convex, and heart-shaped; posteriorly, correspondently concave. At the junction of the arch with the body are situated four small cup-shaped articular surfaces, two presented forwards, two backwards, which in conjunction with those next to them form sockets for the reception of the heads of the ribs. The vertebral foramen is of less diameter than in the neck, and is oval from side to side. Spinous process long and flattened on its sides; thick and triangular or prismatic at its root: presenting a sharpened edge forwards, a flat or obtuse border backwards; thick, irregular, and tuberous at its summit. Transverse processes, short and thick, incurvated upwards, and tuberous at their extremities; their sides presenting circular articulatory surfaces for the tubercles of the ribs. Articular processes, very short and proceeding from the roof of the arch: the anterior, face upwards; the posterior, downwards and backwards. There are only two notches, and these are smaller than those of the cervical; they are situated between the posterior articulatory processes and the costal surfaces upon the body.

LUMBAR VERTEBRÆ.

Volume, between that of the cervical and dorsal.—*Number,* in some subjects five, in others six. Body, short and thick: flattened superiorly, prominent inferiorly; and bearing much resemblance to that of a dorsal, only that it is something larger, is oval from side to side, and thicker anteriorly than posteriorly: its articulatory convexity in front and concavity behind assume also rather an oval than a heart shape. The vertebral hole is semi-circular, and of larger diameter than in the dorsal vertebræ. The spinous process is shorter than most of the dorsal; has broad flat sides; protuberates at the front of its summit; and stands erect with a very slight inclination forwards. The transverse processes stand out horizontally, at right angles from the body, slightly inclined in the form of arches: are long and broad; flattened above and below; and gibbous at their extremities. The articulatory processes, though small when compared with the cervical, are larger than the dorsal; they project from the roof of the arch in the horizontal direction; the anterior, protuberate at their extremities, are wide apart, and present concavities inwards; the posterior, are nearer together, and present convexities outwards. The notches are similar to those in the dorsal vertebræ.

PECULIARITIES OF THE VERTEBRÆ.

Of the cervical, four vertebræ are distinguished by peculiar characters.

The First Vertebra, inappropriately named the *atlas,* (for the head is suspended from it instead of being supported by it,) is defective in the essential vertebral properties; being simply an irregular ring with broad projecting sides. It has no body; the place being in part supplied, in the articulated spine, by the odontoid process of the second vertebra, for the reception of which, the infero-posterior part of the ring is made smooth and articulatory; this sometimes reduces the dimensions of the vertebral hole, though it remains even then the most capacious of any, and measures more from side to side than contrariwise: its inferior surface is deeply impressed by the odontoid ligaments. It has no superior spinous process, but there is a prominence in the situation of it; and the inferior spine is shorter, thicker, and more obtuse than the others. The transverse processes are broad, undivided, lateral plates, sloping downwards, perforated by three pairs of foramina: one posteriorly to their middles, through which run the vertebral arteries; two through their anterior parts, one of which is directed outwards and downwards, the other runs inward and opens into the vertebral canal: the latter give exit to the sub-occipital nerves. The anterior articular processes are represented by four horizontal projections, with semicircular borders, whose internal surfaces are smooth, look towards each other, and together form two lateral concavities for the reception of the condyles of the occipital bone. The posterior articular processes are formed into broad, triangular, convex, smooth surfaces, looking backwards, with an inclination inwards.

The Second Vertebra, or *axis*, also denominated the *dentata* (from a peculiar projection anteriorly, which in the human subject is resembled to a tooth) is the largest of the cervical class, exceeding the others, however, more in length than in breadth. The body is elongated, and (in place of a hemispherical termination) anteriorly, presents the remarkable process named the odontoid, which is smooth and convex below, where it articulates with the infero-posterior part of the ring of the atlas; excavated and impressed above by the odontoid ligaments. The spinous process is very broad, and forms an elevated crest, bifid posteriorly. In front of the body are two oval foramina, corresponding to the holes of conjugation. The transverse processes are slender, and have only posterior extremities; the holes through them are also small. The anterior articular processes are represented by two broad ovoid smooth surfaces; united with the sides of the odontoid projection; and sloped off backwards, both above and below, to admit of free motion between them and the posterior articular surfaces of the atlas.

The Third, Fourth, and Fifth possess the genuine characters of cervical vertebræ, and closely resemble one another; the third, however, has commonly a more elevated superior spine than either of the others, and is narrower across the mesio-superior part of the body, measuring from the roots of the articular processes: which dimension increases in the fourth, but is greatest in the fifth.

The Sixth has no inferior spine; and its transverse processes are trifid, consisting each of three eminences.

The Seventh Cervical Vertebra is the shortest, and in its general conformation partakes of the character of the first dorsal. Its body posteriorly presents two semilunar articular hollows for the formation of the sockets for the ribs. The superior spine is elevated and sharp. The transverse processes are short, obtuse, snd not perforated.

Of the dorsal vertebræ, the distinctions are less numerous and striking.

The First Dorsal Vertebra has a cervico-dorsal conformation, manifested in the form of the body, the length and sharpness of the spinous process, the protuberance and singleness of the transverse processes, the breadth and direction of the articular processes.

The Second Dorsal Vertebra differs from the others in the curvation of its spine backwards, against that of the third; and in the breadth and direction of its anterior articular processes.

The other dorsal vertebræ are distinguishable principally from the comparative form and length of their spines. The first spine is short compared to the second, and terminates in a sharp apex; the second has a broader extremity, and in some instances is bifid; the succeeding grow broader, and more obtuse at their ends until they assume a form similar to those of the lumbar vertebræ. The fifth spine is generally the longest; the 12th or 13th the first that assumes the lumbar character.

M. Girard correctly observes, also, that the articular depressions upon their bodies for the heads of the ribs are less deeply marked as we proceed backwards.

The Eighteenth Vertebra, and the seventeenth generally, have no articular surfaces upon their transverse processes, but *whole* ones upon their bodies for the ribs.

In the lumbar region—

The First, Second, and **Third** have broader spines, and their articular processes are nearer together; **The Fourth** possesses a surface for articulation with the fifth on each transverse process; **The Fifth** assumes somewhat of the character of the first piece of the sacrum, and has four surfaces for articulation on its transverse processes; two anteriorly, opposed to those on the fourth; two posteriorly, adapted to similar surfaces on the sacrum.

GENERAL REMARKS ON THE VERTEBRAL CHAIN.

The Spine exhibits for consideration four surfaces and two extremities.

Surfaces—Extremely irregular, presenting various eminences and projections, hollows, grooves, and foramina.

Superior Surface—In the neck, broad and (from the absence of spinous processes) preserving a general level; the equality being interrupted only, anteriorly, by the spinal crest of the vertebra dentata; posteriorly, by the spine of the seventh vertebra. In the back and loins, the surface offers a continued series of spinal projections; long, with broad tuberous ends, sloping backward, in the withers; short, erect, with broad sides, and terminated by oblong ridges, posteriorly. On the sides, running close to the roots of the spinous processes, extending from the dentata to the last lumbar vertebra, are the vertebral grooves, filled by the spinal and semi-spinal muscles belonging to the neck, back, and loins.

Inferior Surface—Presenting great uniformity from the general regularity of the inferior cervical spines and the angular portions of the bodies of the dorsal and lumbar vertebræ; excepting, that the sixth cervical spine is defective, and that the one or two last lumbar vertebræ are flattened inferiorly.

Lateral Surfaces—Very irregular. Presenting, in the neck, broad, bifid, transverse plates, with capacious vertebral channels or grooves between them and the articulatory processes above, which are occupied principally by the complexus major. Underneath these grooves run the foramina for the vertebral blood-vessels; and through their sides pass the holes of conjugation. —In the back and loins the holes of conjugation are situated immediately behind the transverse processes; and the lumbar vertebræ alone possess lateral vertebral grooves, but which are very narrow compared with those along the neck.

Extremities—Broad and articulatory. The anterior excavated to receive the occipital condyles; the posterior, transversely oblong, presents three smooth surfaces for articulation with the sacrum.

Vertebral Canal—Capacious and semi-oval through the neck; transversely oval and small through the back; semi-circular through the loins, and of greater diameter than in the back, less than in the neck. United, anteriorly, with the cavity of the cranium; continuous, posteriorly, with the sacral canal. Containing the spinal marrow and its membranes.

II.—THE CHEST. (THORAX.)

The thorax or chest is the ample conoid cavity constituting the anterior part of the trunk, formed by the ribs laterally and the sternum inferiorly, in which are contained the organs of respiration and circulation.

THE RIBS.

Number. Thirty-six; ranged in pairs, eighteen on either side: occasionally there exist thirty-eight, and even forty ribs. They are distinguished by their numerical order, counting from before backwards.

Conformation. In general similar: they are elongated, curved or twisted, convex along their outer sides, concave along their inner, and taking a direction from within outwards and from above downwards; they vary, however, in their length, degree of curvature, and obliquity of direction.

Division. Into true or sternal ribs, and false or asternal; the former, nine in number, being those whose cartilages are actually inserted into the sternum; the latter, the remaining nine, being only connected therewith through the intervention of others. Each rib possesses two extremities, two surfaces, and two borders.

Extremities. The superior or vertebral, comprehends—1. The head, the protuberant or antero-superior portion, presenting two convex smooth surfaces, for articulation with the bodies of the vertebræ between which it is received, and these divided by a rugged notch, into which is fixed the inter-articular ligament of the head. 2. The neck, the contracted part, supporting the head. 3. The tubercle, the prominence behind the head, at the root of the neck, which has a flat smooth surface for articulation with the transverse process of the hinder vertebra connected with the head. 4. In front of the tubercle, running across the back of the neck, is a groove, along which make their exit branches from the intercostal vessels and nerves. The inferior or sternal extremity swells a little in volume, and is of less compact or more porous texture than the bone above: it is terminated by an oval roughened depression; from this takes root the cartilage of the rib, which thence proceeds at an angle more or less obtuse and rounded to the sternum.

Surfaces. The external is convex and more or less uneven. The ribs do not form regular arches; they project outwards from the spine, and then curve suddenly downwards, the posterior ones at the same time inclining backwards: the place where the rib commences its descent, the most curved or crooked part, is named its angle. In all the long ribs this surface, anteriorly, is more or less grooved for the attachment of the external intercostal muscles.—The internal surface is uniformly concave, smooth, and polished. It is lined by the pleura.

Borders. With the exception of the first and last ribs, the anterior borders are thin and sharp; the posterior, obtuse and rounded: the former give attachment to the intercostal muscles; the latter, along the upper half, however, only, present grooves in which run the intercostal vessels and nerves.

Peculiarities. The first is the shortest and thickest of the ribs; its upper part is rounder, and its lower broader and more expanded than any other: it is but little and irregularly arched, and the concavity of its arch is turned directly forwards. The second is a remarkably straight rib, being only curved in its neck. From the second the ribs progressively increase in breadth to the seventh, in length to the ninth, and in curvature to the very last; the eighteenth being in proportion to its length the most crooked rib: from the tenth, the ribs grow shorter, narrower, and more obtuse or rounder in their borders. The posterior differ also from the anterior ribs in being curved throughout their entire length; whereas the former are only very perceptibly bent at their angles. In the eighteenth, and sometimes in the seventeenth rib, the articulatory surface of the tubercle is confounded with that of the head, and the neck is wanting.

THE CARTILAGES OF THE RIBS, properly so called in the young subject, receive depositions of osseous matter as the animal advances in life, until at length they acquire rather the character of spongy fragile bones than cartilage. They correspond in number to the ribs, and like them increase in length from the first to the ninth or tenth, after which they progressively decrease; but this is liable to variation: the first cartilage is remarkably short; those belonging to the true ribs are in general not very long, but broad, thick, and resisting; those proceeding from the false ribs are, on the contrary, mostly very long and comparatively slender, and incapable of offering much resistance—are, in fact, so formed and connected that they admit of considerable motion.

THE BREAST-BONE. (STERNUM.)

Conformation. The sternum (being a single bone) is symmetrical in its form, shaped, altogether, like the keel of a ship; posteriorly, flattened from above downwards; anteriorly, from side to side. It is composed of seven irregularly formed bones, and of the ensiform and cariniform cartilages.

Division. Into four surfaces and two extremities.

The Superior and Inferior Surfaces are pyramidal in figure, being broad posteriorly, contracted into borders anteriorly: the former, slightly concave, terminates between the cartilages of the first two ribs; the latter, irregularly convex, ends in the cariniform cartilage.

The Lateral Surfaces are broader anteriorly than posteriorly. The three foremost bones present broad, superficial, lateral concavities; the four hindermost, projecting lateral borders, which incline downwards and form the boundary lines between the inferior and lateral surfaces. The indentations upon the fore and hind parts of the separate bones form, in the united state, laterel concavities for the reception of the cartilages of the ribs: the hindermost bone, itself, receiving two entire cartilages.

The Extremities are constituted of projecting cartilages.—*The Cariniform Cartilage,* arising in a curve from the inferior border, forms a prominent and remarkable convexity in front, flattened on either side, and affords attachment to the sterno-maxillares and sterno-thyro-hyoidei. The *Xiphoid* or *Ensiform Cartilage* is fixed to the last bone, and assumes a form in some measure correspondent therewith, being broad and flattened above and below: it is terminated however by a thin border, to the figure of which it owes its name, though this is subject to much variation.

GENERAL REMARKS ON THE THORAX.

Form. That of a truncated cone slightly incurvated, the basis of which is cut obliquely, from above downwards and from behind forward; the point of the apex cut off perpendicularly; the axis running in a direction from the front backward and downward.

Dimensions. The antero-posterior diameter is the greatest. As we approach the apex the perpendicular more and more exceeds the lateral measurement; towards the basis, in consequence of the sides diverging, these two diameters become about equal.

Division. Into two surfaces and two circumferences.

Exterior Surface.—Presenting, anteriorly,t he cariniform cartilage projecting from the sternum, with its sharp edge turned downwards, for affording attachment to the pectoral muscles; laterally, the convexities of the costal arches and their cartilages, and between them the intercostal spaces filled by the intercostal muscles; superiorly, the dorsal spines, transverse processes, and vertebral grooves; inferiorly, the sharpened lower border of the sternum, terminated by the xiphoid cartilage.

Interior Surface—Formed, below, by the incurvation of the sternum and xiphoid cartilage; on the sides by the smooth concavities of the ribs together with their cartilages; above and along the middle, by the angular, smooth, descending portions of the bodies of the dorsal vertebræ; above and along either side, by an oblong fossa formed by the angles of the ribs, into which are received the superior thick borders of the lungs.

Anterior Circumference—Perpendicularly semi-oval, the small end turned downwards; bounded by the first dorsal vertebra, the first pair of ribs, and the sternum; making a passage for the trachea, œsophagus, longus colli, carotid arteries, jugular veins, vertebral arteries and veins, axillary arteries and veins, par vagum, sympathetic and recurrent nerves, and thoracic duct.

Posterior Circumference—Wide, but most extensive from above in the antero-inferior direction; bounded by the last dorsal vertebra, the ensiform cartilage, the last two ribs, and the false cartilages; affording attachment to the abdominal muscles, but more particularly to the diaphragm, by which the intervening space is occupied.

III.—THE PELVIS

Forms the posterior boundary of the trunk; is connected with the spine, and supported by the femoral bones; presents a large, irregular cavity, open before and behind, in which are contained part of the intestines and the urinary and genital organs; and is composed of four bones,—the sacrum and os coccygis, and the two ossa innominata.

THE RUMP-BONE. (OS SACRUM.)

Situation. At the superior part of the pelvis, continued from the vertebral chain between the ossa ilia.

Figure. Resembling the lumbar portion of the spine, from which it declines with a slight bend, presenting a convexity externally, a concavity internally, thereby augmenting the area of the pelvic cavity.

Division. Into two surfaces, two borders, a base, and an apex.

Superior Surface—Very irregular. Presenting, 1st, On the mesian line, five considerable eminences, corresponding to the lumbar spines, from which they differ in sloping in an opposite direction, in increasing in breadth, while they diminish in length, from first to last. 2dly, Laterally, two superficial grooves, pierced by the four superior sacral foramina, through which pass out the superior sacral nerves.

Inferior Surface—Regular, smooth, and slightly concave. It presents—Four transverse lines of demarcation, denoting the original division of the bone into four separate pieces. These are bounded laterally by two superficial grooves, pierced by four pairs of inferior sacral foramina, through which make exit the corresponding sacral nerves.

Lateral Surfaces—Thick anteriorly, growing thin posteriorly, and presenting slight protuberances, (corresponding to the vertebral transverse processes,) which serve for the attachment of the sacro-iliac ligaments.

Base—Composed of a middle and two lateral parts. The middle presents a convex articulatory surface, transversely oval, for adaptation to the last lumbar vertebra; surmounted by two articulatory processes, between which are received the last two of that name of the loins; and having on its sides two notches of conjugation for the last pair of lumbar nerves. The lateral or anterior transverse processes, broad, thick, and projecting, and triangular in figure, point forwards and upwards as well as outwards: superiorly, they have two surfaces of articulation for the ossa illa; anteriorly, two others which unite with the last transverse processes of the loins.

Apex—Presents also an oval surface, which articulates with the foremost bone of the tail; having on its sides two notches, for the fifth pair of sacral nerves; and, farther removed outward, two little posterior transverse processes.

The Sacral Canal for the spinal marrow is triangular in figure, and gradually contracts its diameter from before backwards.

Development. In the young subject this bone consists of five distinct and separable pieces, united, one to another, by a fibro-cartilaginous substance which in the adult is converted into bone.

THE TAIL-BONES. (OSSA COCCYGIS.)

Situation. Behind the sacrum, to which the coccyx forms an appendix.

Form. (*Of the coccyx entire.*) Conical, elongated, and more or less curved.

Conformation. The coccyx or tail is constituted of several small bones resembling vertebræ, varying in size and development, and also in number from thirteen to eighteen.

Division. As a whole, the coccyx presents for consideration two surfaces, two borders, a base, and an apex.

Superior Surface—Convex. The two and sometimes three first bones possess complete bony arches, from which arise one or two spinous eminences giving attachment to the erectores coccygis, and consequently they possess an uninterrupted spinal canal; in the following two or three pieces, the spinal arch becoming gradually more defective, the closed canal degenerates into a channel, open superiorly, and that in the four or five subsequent pieces into a simple groove; until at length all traces of such formation disappear.

Inferior Surface—Concave. The first bone possesses breadth and flatness inferiorly, the same as a lumbar vertebra: the others display less and less of the vertebral character back to the fifth or sixth, after which they present angular borders. Into these parts are inserted the depressores coccygis.

Lateral Borders. The three or four anterior bones have transverse processes, increasing in length with their priority; which give attachment to the sacro-sciatic ligaments, and also to the curvatores and compressores coccygis. The fifth and subsequent bones are nothing more than cylindrical forms, and differ in little else than in a regular respective diminution in volume.

Base—Presents an oval surface for articulation with the end of the sacrum; and also two little articulatory processes, receiving between them correspondent sacral eminences; and below these processes two notches, for the transmission of the fifth pair of sacral nerves.

Apex—Obtuse and rounded.

THE HIP, HAUNCH, OR EDGE BONES. (OSSA INNOMINATA.[*])

Situation. Forming the lateral and inferior parts of the pelvis.

Form. Very irregular: large and flat; broad at the extremities, which turn in different directions; middle portion contracted.

Division. Into two surfaces and four borders.

The External or Dorsal Surface—Divided by the contracted portion in the middle into two parts. The anterior part, also distinguished as the dorsum ilei, is even and smooth, slightly concave, triangular in figure, and faces outwards and backwards: it affords attachment [illegible] the glutei, maximus et internus.—The posterior division presents, outwardly, the acetabulum or cotyloid cavity, hemispherical, nearly three inches in diameter, looking outwards and downwards, surrounded by a prominent lip of bone which is interrupted below by a notch, and having a roughened depression in its middle into which is implanted the round ligament confining the head of the os femoris within the cavity; above and in front of the acetabulum the bone is depressed and roughened in two places from which takes root the bifurcated tendon of the rectus femoris; to the inner side of and below the cavity is the obturator foramen, a large oval opening, closed by an expansion of ligament, through the anterior part of which is a perforation for the passage of the obturator vessels and nerves. Behind the foramen the surface is broad, even, and smooth, and gives origin to the abductor muscles of the thigh; above the foramen, it is smooth but rounded, over which part play the obturator internus and gemelli.

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[*] Literally, *unnamed* bones; but answering to the other English appellations.

The Internal or Ventral Surface—Divided the same as the external. The anterior part faces inwards and forwards, is slightly and unevenly convex, has a superficial scabrous depression posteriorly, marking the place where the bone rests upon, and has strong ligamentous attachment to the transverse processes of the sacrum: the remainder of the surface below is occupied by the iliacus, the part above being opposed to the sacrum.—The posterior part is subdivided by a prominent border (upon which is a rough mark showing the point of insertion of the psoas parvus) into a small triangular superficial concavity, looking forwards, which gives origin to the sartorius, and an extensive but irregular one directed upwards; this last is much consumed by the obturator foramen, posteriorly to which the surface is remarkably smooth and slightly excavated for sustaining the bladder.

Anterior Border—Sigmoid in figure, slightly concave and thin in the middle; terminating, behind, in a sharp salient angle, the posterior iliac spine; before, in a thick quadrangular part which gives rise to four eminences: the two larger ones are the antero-superior and antero-inferior iliac spines; the two smaller, tubercles or appendices to them. The border itself is called the crista ilei. It affords attachment to the longissimus dorsi, obliqui abdominis, externus et internus, and transversalis abdominis.

Posterior Border—Having its anterior third thick and scabrous, where it is united through the intervention of fibrous cartilage with its fellow, forming the symphysis pubis; posteriorly to this, it grows thin, which part has also a ligamentous connection with the opposite bone, and afterwards recedes from its fellow, terminating outwardly in a thick, oblong, waving, roughened prominence, called the tuberosity of the ischium, to which are attached the adductor magnus, bicep femoris, and abductor tibialis, and also the sacro-sciatic ligaments.

The Superior Border—Extending from the posterior iliac spine to the ischiatic tuberosity, is waving in its course, forming an irregular semicircle, and presents along its anterior two thirds a sharp edge, which opposite to the acetabulum is roughened by the implantation of the sacro-sciatic ligaments; after this it is rounded by the play over it of the obturator internus and gemelli, and at length ends insensibly in the tuberosity.—There is a lesser superior border, running from the tuberosity to the acetabulum, whose posterior half is prominent, very sharp, and irregular, forming the ischiatic spine.

The Inferior Border—Describes a sigmoid flexure: it extends from the anterior iliac spine to the symphysis pubis. Its anterior third is sharp; about its middle is a medullary hole running backward; here it gives rise to two borders: one obtuse and smooth, ending at the edge of the acetabulum; the other, more prominent and sharp, is the linea ilio-pectinea, or brim or boundary of the cavity of the pelvis, running onward to the symphysis. Upon its anterior part is a rough place, the ilio-pectineal eminence, marking the insertion of the psoas parvus; posteriorly are two rough eminences, with a groove between them wherein run the united tendons of the psoas magnus and iliacus: to the outer one, the pubic spine, is fixed the external chord of the abdominal ring.

Connection. Anteriorly and inferiorly with the sacrum; posteriorly and inferiorly and in the middle with each other; outwardly with the femoral bones.

Development. In the fœtus this bone is separable into three distinctly formed pieces:—the ileum, the largest division, the triangular plate in front; the ischium, the part projecting backwards; and the pubes, the inferior and middle portion. They all contribute to the formation of the acetabulum; the ischium and pubes together form the obturator foramen. These parts speedily complete their bony union after birth; and the ischium and pubes the soonest.

OF THE PELVIS IN GENERAL.

Division—Into exterior and interior, inlet and outlet.

The Exterior presents—in front, the crest and anterior and posterior spines of the ileum; behind, the divergent tuberosities of the ischium; on the sides, the triangular planes of the ilea which are clothed by the gluteal muscles, the acetabula, and, between them and the ischiatic tuberosities, the rounded smooth surfaces of the ischia, over which play the rotating muscles of the haunch; above, the sacrum; below, the symphyses of the pubes and ischia; laterally and inferiorly, between the symphyses and the acetabula, the foramina obturatoria.

The Interior is divided into two compartments by a prominent circumferent line forming the brim of the pelvis: the open irregular space before this line, is the inlet or entry; behind it, commences the cavity of the pelvis, which again is bounded posteriorly by the outlet. The lateral walls of the cavity are formed principally by the ilea; the ischia and pubes, united at their symphyses, including the obturator foramina, are mostly consumed in completing the cavity below; while the sacrum alone constitutes the superior boundary. The supero-inferior diameter of the brim in the young subject exceeds the lateral; in the adult mare these two diameters, and also the antero-posterior length of the cavity, measuring from the brim to the extreme points of the ischiatic tuberosities, are about equal—about ten inches.

The Inlet displays—laterally, the ilea, with their thin projecting anterior spinous processes; superiorly, the promontory of the sacrum and the sacro-iliac articulations; inferiorly, the grooves for the psoas and iliacus, and the symphysis pubis.

The Outlet presents three notches: two lateral, very extensive; one middle, considerably smaller. The two former, named the great sciatic notches, constituted by the posterior borders of the ileum and ischium and the sides of the sacrum, are principally occupied by the sciatic ligaments, although they give transit to the pyramidal muscles, the gluteal and obturator vessels, and the sciatic nerves. The middle notch is the pubic arch, formed by the divergence of the ischiatic tuberosities: it is occupied in either sex by the urinary canal.

OF THE HEAD.

The head is an oblong quadrangular form, broad and flattened on its sides, narrow and contracted anteriorly and superiorly, bulky at the opposite points, hollow inferiorly. It is remarkable for the prolongation and capaciousness of the parts devoted to the formation of the nose and mouth, and for the diminished sphere of the cranium. It constitutes the anteriormost part of the skeleton, is articulated with the spine by which it is suspended, and is divided into cranium and face.

I.—THE CRANIUM.

The cranium or brain-case is but small when compared with the bulk of the body in general: it forms the supero-posterior part of the head; is prominent and convex, superiorly and laterally; irregular, and in places open, inferiorly; hollow and vaulted within. It is composed of ten pieces—three pairs and four single bones; viz., superiorly and anteriorly, of the two frontals; superiorly and in the middle, of the parietal; superiorly and posteriorly, of the occipital; laterally, of the four temporals; inferiorly and anteriorly, of the ethmoid; inferiorly and in the middle, of the sphenoid; inferiorly and posteriorly, of the occipital bone.

FRONTAL BONES. (OSSA FRONTIS.)

Situation. The frontal bones form the antero-superior part of the cranium, that broad flat part which we term the forehead, and which in the living horse is commonly marked with a patch of white hair, denominated a star.

Figure—Irregular. Flat, superiorly; concave, underneath.

Division—Into two surfaces and four borders.

The External Surface is flat and smooth, sometimes even slightly depressed in the situation of the frontal sinus. Projecting from it outwardly is the external orbital process, forming the frontal arch and articulating with the temporal bone; underneath, the arch is excavated for the reception of the lachrymal gland; and through its inward end is a hole, (in some rare instances, two,) the supra-orbital foramen, for the transmission of a small artery and nerve of the same name to the forehead; below the foramen, internally, is a small depression, marking the place of attachment of the cartilaginous pulley belonging to the superior oblique muscle of the eye. From below and behind the arch proceeds downwards and backwards the internal orbital process or plate, divided into two by a notch into which projects the wing of the ethmoid bone, whose extremity is received into a mortise formed within the base of this plate; this part also articulates, within the orbit, inferiorly, with the sphenoid, posteriorly, with the temporal, and, anteriorly, with the lachrymal and superior maxillary bones. The anterior portion of this process, behind, where it joins the sphenoid, is pierced by the internal orbital foramen, which gives passage to the lateral nasal nerve; the surface behind the posterior portion is smooth and depressed, making by union with it part of the temporal fossa.

The Internal Surface is divided by a vaulted cranial septum into two unequal concavities: the posterior forms a cap for the anterior lobe of the cerebrum, which rests upon the septum, the indentations upon the surface answering to the cerebral eminences; the anterior concavity constitutes the frontal sinus, whose interior is much enlarged by the slant taken by the septum, and the cavity continues to extend with age until it occupies the entire front of the bone. One frontal sinus is separated from the other by the nasal spine, composed of a lamina from each bone; there are also several imperfect septa traversing the interior of each sinus, partially dividing it into as many different chambers.

Borders—Denticulated and squamous. The posterior or parietal is arched, describing segments of two distinct circles, one running from within outwards, the other from above downwards, and is overlaid by the parietal and temporal bones. The anterior or nasal border is waving, inclines backwards as well as outwards, is terminated internally by the nasal process, and is overlapped by the nasal and lachrymal bones. The frontal border is straight; broad and triangular anteriorly, where it forms the septum between the sinuses: it unites with its fellow; and has at the place of junction, internally, a slightly elevated longitudinal crest or spine, which with the opposite one forms a groove for the reception of the longitudinal process of the dura mater. The ethmoidal or outer border is irregular, forming a junction with the lachrymal and sphenoidal, and, by overlapping, with the ethmoidal bone.

PARIETAL BONE. (OS PARIETALE.)

Situation. Mesio-superior part of the cranium.

Figure—Symmetrical; quadrilateral; vaulted: convex externally, concave internally.

Division—Into two surfaces and four borders.

The External or Convex Surface is divided longitudinally by a mesian crest, which is bifurcated anteriorly and marks the course of the suture existing in early life, into two lateral convexities; these are most elevated towards the supero-external angles, and their surfaces, though otherwise smooth, exhibit a few scattered small foramina, and are imprinted by the continual action of the muscles covering them, the prints growing deeper with age; and, it appears, the general prominence less. The triangular space between the bifurcations of the crest generally rises above the level of the surrounding surface.

The Internal or Concave Surface is divided into two concavities by an internal crest which is commonly double, having a longitudinal groove in the middle: it is terminated posteriorly by a three-sided process, the parietal protuberance, to which, as well as to the crest itself, is attached the falciform process of the dura mater. In front of this projection the longitudinal furrow ends in the two transverse grooves, which run along the posterior border, between it and the temporal bones: the former lodges the longitudinal, the latter the lateral sinuses of the dura mater. The cavities themselves are adapted to cover the middle lobes of the cerebrum, by which they are indented; they also show the traces of the ramifications of the arteries supplying the dura mater.

Borders—Denticulated and squamous. The anterior is serpentine and unites with the frontal bones; the posterior lies upon the occipital bone, and internally has two short bifid crests growing from it, forming sides of the transverse grooves, from which it extends down, on either side, to the wing of the sphenoid bone; the lateral borders are irregular, and are overlaid by the temporal bone.

Development. In the foal, indeed generally until the second or third year, a longitudinal suture is demonstrable, dividing this bone into two correspondent pieces.

OCCIPITAL BONE. (OS OCCIPITIS.)

Situation. Postero-superior and inferior parts of the cranium.

Figure—Symmetrical; irregular: presenting convexities and projections outwardly; concavities, and a large circular aperture inwardly.

Division—Into two surfaces, external and internal, and four borders.

The External Surface is divided by a transverse mark into two portions, a super-occipital and a sub-occipital portion, which were once two separate bones, and presents, 1st. Along its median line, and from above downwards, the occipital crest, bounding the cranium posteriorly, and giving attachment to the complexus; below this, the occipital tuberosity, to which is fixed the cervical ligament, with broad, rugged, posterior occipital depressions marked by the attachments of the recti capitis postici; still lower, the occipital hole, transversely oval, and traversed by the spinal marrow and its membranes, the vertebral artery, and accessory and sub-occipital nerves; below and in front of this hole, the basilar process, articulating with the sphenoid bone, whose under surface shows the basilar fissure, triangular and widening in its course to the occipital hole, where it terminates: to this process are attached the recti capitis antici. 2dly. On each side, the continuation of the crest, descending to the root of the styloid process of the same bone, into which is implanted the obliquus capitis superior; below this, continued from it, the styloid process, whose length is regulated by that of the jaws, affording attachment to the obliquus capitis anticus; inwardly to this, bordering on the occipital hole, the occipital condyles, extending backward for articulation with the atlas, and roughened upon their inner sides

TEMPORAL BONES. (OSSA TEMPORUM.)

Situation. Lateral parts of the cranium.

Conformation. They consist of four separate pieces, in pairs, *each irregular in its form. One pair presents vaulted ovoid plates, surmounted by curved or hooked projections; the other are solid convex forms, remarkable for their hardness and whiteness.*

Division. In man these pieces are united and are considered as the squamous and petrous portions of one bone: in the horse, although the same names are preserved, the *portions* are in reality distinct bones.

THE SQUAMOUS PORTION. (PARS SQUAMOSA.)

Presents two surfaces, an external and internal, and a circumference.

The External or Auricular Surface is convex, and has projecting forward from its middle in a curvilinear direction the zygomatic process; this unites with a similar projection coming from the malar bone, the two forming the zygomatic arch, against which abuts the frontal arch: superiorly, this process presents a broad concave surface contributing to the temporal fossa, and has a narrow sharpened convexity projecting upwards and backwards from it called the zygomatic crest; inferiorly, running transversely to its root, is the glenoidal cavity, for the reception of the condyle of the inferior maxilla, bounded in front by a smooth transverse eminence denominated the articular from its being included within the temporary-maxillary articulation, and behind by the anterior mastoid process, which descends in the form of a cone, serves to strengthen and limit the motion of the articulation, and gives attachment to part of the levator humeri. Behind the root of the posterior articular process is the mastoid foramen, for transmitting blood-vessels to and from the temporal fossa. Farther backward is the orifice of the temporal conduit, which gives passage to a vein.

The Internal or Cerebral Surface is concave, to contain and support the posterior lobes of the cerebrum by which it is imprinted, and displays several arborescent grooves, marking the course of the posterior arterial ramifications of the dura mater.

The Circumference, ovoid and elongated posteriorly, is denticulated and squamous, excepting at the posterior part, where it is joined to the petrous portion. The superior part lies upon the side of the parietal bone, and behind that upon a very small proportion of the occipital; in front, it lies upon the frontal, and below upon the sphenoid.

THE PETROUS PORTION. (PARS PETROSA.)

Is important from lodging the internal organ of hearing. It presents two parts perfectly distinct from each other in structure, position, and use; one is external or mastoideal, the other internal or cerebral. From the former projects downwards the posterior mammiform or mastoid process, in which is distinguished a base inferiorly, and a crest superiorly: the latter joins the occipital crest. Below and rather towards the front of the process is the external orifice of the aqueduct of the vestibule; directly in front of the process is the external auditory meatus and foramen, surrounded by a jutting oval rim, notched in the middle, which constitutes the auditory process; to the inner side of the meatus is the hyoideal process, surrounded by a prominent circular edge, with which is connected the os hyoides. Behind the meatus is a general protuberance, spheroid without, cavernous within, bottomed by a thin bony shell, within which are enclosed the mastoid cells; proceeding from the inferior, anterior, and inner part of the bone is the styloid process; at whose root are two openings, one below for the Eustachian tube, the other above, the styloid foramen for the chorda tympani.

The Internal Part exhibits three surfaces for consideration. One superior and posterior, smooth though uneven, is excavated for adaptation to the side of the cerebellum, by which it is impressed in places; it has a prominence running across its middle, and just beneath this an irregular aperture, having interiorly two distinct passages, one terminated by a cul-de-sac, including a foramen, which leads to the cochlea and communicates through some small pores with the labyrinth; the other, the internal auditory foramen, is for the conduit of the auditory nerves, and communicates with the aqueduct of the vestibule. Another surface, the anterior, contributes in a small degree to the formation of the concavity for the posterior lobe of the cerebrum. The inferior surface, parted from the superior by a fissure, is convex and prominent, but irregularly so: it constitutes the exterior wall of the labyrinth.

The petrous portion is received between the squamous and the occipital bone, and though it is rarely found united with either of them by bony matter, yet, loose as it is, it is so locked in that it cannot be disjointed but with considerable difficulty and even fracture of some part.

SPHENOID BONE. (OS SPHENOIDES.)

Situation. Inferior and middle parts of the cranium.

Form. It bears a striking resemblance to a bird in flight, with its wings and legs extended: a comparison that has given rise to its—

Division—Into body, alæ or wings, and pterygoid processes or legs: altogether presenting for consideration two surfaces and two borders.

The Inferior Surface, irregularly convex, is distinguishable into three parts:—a middle and two lateral portions. The middle, thick, prominent, cylindroid, and oblong from before backwards, by its union with the basilar portion of the occipital bone and the body of the ethmoid, forms the base of the cranium: its porousness denotes muscular attachment. Between the middle and lateral parts, on either side, runs a narrow fissure denominated the pterygoid, which leads into two small canals, one entering the cavity of the nose, the other the orbital hiatus: this fissure affords a passage to the pterygoid branch of the portio dura.—The lateral divisions send forth by the sides of the fissures the pterygoid processes, which project downwards and forwards, form a union with the palate bones, and afford attachment to the internal pterygoid muscles. At the b
processes are the pterygoid foramina; above and
the base is the orbital hiatus, a considerable aperture,
ovoid from above downwards, opening into the
orbit, and including the supero-posterior and i
bital foramina: the former transmitting t

and artery, and the third pair of nerves; the latter, the superior maxillary nerve. Immediately over the hiatus is the opening of the canal which conducts the pathetic nerve into the orbit: it is in part formed by the ethmoid bone.

The Superior or Cerebral Surface is unevenly concave, being impressed by the middle lobes of the cerebrum, which it supports. It presents three general concavities:—a middle and two lateral. In the centre of the middle division is the pituitary fossa for lodging the gland from which it takes its name; it is bounded on the sides by the optic fossæ, which are occupied, inwardly, by the optic nerves, outwardly, by the cavernous sinuses. Farther removed outward and forward is the foramen lacerum orbitale; and immediately over it the spinal foramen, through which passes the pathetic nerve before it enters its canal.

Borders. *The Posterior or Occipital* consists of an oval solid part in the middle, which is united with the basilar process of the occipital bone, and laterally, of two wide irregular notches contributing to the formation of the foramina lacera basis cranii. —*The Anterior or Palatine Border* has a similar oval middle, joined to the ethmoid bone; and has a connection also with the vomer.—Each *Lateral Border* is distinguishable into two parts: —a posterior, which is scaly and denticulated for adaptation to the squamous temporal bone; and an anterior or orbital portion, projected forward to unite with the anterior extremity of the same bone, and also with the ethmoid, while it forms the posteriormost part of the orbit.

Connection—With the occipital, ethmoid, and squamous temporal bones; also with the palate bones and vomer.

ETHMOID BONE. (OS ETHMOIDES.)

Situation. Antero-inferior part of the cranium; immediately before the sphenoid bone; where it constitutes the partition between the cranial and nasal cavities.

Form. One portion, the posterior, bears a resemblance to a bird with its wings extended, as in the act of flight, having no legs, but a long erected neck and a small round head: the anterior part consists of a thin, brittle, porous, spongy structure, of considerable volume.

Division—Into a middle and two lateral parts.

The Middle Portion is large in bulk, consisting of a body behind, and of two voluminous spheroid spongy masses in front, parted by a septum. The body is oblong from before backwards, concave superiorly, convex inferiorly, and interiorly formed into two concavities, the ethmoidal sinuses; these are divided by a broad perpendicular plate, which extends upwards to unite with the nasal spine; (the partition between the frontal sinuses;) below, it is received into the groove of the vomer; while in front it sustains the cartilaginous septum of the nose, the septum nasi; altogether completing the division of the nasal cavity into two chambers: the ethmoidal plate itself is composed of two thin laminæ which in old subjects become consolidated into one. Posteriorly, on either side, the body presents *the optic hiatns, transverscly oval, leading to the optic foramen; the posterior surface is oval to form a junction with the sphenoid bone. Arising from the upper and fore part of the body is a pyramidal eminence somewhat curved, called the crista galli*: it sustains in front the perpendicular plate, the falciform process of the dura mater behind, while from its sides extend the cribriform plates—two ovoid, thin, brittle lamellæ, which are received between the frontal orbital plates and the floors of the frontal sinuses, pierced by numerous small holes for the transmission of the filaments of the olfactory nerves, and whose concave cerebral surfaces are denominated the ethmoidal fossæ and are occupied by the olfactory sinuses. To the outer side of either fossa opens the internal orbital foramen; from which a fissure runs upward to the part of the cribriform plate connected with the principal cornu of the ethmoidal cells.

THE ETHMOIDAL CELLS, the voluminous structure protruding from the front of the cribriform plates, consists of a great many thin, brittle, porous osseous plates, curved or rather convoluted so as to form numerous narrow, elongated, cornuform sinuses, rendered separate and distinct from one another by intervening longitudinal grooves, with which from above they all in common have communication. These canals proceed, converging a little as they advance, to terminate underneath the superior turbinated bone, at the back of the nasal fossa, within a space communicating with the middle meatus. The anteriormost cornu or cell is conspicuously long and capacious: the rest increase in dimensions according to their proximity to this large one. Issuing from the front of the cells is a broad, thin, funnel-like process, which unites with the superior turbinated bone and forms a sharp prominent crest, serving as an imperfect septum between the frontal and maxillary sinuses.

The Lateral Portions, alæ or wings, display more convexity than concavity superiorly, the reverse inferiorly: they originate from the supero-lateral parts of the body; consist of thin, flexible plates; spread outward and upward, contributing to the posterior and inward parts of the orbits; and terminate in semi-circular borders, sloped off behind, which, posteriorly, lie upon the wings of the sphenoid, laterally, are embraced by the bifid orbital plates of the frontal bone, and, in fine, received into the mortise of the same. Upon their internal surfaces the alæ support the anterior lobes of the cerebrum: their opposite surfaces constitute within the orbits the ossa plana.

Connection—With the sphenoid and frontal, the vomer and superior turbinated bones; and with the cartilaginous septum of the nose.

II.—THE FACE.

The face constitutes the antero-superior, anterior, and inferior parts of the head, making altogether (including the inferior maxilla) about four fifths of the whole: it is the part to which the head owes its prolongation anteriorly, and principally its lateral breadth. It is bounded, behind, by the cranium; at the sides, by the zygomatic and orbital arches; infero-posteriorly, by the ethmoid and sphenoid bones, and the basilar process of the occipital. It is composed of two perfectly distinct and separable parts; viz., the superior maxilla or syncranium; and the inferior maxilla or diacranium: the latter consists of a single or indivisible piece, called the lower jaw; the former or upper jaw is constituted of seventeen pieces, but which are closely and immoveably united; viz., the nasal bones, the superior and anterior maxillary, the malar, the lachrymal, the palatine, the superior and inferior turbinated, and the vomer: the teeth are equally distributed between the jaws. First, of the superior maxilla.

NASAL BONES. (OSSA NASI.)

Situation. Superior part of the face; where they constitute the roof of the cavity of the nose.

Figure—Vaulted, thin, elongated; mostly convex externally, concave internally; broad posteriorly, tapering and terminating in a sharp point anteriorly: the single bone represents the section (about one third) of a hollow cone, split longitudinally; the two bones together form the outline of a heart as painted on cards.

Division—Into two surfaces, two borders, a base, and an apex.

SURFACES. *The External* is not merely smooth; it is polished. It is not everywhere uniformly convex: indeed, the sides are towards their middle slightly concave; and the outward side is most depressed.—*The Internal Surface* is concave, that it may enlarge the area of the cavity of the nose: the channel it forms is the nasal fossa, the posterior and inferior parts of which are occupied by the superior turbinated bone; the unoccupied part constituting the upper nasal meatus. Posteriorly, between the two bones a sinus is formed, which, though sometimes called the nasal, proves to be nothing more than the anterior chamber of the frontal, the two uniting into one cavity.

BORDERS. *The Superior* is straight; but its edge is turned inward, forming a sort of internal crest, which along with its fellow is embraced by the superior border of the cartilaginous septum of the nose. Along their superior borders the two nasal bones are united—in the young subject by a sort of mortise-connection; in the adult, by a suture half denticulated and half plain or smooth-edged. *The Inferior Border* is waving, and is denticulated and mortised in its articulation with the superior and anterior maxillary bones; it is united also by denticulation with the lachrymal.

The Base has its border broadly sloped off and denticulated, and is united with the frontal bone, lying upon its anterior border.

The Apices of the two bones form together the nasal peak; a perfectly insulated or unconnected and remarkable projection, which gives support to the nostrils, and has attached to it the dilatator narium anterior.

Connection—With the frontal, superior and anterior maxillary, and lachrymal bones: the two together maintain, superiorly, in its place, the septum nasi.

SUPERIOR MAXILLARY BONES.

(OSSA MAXILLARIA SUPERIORA.)

Situation. Supero-lateral parts of the face.

Figure—Trilateral: thick in the middle; posterior part, gibbous; anterior, thin, tapering, and laminous.

Division—Into three surfaces, two extremities, and three borders.

The External or Facial Surface is partially subdivided into antero-superior and postero-inferior portions by a protuberant ridge named the superior maxillary spine, which forms one continuous line with the zygomatic spine and ends abruptly opposite to the third molar tooth: the upper subdivision is much the larger, and affords attachment to the masseter. Rather above the middle of the upper surface opens the infra-orbital foramen, traversed by blood-vessels and nerves bearing the same name.

The Inferior or Palatine Surface exhibits the concave side of a vaulted, demi-arched, oblong plate, called the palatine process or bony palate, which forms the partition between the cavities of the nose and mouth: posteriorly, this plate denticulates with the palate bone; anteriorly, with the anterior maxillary bone. The surface is bounded along the outer side by the alveolar processes, and between it and them runs a groove for the conduit of the palatine artery.

The Superior or Nasal Surface forms the outer side and half of the floor of the nasal cavity. Like the inferior surface it is concave, but unevenly so, being more excavated towards the posterior than the anterior part: in fact, the broad channel formed by both bones constitutes three fourths of the bony parietes of the nasal cavity. To a longitudinal spine running along either side of this channel is attached the inferior turbinated bone, dividing it laterally into two canals, named the inferior and middle meatus. At the supero-posterior part of the nasal chamber, behind the superior turbinated bone, the maxillary sinus opens through an oval aperture into the middle meatus: within the meatus itself, anteriorly to this, arched over by a little transverse eminence, is the orifice of the lachrymal conduit, which is traversed by the lachrymal duct.

EXTREMITIES. *The Posterior* swells into a large rounded protuberance, the maxillary tuberosity; between which and the palate bone is a hiatus presenting three apertures: one is the posterior palatine foramen; another, the anterior palatine foramen and conduit leading to the palato-maxillary canal; the third is that of the infra-orbital canal, leading to the foramen of the same name. To the outer side of the tuberosity is the malar process, articulating with the malar and lachrymal bones and the zygomatic process of the temporal. *The Anterior or Dental Extremity* is pyramidal and laminous, and contains an incurvated, conoid, alveolar cavity for the lodgement of the tusk: it denticulates with the anterior maxillary bone.

BORDERS. *The Superior or Nasal* is laminous to be united to the nasal bone; and has a mortise in its fore part to receive the border of the anterior maxillary bone. *The Inferior or Alveolar Border* presents two parallel plates divided by transverse septa into six quadrangular cavities, the alveoli, for the implantation of the molar teeth. Behind the last molar tooth is the alveolar tuberosity, a rugged eminence giving attachment to the pterygoideus internus. *The Internal or Palatine Border* denticulates with its fellow.

Connection—With the squamous temporal and nasal bones; and with the anterior maxillary, malar, lachrymal, palate, and inferior turbinated bones.

ANTERIOR MAXILLARY BONES.

(OSSA MAXILLARIA ANTERIORA.)

Situation. Supero-anterior and antero-lateral parts of the face.

Form—Irregular; consisting of a broad, thick portion or base, turned forwards, from which is sent off a thin flexible plate; and a narrow, elongated, tapering portion, turned backwards.

Division—Into three surfaces and three borders.

SURFACES. *The superior* or *nasal surface* is smooth, convex, and oblong; more extensive externally than internally; and free from all connection, it forming one side of the nasal space, in correspondence with its fellow. Outwardly, it affords attachment to the nasalis brevis labii superioris; inwardly, it is invested by the pituitary membrane. *The inferior* or *palatine surface* is vaulted, it contributing to the formation of the palate: within it, of an oval form, is the interdental space, which is occupied by two thin flexible plates, the palatine processes, denticulating along the sides with each other. In the side of the bone is a deep hollow, for the reception of that portion of the superior maxillary bone which holds the tusk; and the remainder of the surface, posteriorly, is articulated with the same. *The anterior* or *labial surface* is broad, smooth, and convex, and gives attachment to the depressor labii superioris, the gums, and the membranous and cellular tissue entering into the composition of the upper lip.

BORDERS. *The anterior border* is broad and curved, and is composed of two laminæ, formed apart and divided by five transverse *septa* into six conical alveolar cavities, for lodging the incisive teeth. *The posterior border* is narrow and sloped off, and denticulates with the nasal bone. *The internal border* is broad, quadrilateral, and curved, and denticulates with its fellow, forming thereby the superior maxillary symphysis, through which runs the foramen incisivum, for the transmission of the palatine arteries.

Particularities. These bones are remarkable for smoothness of surface, and closeness and hardness of texture. They are united at the symphysis, in the young subject by a fibrous cartilage, in the adult by osseous matter; so that, by maceration, they are separable in the one instance, inseparable in the other. Their alveolar cavities increase in number and size with the age and growth of the animal.

Connection—With the superior maxillary and nasal bones, and with each other.

MALAR BONE. (OSSA MALARUM.)

Situation. Antero-external part of the orbit.

Figure—Irregularly triangular, presenting a broad basis forwards.

Division—Into three surfaces, three angles, a basiform and an apiform extremity.

Surfaces. *The internal* or *facial surface* is divided into two portions by the zygomatic angle or spine: the upper division is smooth and nearly flat, with the exception of a depression anteriorly, which marks the attachment of the nasalis longus labii superioris; the lower part is narrow, and roughened by the adherence of the masseter. From this surface, posteriorly, arises the zygomatic process, which is very obliquely sloped off, and laminated for adaptation to the process of the same name, meeting it from the temporal bone, the two together forming the zygomatic arch. *The internal* or *maxillary surface* is concave, to enlarge the capacity of the maxillary sinus, to which it contributes. *The orbital surface* presents a smooth concavity, which forms the infero-external part of the orbit, and is separated from the facial surface by the orbital angle.

Angles. *The inferior angle* constitutes the principal part of the zygomatic spine: it is continuous with the temporal bone behind, and in front by the superior maxillary. *The superior angle* is lunated, and constitutes the infero-external portion of the orbital circumference. *The posterior angle,* or rather border, is jagged and irregular, and unites with the superior maxillary bone.

Extremities. *The anterior extremity* or *base* is broad, irregular, and denticulated, and articulates with the superior maxillary and lachrymal bones. *The posterior* or apiform end forms the zygomatic process.

Particularities. These bones contribute to the formation of the orbits, maxillary sinuses, and zygomatic arches, and their articulations exhibit a sort of dove-tail mechanism.

Connection—With the temporal, superior maxillary, and lachrymal bones.

LACHRYMAL BONES. (OSSA LACHRYMALIA.)

Situation. Antero-external part of the orbit.

Form—Irregularly infundibuliform.

Division—Into three surfaces and five borders.

Surfaces. The external or facial surface, triangular, flattened, and smooth, is bounded, laterally, by the external and internal facial borders; superiorly, by the orbital ridge. It exhibits, a little above its centre, a rounded eminence, the lachrymal tubercle, to which is fixed the orbicularis palpebrarum. *The internal* surface is concave, but very irregularly so, being divided into two hollows by a cylindrical prominence, caused by the lachrymal conduit. It constitutes part of the roof of the maxillary sinus.

The orbital surface is triangular and smooth, deeply excavated in front, extended and flattened posteriorly, and makes the antero-external side of the orbit. In the excavated part are observable—a circular depression, marking the origin of the short oblique muscle of the eye, and, before the depression, the lachrymal fossa, a funnel-shaped hollow, forming the entrance into the lachrymal canal: within the hollow reposes the lachrymal sac; the canal is traversed by the lachrymal duct.

Borders—Denticulated, with the exception of the nasal, which is plain. *The external facial border* articulates with the malar bone; *the internal facial* (including the nasal border), with the nasal and frontal bones: *the external orbital border* unites with the malar and maxillary bones; *the internal orbital border* with the frontal bone.

Particularities. A semi-transparent bone, important from its connection with the lachrymal apparatus.

Connection. With the frontal, nasal, malar, and superior maxillary bones.

PALATE BONES. (OSSA PALATI.)

Situation. Infero-posterior part of the face, adjoining the base of the cranium.

Figure. One portion is semi-circular; otherwise it is irregular.

Surfaces.—*The palatine surface* is that which is turned downwards, and contributes to the formation of the palatine arch. *The nasal surface,* the broadest, confronts its fellow, the two forming the sides of the posterior opening of the nose: its supero-posterior part is pierced by the posterior palatine foramen. *The orbital surface* is in part smooth, where it enters into the composition of the back of the orbit; and in part rough and laminated, where it articulates with the superior maxillary bone: the latter portion exhibits the palatine canal, which leads to the anterior palatine foramen. Between this and the superior maxillary bone, a hiatus or sort of vestibule is left vacant, in which is observable the posterior opening of the foramen above mentioned, besides two others formally described. *The ethmoidal surface* is divided from the nasal by the palatine crest, to which the vomer is joined: it is oblong and concave, and constitutes the floor of the ethmoidal sinus, possessing several irregular ridges, which form so many imperfect septa, projecting into the cavity.

Borders.—*The palatine,* round, smooth and lunated, forms the circumferent boundary-line of the posterior opening of the nose, and affords attachment to the velum palati: from it, posteriorly, descends the styloid process, whose extremity, in the recent subject, is provided with a cartilaginous pulley, in which runs the tensor palati; the posterior side of the process is rough and laminated for articulation with the pterygoid process of the sphenoid bone. *The supero-lateral* and *infero-lateral borders* unite with the superior maxillary bone: the former has also a connection with the inferior turbinated bone: these borders are both denticulated.

Extremities.—*The posterior* or *orbital* is expanded, and is received between the frontal and ethmoid bones: *the anterior extremity* is narrow, incurvated upwards, and joins its fellow.

Particularities. The styloid processes, or rather epiphyses, are rarely preserved disunited and entire after maceration, owing to the late period at which they continue to be ligamentous at their roots, as also to the length, slenderness, and consequent frangibleness of them.

Connection. With the frontal, ethmoid, and sphenoid; and with the superior maxillary, inferior turbinated bones, and vomer.

THE TURBINATED BONES, SUPERIOR AND INFERIOR.

(OSSA TURBINATA, SUPERIORA ET INFERIORA.)

Situation. Within the chambers of the nose, attached to the outer walls; the superior above; the inferior below.

Form. Oblong, thin, foliated, convoluted, cavernous.

Division. Into external and internal surfaces; superior and inferior extremities.

Surfaces.—Porous. *The external* is convex; and presents series of longitudinal grooves, disposed in an arborescent manner, which mark the ramifications of very small blood-vessels. In consequence of the bone being rolled up or twisted round itself after the fashion of a turban, the outward superficies becomes extensive, although it diminishes in breadth beyond the exterior, from the internal convolution being, in course, smaller than the external. *The internal surface,* or opposite side, is concave, and, like the former, necessarily diminishes as it proceeds inward. The interior itself is cavernous, or rather cellular, being unequally divided by transverse septa into several little sinuses or cells, communicating through small apertures one with another, and through the intervals between the convolutions, with the middle nasal meatus.

Extremities.—*The posterior* or *basiform,* are broad; their interior is capacious, and opens superiorly; and they communicate with the sinuses immediately behind them. *The anterior* or *api-*

form extremities are contracted and closed; and give origin, in the recent subject, to two cartilaginous productions, which project into the chambers of the nose.

Particularities. These bones are four in number: two superior, and two inferior. They are thin, and porous or spongy in their texture; brittle, and yet possessing sufficient elasticity to enable them to resist considerable pressure, and withstand, without fracture, any ordinary injury.

Difference. The superior bone exceeds in volume the inferior, and makes its convolution from below, its upper border being attached; whereas, the reverse is the case with the inferior one.

Connection. The superior bone is connected, above, with the ethmoid; and laterally, with the nasal bone. It contributes to the formation of the anterior part or floor of the frontal sinus. The inferior turbinated is fixed to the superior maxillary bone.

THE VOMER.

Situation. Along the floor of the nose, preserving the median longitudinal line dividing the chambers.

Figure. Elongated: posterior portion, broad, quadrilateral, and flattened; anterior, narrow, grooved, and lengthened.

Division. Into two extremities and two borders.

Extremities.—THE POSTERIOR OR BROAD PART exhibits *a lower surface,* somewhat convex, which is smooth and free; *an upper surface,* somewhat concave, which embraces and almost conceals the body of the ethmoid bone; *a superior crescentic border,* between which and the ethmoid is a narrow hiatus, giving passage to some blood-vessels and nerves to the septum narium; *two lateral borders,* united with the palate bones; and *four cornua* or projecting acuminated ends, the two superior articulating with the sphenoid bone, the inferior with the palate bones. THE ANTERIOR EXTREMITY is broader than other parts of the grooved shaft, in consequence of being flattened above and below; it reaches as far forward as the palatine processes of the anterior maxillary bone.

BORDERS.—*The superior* presents a long narrow chasm or groove, deeper posteriorly than anteriorly, which receives the cartilaginous partition called the septum narium. *The inferior border* is semi-cylindrical, and presents a posterior part, smooth and free from any connection; and an anterior, which denticulates with the palatine processes of the superior maxillary bone.

Connection. With the ethmoid and sphenoid, and with the superior and anterior maxillary and palate bones.

THE INFERIOR MAXILLARY BONE.
(OS MAXILLARE INFERIUS.)

Constituting, by itself, *the inferior maxilla,* or lower jaw.

Situation. Composing the inferior and posterior parts of the face.

Form. Symmetrical, bearing much resemblance to the letter <; the angular or narrow part being presented forwards, the sides diverging and opening backwards.

Division. Into body, neck, sides, and limbs or branches, together with their respective external and internal surfaces and borders.

THE BODY is the anterior undivided portion, reaching back so far as to include the tusks within their sockets. THE NECK is the contracted part springing from the body; the two together forming a solid bond of union between the sides, sustaining them, together with the branches, in immovable relative position. In the young subject, a longitudinal median suture, named the inferior maxillary symphysis, divides the bone at this part into separable symmetrical halves; bony union, however, solidifies the two early in life, after which they are no longer distinct pieces. *The external surface* of the body is convex and rounded, and in places rough and porous, from the attachment of the levator menti and gums. A groove across the neck marks the course of the former symphysis. At the place where the neck joins the side, near the superior border, is the anterior maxillary foramen, which forms the outlet of a canal running between the laminæ of the bone along the roots of the molar teeth: it is traversed by the third division of the fifth pair of nerves. *The internal surface* of the body is slightly concave, and is rough and porous from the attachments of the gums and membrane of the mouth; that of the neck forms a channel for the tongue, and receives the insertion of the frœnum linguæ. *The border* projects forward, forming a parabolic curve, and presenting, superiorly, conical alveolar cavities for the six lower incisive teeth and the two inferior tusks; posteriorly, on the neck, the border rises into a sharp edge, which is rendered less prominent in old horses, in consequence, it would appear, of the repeated pressure and friction of the bit.

THE SIDES are the parts comprehended between the neck and the branches: they support all the inferior molar teeth. They increase in breadth from before backward, are flattened laterally, and present external and internal surfaces, superior and inferior borders. The surfaces, though, generally speaking, they may be pronounced to be flat, possess a degree of prominence in early and adult life which they lose in age: this may be ascribed in part to the teeth, and in part to the comparative porousness or incompactness of structure of the young bone. The external surface is occupied by the depressor labii superioris; the internal by the muscles of the hyoidean region. The vacuity between the sides takes the name of inter-maxillary space.—*Of the borders,* the superior exhibits twelve quadrangular alveolar cavities for the molar teeth, formed by the separation of the laminæ composing the bone, and the addition of so many transverse thin partitions or septa. The inferior border is thick, round, and smooth in early life; but, as age advances, grows thin, sharp, and irregular.

THE BRANCHES, the parts directed upwards, are broad, thin, and slightly curved; and offer for notice two surfaces, two borders, two processes, and a notch. *The surfaces* are generally smooth, though they exhibit marks of muscular attachment: the external one is clothed by the masseter; the internal, by the pterygoideus internus; the latter, also, is pierced a little behind the last molar tooth, by the posterior maxillary foramen, which forms the entrance to the dental canal, the anterior maxillary hole being its outlet. *The borders*:—The posterior is broad, and roughened by the attachment of the stylo-maxillaris and masseter: the part where it makes its curvature to join the side is called the angle of the jaw. The anterior border is thin, and presents a sharp edge, turned inwards: it gives attachment to the buccinator and depressor labii inferioris. *Processes*:—The posterior border is surmounted by the condyle,—the transverse, cylindroid, smooth convexity which is received into the glenoid cavity in the temporal bone. The anterior border ends in the coronoid process, which is flattened on its sides, has sharpened edges, and is slightly curved backwards; into it is implanted the temporal muscle. Between the two processes is *the corono-condyloid notch,* which affords space for the motion of the jaw, as also for the insertion of the temporal muscle.

III.—THE HEAD IN GENERAL.

We shall now take a review of the head in its entire or articulated state, making, to facilitate the description, a

Division of it into External and Internal parts.

The External Parts

may be conveniently distinguished into superior, posterior, inferior, and lateral surfaces; and each of these surfaces admits of a further subdivision into cranial and facial regions.

THE SUPERIOR EXTERNAL SURFACE comprehends—

1. THE SUPERIOR CRANIAL REGION, in which we find several zigzag denticulated lines, denominated *sutures,* indicating the boundaries and articulations of the several individual bones.

In this region, commencing from its anterior limits, we observe *the frontal suture,* formed by the articulation of the frontal bones; surmounted by a transverse serpentine one, *the coronal suture,* showing the line of junction of these bones with the parietal; next, *the parietal prominences,* bounded posteriorly by *the lambdoidal suture,* which joins the occipital with the parietal bones: lastly, forming the posterior boundary of the region, *the occipital crest.*

2. THE SUPERIOR FACIAL REGION, continuous, behind, with the last-described region, presents to view, commencing from its posterior boundary, *the transverse suture,* the line of union between the bones of the cranium and those of the face, joining the frontal to the nasal and lachrymal bones; continued forwards, in a direct line with the frontal, *the nasal suture,* which unites the nasal bones: this suture runs within a sort of hollow from the bone, on its sides, rising into *the nasal prominences:* these are bounded laterally by the *lateral nasal sutures,* formed by the junction of the nasal with the maxillary bones, both superior and anterior. *The nasal peak* is the united apices of the nasal bones, projecting forward over *the anterior nasal opening;* which aperture is bounded laterally by the *superior convex surfaces* of the anterior maxillary bones, and in front is oviform and continued into *the superior maxillary symphysis,* through which runs *the foramen incisivum:* lastly, *the superior alveolar processes,* and *the incisive teeth,* ranged in a row and fixed within *the alveolar cavities.*

The POSTERIOR SURFACE is entirely CRANIAL: it is bounded, superiorly, by *the occipital crest,* and, inferiorly, by *the occipital hole;* it presents *the occipital tuberosity,* and on its sides the broad *posterior occipital depressions,* deeply and ruggedly pitted by muscular attachments; also, projecting from the postero-lateral parts of the foramen magnum, *the occipital condyles.*

The INFERIOR SURFACE comprises—

1. THE INFERIOR CRANIAL REGION, which is bounded, posteriorly, by the occipital hole and condyles; anteriorly, by the vomer and palate bones; laterally, by the zygomatic arches. Proceeding from behind forwards, we observe—1st, along the median line, *the basilar process,* impressed by *the basilar fissure;* the *condyloid foramina* on its sides, near the roots of the condyles; *a semicircular prominence* denoting its junction with the sphenoid bone; *the body of the sphenoid bone,* its *articulation* with that of the ethmoid, and a small *semilunar portion* of the latter left visible within the crescentic border of the vomer. 2d, On either side, *the occipital styloid process;* between it and the condyle, *the*

occipital notch; in front of the notch and root of the occipital styloid projection, THE PETROUS PORTION of the temporal bone—exhibiting, posteriorly, *the posterior mastoid process*, having at its root the external orifice of *the aqueduct of the vestibule*: directly in front, *the auditory process* and *meatus*, at the inner side of which is *the hyoideal process*; behind the meatus are *the mastoid cells*: projecting from the inner and anterior part, is the slender *temporal styloid process*, having at its root *the Eustachian opening* and *styloid foramen*. In front of, and rather outwardly to the petrous portion, we observe,—*the anterior mastoid process*; at its root, *the mastoid foramen*: extending outwardly, in front of it, *the glenoid cavity*, bounded anteriorly by *the temporal articular process*. *The foramen lacerum* is the large irregular opening formed by the occipital, temporal, and sphenoid bones, comprehending *the tempero-occipital* and *spheno-occipital hiatus*, and traversed by the internal carotid artery, the jugular vein, the eighth pair of nerves, and the inferior maxillary nerve. This foramen is bounded in front by the ala of the sphenoid bone, whose borders are joined to the temporal and ethmoid bones by *the sphenoidal suture*. Curving forwards and downwards from the ala is the *pterygoid process*: it articulates along its front part with *the palatine styloid process*, which is comparatively slender and descends beyond it. At the root of the pterygoid process is seen *the pterygoid foramen*, forming one continued passage with the infero-posterior orbital hole.

2. THE INFERIOR FACIAL REGION constitutes the remainder of the inferior surface: it is bounded, posteriorly, by the sphenoid and ethmoid bones; and, anteriorly, by the incisive teeth. Beginning from behind, we perceive,—in the middle, *the broad part of the vomer*, embracing the body of the ethmoid; and its *superior cornua* extending under that of the sphenoid bone, at whose points are found *the spheno-palatine foramina*, which open again under the infero-posterior orbital: anteriorly to this it articulates with the palate bones, both laterally and along their middle.—Laterally, *the palatine styloid processes*, and the *nasal* and *palatine surfaces* and *borders* of the palate bones, by which latter is formed *the posterior opening of the nose*: this aperture in its general figure is oval lengthwise, and is equally divided into two semilunar halves by the shaft of the vomer, about one third of whose length is seen through the orifice. Farther outward, on the sides of this opening, *the maxillary tuberosities*; immediately above them, *the maxillary hiatus*, or entrance to *the posterior palatine foramen*, *the infra-orbital canal*, and *the anterior palatine conduit*; extending forward from the tuberosities in parallel lines, *the alveolar processes* and *cavities* for *the twelve superior molar*

teeth; from which project inward *the palatine processes* belonging to the same bone, joined by the palate bones above, and *the palatine processes of the anterior maxillary bones* below: these parts, altogether, constitute *the bony palate.* The anterior third of the palate takes the name of *interdental space*; it is, in fact, a longitudinally oval interval, which is incompletely filled by the anterior palatine processes. At the junction of the contributing portions of the palate and maxillary bones to the palatine arch, opposite and near to the last molar tooth, is *the palato-maxillary foramen*; from which takes its rise *the palato-maxillary canal,* which courses the roots of the alveolar processes, and conducts an artery of the same name forwards. Along the middle of the arch runs *the palatine suture,* uniting the palate and superior and anterior maxillary bones of one side to their fellows on the other. At the external borders of the interdental space, formed by the superior and anterior maxillary bones, are *the alveolar cavities for the tusks,* commonly nearer by about one third to the corner incisive than to the first molar teeth. *The symphysis of the superior maxilla* continued in a line from the palatine suture; pierced by the lower opening of *the foramen incisivum,* which is situated at the roots of the anterior palatine processes, and gives passage to the palato-maxillary arteries. The anterior maxillary surface is vaulted in front, to extend the superficies of the palate. In conclusion, we have *the inferior alveolar processes, alveolar cavities,* and *inferior surfaces* and *faces of the incisive teeth.*

EACH LATERAL SURFACE includes—

I. THE LATERAL CRANIAL REGION, which is bounded, posteriorly, by the occipital crest and condyloid process; anteriorly, by the orbit. It presents to observation—*one side of the occipital crest,* descending to the base of the styloid process, whence a sharp ridge extends from it to the zygomatic crest, which ridge forms the inferior boundary of *the temporal fossa. The external side of the occipital styloid process,* roughened from the attachment of the stylc-maxillaris. THE PETROUS PORTION of the temporal bone, locked in between the squamous portion of the same and the occipital bone, comprising—*the mastoid process,* in apposition with the base of the occipital styloid process behind, and with *the descending plate* of the squamous portion in front. Within a circular space formed by this plate behind, and *the anterior mastoid process* before, protrudes *the auditory process,* to which is attached the external ear: it is perforated by *the meatus auditorius externus,* whose orifice is expanded or trumpet-shaped. *The temporal zygomatic process* is continuous, posteriorly and inferiorly, with the anterior mastoid; at which part its surface is excavated to make room for the attachment of the external ear;

from this the process curves upwards and outwards, and subsequently forwards, in the form of an arch, meeting on the outer side of the orbit with the zygomatic process of the malar bone, and articulating with it through *the zygomatic suture,* the two completing *the zygomatic arch,* against which abuts *the frontal arch. The zygomatic crest* and *the articular process,* the one rising, the other descending, from the temporal part of the arch, are also observable.

2. THE LATERAL FACIAL REGION extends from the orbit to the incisive teeth. It is partially and very unequally divided into superior and inferior departments by *the zygomatic spine;* which arises from the infero-external and anterior part of the arch of the same name, reaches forward about one third of the length of the face (measuring from the orbit), and ends abruptly: the inferior department is occupied by the masseter, to which the spine gives attachment; the superior, by much the most extensive surface, exhibits, a little higher than its middle, *the infra-orbital foramen;* near the inner angle of the orbit, *the lachrymal tubercle*; between the foramen and the tubercle, *a depression,* marking the attachment of the nasalis longus labii superioris; anteriorly, *a superficial hollow,* denoting the place of attachment of the caninus: besides these, various other muscular impressions are perceptible. *The sutures* displayed upon this surface are,—*the lateral nasal,* extending from the transverse suture to the lateral opening of the nose, and uniting the nasal to the lachrymal and superior and anterior maxillary bones; *the malar suture,* running transversely downward and outward from the lateral nasal, and connecting the superior maxillary to the lachrymal and malar bones; *the lachrymal suture,* extending perpendicularly backward from the malar, and continuing its course within the orbit, uniting the lachrymal and malar bones; *the maxillary suture,* extending obliquely, forward and downward, from the anterior part of the lateral nasal, and joining the superior and anterior maxillary bones. Supero-anteriorly (in relation to this surface) we perceive one of *the lateral openings* of the nose, bounded in front by *the nasal peak,* behind by *the superior* or *convex border* of the anterior maxillary bone. In front of this border, the bone shows the surface for the attachment of the depressor labii superioris. From the inferior parts of this region project *the molar, canine,* and *lateral incisive teeth.*

INTERNAL PARTS:

Comprehending the Cavities of the Cranium, Orbit, Nose, and Mouth.

I.—CAVITY OF THE CRANIUM.

Constructed for the lodgement of the brain with its appendages: is in form ovoid, flattened inferiorly, broader anteriorly than posteriorly; its antero-posterior or long diameter measuring about seven inches; its transverse or lateral diameter, about four inches; its vertical or perpendicular diameter, about three and a half inches. At the same time it is to be observed, that, although the general form of the cavity is the same, its dimensions may and do vary in different heads. The eight bones composing the cranium all present internally surfaces more or less concave, which, united, form the cavity under consideration; hence it is that the interior is not regular or uniform, but presents to view different hollows, which are adapted to distinct prominences of the cerebral mass.

DIVISION of the interior surface into roof and base of the cranium:

THE ROOF *is formed by the frontal, parietal, and occipital bones: its superficies is larger than the extent of the base, and* it is without any apparently defective places, observable in the latter. It presents—1st. On the mesian line, from front to back, *the sagittal groove,* for the longitudinal sinus, formed by *the frontal* and *parietal crests,* crossed towards the front by *the coronal suture,* and bounded posteriorly by *the parietal protuberance,* to which is attached the tentorium, and behind which is *the occipital cupula,* for covering the cerebellum. 2d. On either side, along the same line, *the cerebral concavities of the frontal bone; the coronal suture,* the boundary line between them and *the parietal concavities; the transverse grooves,* for the lateral sinuses; and, sunk within them, *the lambdoidal suture.*

THE BASE is formed by the temporal, sphenoid, ethmoid, and occipital bones. It presents, 1st. On the middle line, from before backwards, *the crista galli,* and on its sides *the ethmoidal fossæ* and *cribriform plates,* bounded laterally by *the internal orbital plates of the frontal bones,* and them pierced by *the internal orbital foramina; the concave surface of the body of the ethmoid bone; the optic hiatus* leading to *the optic foramina; a transverse suture* between the ethmoid and sphenoid bones. Upon the sphenoid bone, *the pituitary fossa,* bounded laterally by the two *optic fossæ;* the latter leading to the foramina lacera orbitalia, over which are *the spinal foramina: a transverse elevated line* denotes the place of junction of the sphenoid with the occipital bone. Belonging to the occipital bone, are *the basilar fossæ* and *the occipital hole.* 2d. On either side, in the same direction, *the internal surface of the wing of the ethmoid bone,* rather more convex than concave, for the support of the anterior lobe of the cerebrum; *the concavity of the wing of the sphenoid bone,* for the reception of the middle lobe; *the concavity of the squamous part of the temporal bone,* for lodging the posterior lobe: and the sutures bounding these three cerebral surfaces. *The foramen lacerum basis cranii,* formed between the wing of the sphenoid anteriorly, the basilar process of the occipital bone internally, and the petrous portion of the temporal bone externally and posteriorly: it is wide and irregular before, narrow behind, and is distinguished into *the spheno-occipital* and *temporo-occipital hiatus.* THE PETROUS PORTION OF THE TEMPORAL BONE, presenting a narrow triangular surface forwards and upwards, which contributes to the posterior cerebral concavity; a broad smooth but uneven surface inwards, against which inclines the cerebellum, and upon which we distinguish—*a,* the orifice of *the meatus auditorius internus; b,* a *transverse prominence,* and several *cerebral indentations; c,* an irregular convexity downwards, which forms the boundary wall of the labyrinth; *d,* a *fissure* separating it from the former. Lastly, *the sutures* uniting the petrous to the squamous portion and to the occipital bone. Of THE OCCIPITAL BONE, a part of the internal surface assisting in the formation of a concavity for the cerebellum, by the convolutions of which it is indented; the surface even and smooth, and slightly excavated below this, for the support of the medulla oblongata; still lower, *the condyloid foramina,* through which the ninth pair of nerves pass out.

II.—THE ORBITS,

Two in number, are formed for the lodgement, attachment, and protection of the eyes and their appendages.

Figure.—Symmetrical. The cavity, which is extended horizontally backward and inward, has, viewed in front, a pyramidal aspect: the base, represented by the front, has four sides and four angles; one only of the sides, however, is sufficient in extent to reach the apex, the others being all more or less imperfect. A line drawn in the horizontal direction through the axis of this figure, inclines more outwards than forwards, more forwards than downwards, intersecting another horizontal line projected directly forward at an angle of about 70°, and one extended laterally, directly outward (at right angles with the former), at about 20°: the inclination downward, however, will in course vary with the erect position of the head.

Structure. The orbit is composed of unequal portions coming from four of the bones of the cranium, and from three of those of the face; viz. the frontal, ethmoid, sphenoid, and temporal bones; the malar, lachrymal, and palate bones.

Division. Into sides, angles, base, and apex.

SIDES.—THE SUPERIOR SIDE or roof of the cavity consists only of *the frontal arch;* which is concave and smooth internally, to make room for the lachrymal gland, and has anterior and posterior borders, sharp and slightly curvated. THE INFERIOR SIDE or floor of the orbit is formed by *the orbital surfaces of the lachrymal and malar bones,* is broader than the roof, though, like it, is deficient as a whole. It comprises *the orbital portion of the lachrymal suture:* it is terminated, in front, by *a smooth, rounded, curvated border;* behind, nearly midway between the base and apex, by *a shorter and straighter border.* THE INTERNAL OR NASAL SIDE, the broadest and only complete one, is formed principally by *the internal orbital process of the frontal bone,* into the notch of which is received *the os planum: the ethmoid bone* further contributes, and also *the sphenoid* and *palate bones,* the three constituting that irregular termination of the cavity behind which represents the apex. The frontal orbital plate is smooth and slightly concave, and is united below by a continuation of *the transverse suture* with the lachrymal bone. Its *border in front,* though slightly curvated, is *very irregular,* having several notches and *one* or *two small foramina* in it; it also presents *a little tubercle,* to which the lachrymal caruncle is attached. THE EXTERNAL OR ZYGOMATIC SIDE is formed principally by the *zygomatic process of the malar bone,* that of the temporal contributing but little: it is concave and smooth internally, somewhat broader below than upwards; is intersected obliquely by the zygomatic suture, and has an anterior border, smooth and curvated; a posterior one, sharp and straight.

ANGLES.—THE SUPERO-INTERNAL ANGLES, one before, the other behind, are formed by the beginning of the frontal arch, through which, midway between them, passes the supra-orbital foramen. The infero-internal angle includes *the lachrymal fossa.* THE SUPERO-EXTERNAL ANGLES, one anterior, the other posterior, are intersected by the *suture* uniting the frontal and zygomatic arches. The infero-external angles, particularly the anterior, are rounded and smooth.

BASE.—Of the circumferent border, the superior and internal parts, about two fifths of the entire circle, are formed by the os frontis; the inferior and internal parts, about one fifth, by the lachrymal bone; and the remaining two fifths by the malar and temporal bones, in the proportion of three parts of the former to one of the latter.

THE APEX or back of the orbit, formed by the ethmoid, sphenoid, and palate bones, is pierced by five foramina: the two round are *the internal orbital* and *optic,* which are ranged in a row with two oval and larger in size, *the supero-posterior* and *infero-posterior orbital;* the one behind is *the spinal foramen.*

III.—CAVITIES OF THE NOSE,

Comprehending the nasal fossæ or chambers, and the sinuses. These cavities occupy about two thirds of the internal space of the superior maxilla, the remaining third belonging to the cranium; from which they are partitioned by the cranial septum of the frontal bone, in union with the cribriform plates and crest of the ethmoid.

THE NASAL FOSSÆ may be said to include about two-thirds of the entire space devoted to the olfactory cavities. They constitute the interior of the proboscis; have four boundary walls, one above, one below, and two laterally; are separated from each other by a septum; but are open both before and behind.

THE SUPERIOR WALL presents an irregular concave formed by the internal surfaces of the nasal bones, the cells and grooves of the ethmoid, and small portions of the nasal surfaces of the palate bones.

THE INFERIOR WALL is horizontal; it extends forwards beyond the superior, but is considerably overreached by that wall posteriorly: it is formed by the palatine portions of the anterior and superior maxillary, and by the palate bones. The surface is transversely concave, and presents a slight eminence a little behind its middle.

EACH LATERAL WALL OR SIDE presents an irregular concavity, and is formed by the anterior and superior maxillary and the palate bones. To it are attached the superior and inferior turbinated bones, by which the fossa is divided into three separate passages or meatus. *The superior meatus,* comprised between the nasal and superior turbinated bones, extends from the angle of the lateral nasal opening, passing over the ethmoidal cells, to the cribriform plate, following superiorly the declination of the wall. *The middle meatus,* included between the turbinated bones, leads superiorly into the ethmoidal grooves and cells, and into the sinuses of the head, and ends below beneath the termination of the superior. This passage, like the former one, is narrow; but its greatest diameter is, obliquely, in the perpendicular direction; whereas the other measures most from side to side. It receives the apertures of the ductus ad nasum, maxillary sinus, ethmoidal grooves, and turbinated cells. *The inferior meatus* is the most capacious as well as most direct one: it extends along the inferior wall, from the anterior to the posterior opening of the nose.

THE SEPTUM NASI is the partition separating one fossa from the other. It is formed, posteriorly, by the ethmoidal plate; inferiorly and posteriorly, by the vomer; superiorly and anteriorly (and principally), by a broad perpendicular plate of cartilage.

THE OPENINGS OF THE NOSE are—*The anterior*, divided by the nasal peak and septum nasi into two, and formed by the superior borders of the anterior maxillary bones: *the posterior*, divided after the same manner by the vomer and septum, and formed by the nasal surfaces and crescentic borders of the palate bones.

THE SINUSES OF THE HEAD communicate with, and may be said to constitute part of, the nasal cavities. They are the frontal, nasal, maxillary, sphenoidal, ethmoidal, and palatine.

THE FRONTAL SINUSES, formed within the frontal bones, are situated so that a straight line extended between the supero-internal angles of the orbits passes opposite to about the angular or deepest parts of their cavities. The sinus (on either side) has a triangular figure. *The superior side* or roof is flat, and (barring the septa) even upon its surface; whereas *the posterior side* is irregular, being convex inwardly, where it is formed by the cranial septum; concave outwardly, where it is opposed to the part composing the temporal fossa. The inferior side slants from behind forwards, and from below upwards, is irregular on its surface, and open or deficient outwardly, where the cavity communicates with the maxillary sinus. Of the *angles*, one is directed upwards; another downwards, terminating in the nasal sinus, with which it is conjoined, the two forming one continuous cavity; the third points backwards, and is directly opposite to the imaginary transverse line above alluded to. The cavity is traversed and divided into several unequal open compartments and recesses by *septa;* the principal of which is one extended between the superior and inferior sides: it is partitioned from the opposite sinus by the nasal spine. The sinus is but small in the young compared to its proportionate dimensions in the adult subject: it continues to increase afterwards with age, and ultimately extends throughout the whole of the frontal bone.

THE NASAL SINUSES, formed by the nasal bones above and the superior turbinated bones behind, are nothing more than the culs-de-sacs or blind terminations of the frontal sinuses.

THE MAXILLARY SINUSES, the largest of these cavities, are spacious but very irregularly formed. They are situated below and in front of the frontal. Of this sinus, on either side, the posterior and external walls are formed by the malar and lachrymal bones, whose orbital processes constitute a thin partition between it and the orbit; the inferior parts consist of the excavations in the superior maxillary bone; superiorly, the sinus is open, being there continuous with the frontal: the boundary line between these cavities is marked by the suture uniting the lachrymal to the frontal and nasal bones on the outer side, and by the prominent crest formed by the junction of the superior turbinated with the ethmoid bone on the inner; underneath which part, through a curved (and in the recent subject sort of valvular) fissure, the sinus opens into the middle meatus, between the bases of the turbinated bones. The cavity is but small, and still more irregular, in the young subject, in consequence of the intrusion of the yet uncut molar teeth.

The frontal sinus, then, terminates in the nasal, but both discharge themselves into the maxillary; the maxillary has also a blind termination, but empties itself into the posterior part of the middle nasal meatus.

THE SPHENOIDAL SINUS is situated within the palatine portion of the body of the sphenoid bone. It has no existence in the young subject, the bone being solid throughout; but in process of growth a cavernous hollow is formed, which, from the secession and attenuation of the laminæ of the bone, continues to enlarge. It communicates, by two ovoid openings, with the ethmoidal sinuses.

THE ETHMOIDAL SINUSES are two cavities, separated by the perpendicular plate, situated beneath the ethmoidal cells. They have openings in front, communicating with the lowermost and largest grooves of the same bone, and with the palatine sinuses.

THE PALATINE SINUSES are formed between the superior maxillary and palate bones; are situated below and in front of the former; are separated from each other by the vomer; and open into the maxillary sinuses: they are irregular in form and cavernous interiorly. They are not to be found in the young subject. Some might be inclined to treat them as parts of the maxillary sinuses; they are, however, as perfectly distinct from the latter as the frontal are.

IV.—THE MOUTH.

The mouth is the cavity included between the superior and inferior maxillæ, making (in the skeleton) one common vacuity with the inter-maxillary space. Its antero-posterior dimensions can be but little varied; but its supero-inferior diameter will be increased in the ratio of the distance to which the inferior maxilla recedes from the superior; the cavity during the distraction of the jaws assuming the figure of a misplaced >, the angle of which is turned backwards.

The mouth is formed—superiorly, by the palatine and superior and anterior maxillary bones; inferiorly, by the inferior maxilla; laterally, by the molar teeth; anteriorly, by the incisive teeth. Behind, through the posterior opening of the nose, it communicates with the nasal fossæ.

OF THE EXTREMITIES.

In number, four.—*Disposed* in pairs.—*Divided* into fore and hind extremities.

I.—THE FORE EXTREMITIES.

Situation. Antero-lateral parts of the trunk, from which they proceed downward.

Division. Into shoulder, arm, knee, leg, pastern, coronet, and foot.

OF THE SHOULDER.

Constituted of the scapula, superiorly; and of the humerus, inferiorly.

BLADE BONE. (SCAPULA.)

Situation. Antero-lateral part of the thorax. Its position is oblique, the antero-superior angle being directed forwards and upwards; the postero-superior, downwards and backwards. The former rises above the transverse process of the fourth dorsal vertebra; the latter is opposed to the angle of the seventh rib. The coracoid process comes opposite to the sternal extremity of the first rib.

Form. Triangular: inferior angle irregular and detruncated. Broad and thin, superiorly; narrowing, but growing thicker and more substantial, inferiorly.

Division. Into two surfaces, three borders or sides, and three angles.

Surfaces. *External* and *Internal.* The external, sometimes called the dorsum scapulæ, is divided unequally into two superficial concavities, named the fossæ antea et postea spinatæ, by the spine, a longitudinal eminence arising gradually from the superior border, and terminating imperceptibly in the neck, the smooth contracted part above the lower extremity of the bone: the posterior is thrice as large as the anterior fossa; the one giving attachment to the antea spinatus, the other to the postea spinatus muscle; and the spine to the trapezius. In the posterior fossa, near where it joins the cervix scapulæ, is the medullary foramen, directed downward. *The internal surface,* also called the venter scapulæ, and sometimes the subscapular fossa, is smooth, though uneven, being excavated in the middle, flattened laterally and inferiorly, and is marked by the attachment of muscles: in the middle, and principally, by the subscapularis; around the posterior angle, by the teres major; superiorly, by the serratus magnus; still higher, along the border, by the rhomboidei.

Borders.—The superior, nearly straight and but little mor than half the length of the lateral, is thick, and presents a grooved scabrous summit, into which is fixed the cartilage of the scapula, forming a flexible plate of considerable breadth, diminishing in thickness as it ascends from the bone, and terminating in a thin convex edge, which is inclined inward.—*The anterior border* discribes the figure of an inverted S. It is thin, and presents a sharp edge superiorly; below, it grows obtuse and rounded, and terminates in the coracoid process, a rough hemispherical prominence, presenting in front of the shoulder-joint, to which is affixed the coraco-brachialis and flexor brachii. *The posterior border* is obtuse, rounded, and smooth, except that, inferiorly, there are some few unimportant asperities: it affords attachment to the teres minor and large head of the triceps extensor brachii.

Angles.—The two superior are rectangular and sharp: the postero-superior has, externally, a prominence just below it, marking the origin of the teres major. *The inferior angle* is represented, or, rather, has its place supplied, by the glenoid cavity —the smooth ovoid shallow cup, notched inwardly, formed for articulation with the head of the os humeri: it is rendered deeper a marginal cartilage; and has around its border inequalities and porosities, to which is fixed the capsular ligament. Between the glenoid cavity and the coracoid process, internally, is an excavation, serving for a passage to the tendon of the subscapularis.

Connection.—The scapula is attached to the thorax by the several muscles passing between them; also by two ligamentous fasciæ.

.*Development.* In the very young subject, the coracoid process forms an epiphysis: in old age, the cartilage of the scapula takes on ossification.

HUMERUS.

Situation. Between the scapula and the arm; placed in an oblique but contrary direction to the scapula, viz. downwards and backwards; whereby an angular space, of considerable extent, is left between the two bones.

Form. Cylindroid; presenting the appearance of having been twisted around itself.

Division. Into a body and two extremities.

Body.—Angular, with expanded, flattened sides, superiorly; contracted and rounded, inferiorly. From its upper, fore, and outer part, projects the tuberosity; whose point is roughened by the insertion of the levator humeri. The outer side of the body is excavated and smooth; it is occupied by the humeralis externus: the inner side is rather prominent and roughened, and exhibits a small scabrous eminence, which receives the tendons of the latissimus dorsi and teres major; also, lower down, we find the medullary foramen, pointing downwards.

Superior extremity—Larger than the inferior, presents for consideration a head and four tubercles. *The head* is the hemispherical smooth part projecting posteriorly; it is designed for articulation with the glenoid cavity of the scapula, which it much exceeds in extent of superficies, and thereby obtains more freedom and variety of motion. Into the irregular and indented groove by which the head is surrounded, is fixed the capsular ligament. Anteriorly, the head is surmounted by the tubercles: the three directly in front are anti-articular, and have between them two smooth grooves, which, as well as themselves, are covered by cartilage, and altogether serve as a pulley for the tendon of the flexor brachii to play over. The outer articular tubercle is joined by a protuberant ridge with the tuberosity. The fourth, or outer tubercle, serves to guard against dislocation.

Inferior extremity—Displays a specimen of the diarthrodial or pulley-like articulation. It consists of two condyles, dis tinct from each other posteriorly, being theres eparated by a deep ovoid fossa, into which is received the olecranon of the ulna; but united, inferiorly and anteriorly, into a broad semi-cylindrical articular surface, divided by a prominence encircling its middle into two depressed compartments, of which the inner has twice the breadth of the outer, and bounded by two lateral prominent edges: furthermore, the condyles, of which the inner is larger and more projecting behind as well as before, meet at an angle above the fossa, and there run into union with the body. There are also two scabrous pits above the articular surfaces in front, which, like the cavity behind, occasionally receive processes of the bone below.

Connection. The head of the humerus is adapted to the glenoid cavity of the scapula; the condyles are fitted into concavities upon the upper extremity of the radius.

Development. In the young bone, the head, condyles, and tubercles are epiphyses.

OF THE ARM.

The arm is composed of a single bone, the *os brachii,* which corresponds to the human radius and ulna united together.

ARM-BONE (OS BRACHII.)

Form. Cylindroid; flattened before and behind; slightly curved forwards.

Division. Into radial and ulnar portions.

THE RADIAL PORTION consists of a body and superior and inferior extremities.

The body is long; prominent and smooth anteriorly; slightly excavated and roughened posteriorly, where it is pierced in a direction downward by the medullary foramen: the former is clothed by the extensor muscles of the leg and foot; the latter by the flexors of those parts.

The superior extremity, like the inferior, expanded into greater breadth than the body, presents an articulatory surface, divided, by a gentle eminence running across the middle, into two concavities, of which the inner is broader and more circular than the outer; the latter, indeed, has a superficial rising, taking the direction which makes a similar but imperfect subdivision of it: those concavities receive the condyles of the humerus. The external lateral process is more prominent and sharper than the internal, and is surmounted in front by a small tubercular eminence: to these processes the lateral ligaments are attached; the eminence serves also to deepen the outer cup of articulation.

The inferior extremity is remarkable for the number and variety of its articulatory surfaces, and for presenting a hiatus extero-posteriorly, as if a piece of the bone had been chiselled out. It possesses three articulatory surfaces. The largest, or inner one, is quadrilateral in outline, sigmoid in superficies; the middle is similar in form, but of smaller dimensions; the outer, or smallest, is an ovoid convexity. The internal lateral process is the most prominent; the external has a groove along it. The bone is also grooved in front by the passage of the extensor tendons.

THE ULNAR PORTION consists of body, projection, and articulatory surface.

The body is the tapering triangular part which is firmly united above, but more intimately below, with the radial portion; between the two is an interval, admitting of the passage of a circulus of blood-vessels.—*The surface* composing part of the humero-brachial articulation, in form a semilunar concavity, is only in part articulatory, the lower half presenting roughened inequalities for ligamentous attachment: it is adapted to the smooth trochleal surface between the humeral condyles behind.—*The projection,* named *the olecranon;* the part corresponding to the elbow in man, is one of considerable magnitude, standing out in a direction upwards and backwards from the upper extremity of the radius; it is prominent and uneven on its outer side, excavated and smooth on its inner, and terminates in a broad, rough protuberance, into which is implanted the triceps extensor brachii. In addition to two *sides,* it possesses two borders, both sharp, and disposed in curvatures looking inwardly: the anterior terminates in a projecting point, which forms the superior boundary of the articular surface; the posterior extends down, and becomes continuous with that of the body.

Connection. With the humerus, above; with the scaphoid, lunar, and cuneiform bones, below.

Development.—In young life the ulnar portion forms a distinct bone from the radial, the two pieces corresponding to the ulnar and radius in man or the dog: indeed, the former in the colt extends nearly to the knee: but as life advances, the two portions become so completely amalgamated and cemented together, inferiorly, that no longer can any trace be found of their original separateness.

OF THE KNEE. (CARPUS.)

The knee of the horse corresponds to the wrist of man, and for this reason is technically considered as the *carpus.* It is composed of seven small bones: in some instances an eighth has been found. Six of these bones are ranged in rows, forming two tiers, consisting each of three pieces: the seventh is placed completely behind the others.

The First, or Superior Row, is formed by the scaphoid, lunar, and cuneiform bones.

The Second, or Inferior Row, by the trapezoid, great, and unciform bones.

SCAPHOID BONE. (OS SCAPHOIDES.)

Form. Semi-ovoid: convex and curvated on one side; slightly but unevenly concave on the opposite.—*Divided* into four surfaces:—1st, *Superior surface,* sigmoid and smooth, articulating with the arm-bone. 2d, *Inferior surface,* semi-ovoid and smooth, resting upon the trapezoides and magnum. 3d, *Internal surface,* convex, and roughened by the attachment of the lateral ligaments. 4th, *Internal surface,* uniting in two distinct places with the lunar bone.

LUNAR BONE. (OS LUNARE.)

Cuneiform.—*Divided* into four surfaces, base, and apex:—1st, *Superior surface,* triangular, articulating with the arm-bone. 2d, *Inferior surface,* oblong, uniting with the magnum and unciform bones. 3d, *Internal surface,* excavated, joining above and below, with the scaphoid. 4th, *Internal surface,* excavated, articulating in two places with the cuneiform bone.—*Base,* broad and rough, presenting forwards. Apex, obtuse and rounded, turned backwards.

CUNEIFORM BONE. (OS CUNEIFORME.)

The smallest bone of the superior row. *Figure*—Pentangular.—*Divided* into five surfaces:—1st, *Superior surface,* small, oval, and cupped, articulating with the arm-bone. 2d, *Inferior surface,* smooth, resting upon the unciform bone. 3d, *Internal surface,* convex and roughened, receives the attachment of the external lateral ligaments. 4th, *Internal surface,* joining in two places with the lunar bone. 5th, *Posterior surface,* ovoid, smooth, and slanting, unites with the trapezium.

TRAPEZOID BONE. (OS TRAPEZOIDES.)

Situation—Inner side of the knee. *Form*—An irregular, curvated, flattened cone. *Division*—into four surfaces, a base, and an apex:—1st, *Superior surface,* smooth and convex, articulating with the scaphoides. 2d, *Inferior surface,* flattened, articulatory, and divided, the larger part resting upon the inner splint bone. 3d, *Internal surface,* excavated, presenting three smooth places for articulation with the os magnum. 4th, *Internal surface,* convex and roughened. *Base,* looking forwards and inwards. *Apex,* turned backwards and outwards.

THE GREAT BONE. (OS MAGNUM.)

The largest bone of the knee.—*Situated* in the middle of the inferior row. *Figure*—Triangular.—*Divided* into two surfaces, two sides, a base, and an apex. 1st, *Superior surface,* presenting two articulary compartments, one, sigmoid and oblong, for the lunare; the other, ovoid and flat, for the scaphoides. 2d, *Inferior surface,* broad and flat, resting upon the cannon bone. 3d, *Internal side,* excavated, presenting three little surfaces for articulation with the trapezoides. 4th, *External side,* having two smooth places, with a pit between them, for articulation with the next bone.

UNCIFORM BONE. (OS UNCIFORME.)

Situated outwardly. *Form*—irregularly conoid.

Division into four surfaces, a base, and an apex. 1st, *Su-*

perior surface, convex, and extended outward and backward, uniting with the cuneiform. 2d, *Inferior surface,* articulatory, resting upon the outer splint, and also upon the cannon bone. 3d, *External surface,* convex and rough, and ligamentous. 4th, *Internal surface,* presenting two places for articulation with the magnum.—*Base,* presented forwards.—*Apex,* backwards.

TRAPEZIUM.*

Situation—Behind the cuneiform bone. *Figure*—Flat, broad, quadrilateral. *Division*—Into two surfaces and four borders. 1st, *External surface,* convex, uneven; in places, elevated and roughened for ligamentous attachment. 2d, *Internal surface,* concave and porous.—BORDERS. Into the *superior* is fixed the tendons of the flexores metacarpi; to the *inferior,* a ligament; to the *posterior,* the posterior annular ligament of the knee: the *anterior* possesses two smooth oval surfaces; one for articulation with the cuneiform, the other with the arm-bone.

PISIFORM BONE. (OS PISIFORME.)

Not invariably present: in some instances two are found. *Situation*—Behind the trapezoid bone. *Form*—Orbicular or pea-shaped. *Use*—not apparent.

OF THE FORE LEG. (METACARPUS.)

Frequently called *the cannon*: sometimes *the shank.*

Although three bones enter into the composition of this part, viz., the large and the two small metacarpal bones, yet does the leg owe its form principally and its support entirely, to the former one:—

LARGE METACARPAL, CANNON, OR SHANK BONE.

(OS METACARPI MAGNUM.)

Form. Cylindrical; flattened posteriorly.

Division. Into body and two extremities.

THE BODY presents anterior and posterior surfaces. *The anterior surface* is rounded, prominent, and smooth, and extends round, laterally, so as to form about two thirds of the entire superficies of the cylinder. *The posterior surface* is flattened, and, in places, depressed. About one third of its length down, it is pierced by the medullary foramen, directed inward and downward. Its sides present two triangular slips of rough scabrous surface, extending about half way down, marking the places of attachment of the small metacarpal bones.

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* Stubbs has made this the *Pisiform* Bone; whilst the bone here called the *Pisiform* is his trapezium. Desirous as I am to observe an adherence to the nomenclature of human anatomy, in the present instance the incongruity appeared to be such as to warrant the hazard of a transposition of names. The bone which really is of the form and even magnitude of a *pea,* I have called *pisiform:* whilst to Stubbs' pisiform, a broad, flat, quadrilateral bone, I have given the name of *Trapezium.* GIRARD, the French standard anatomist, calls the small round bone "*pisiforme.*"

The superior extremity presents an articulatory surface, the whole of which is flat, with the exception of a part bevelled off on its outer side, which articulates with the unciform bone; and a small, depressed, bevelled spot on its inner and posterior side, which receives part of the trapezoid bone: the flat surface supports the os magnum, to which in figure it corresponds. In front, and rather inclined to its inner side, the extremity has a roughened prominence, into which is implanted the extensor metacarpi: on either side, the bone is asperated by the insertion of lateral ligaments; and the rough part posteriorly gives origin to the suspensory ligament.

The inferior extremity exhibits an articulatory trochlea, consisting of two equal condyloid surfaces, parted by a semicircular eminence, which is fitted into a counterpart formation in the upper end of the large pastern bone. These condyles have uneven pits in their sides, into which are fixed the lateral ligaments.

Connection. Superiorly, with the magnum, unciform, and trapezoid bones; leterally and posteriorly, with the small metacarpal bones; inferiorly, with the large pastern and sesamoid bones.

SMALL METACARPAL OR SPLINT BONES.

(OSSA METACARPI PARVA.).

Number. Two:—external and internal. *Form*—Elongated; pyramidal.

Situation. Attached to the lateral and posterior parts of the large metacarpal bone.

Division. Into bases, middles, and apices.

Extent. They vary somewhat in length: they commonly reach about two thirds of the large bone, downwards.

The base, or head, is turned upwards, and is surmounted by a flat articulatory surface, which enters into the formation of the knee-joint. Below this, the bone is tuberous and rough, for ligamentous attachment: the external head also receives one of the tendons of the flexor metacarpi externus; the internal receives the tendon of the flexor metacarpi internus.

The middle is trifacial. The anterior surface is asperous, for firm attachment to the large bone; the inner surface is excavated, to make room for the suspensory ligament; the outer surface is smooth and rounded. This part is terminated by a sharp edge posteriorly.

The apex is tapering and ends in a small bony tubercle, which inclines backwards, away from the large bone.

Difference. The external is commonly rather larger than the internal bone; they are, however, with more certainty distinguished by their articulatory surfaces.

Connection. The external bone supports the unciform; the internal, the trapezoid: both are attached to the large metacarpal bone.

Development. In the growing animal the splint bones are maintained by cartilago-ligamentous connections: in most adult, and in all old subjects, the ligamentous substance becomes converted into osseous matter.

OF THE PASTERN.

The pastern, corresponding to the first phalanx of the human foot, is supported by the pastern bone; but it has also two appendices, the sesamoid bones, which are necessary to the formation of the fetlock-joint.

PASTERN BONE. (OS SUFFRAGINIS.)

Situation. Below the cannon bone, with which, from taking an *oblique direction*, it forms an obtuse angle.

Form. Cylindroid, flattened before and behind; larger superiorly than inferiorly: about one-third the length of the cannon bone.

Division. Into body, and superior and inferior extremities.

THE BODY presents two surfaces. *The anterior* is even and convex: *the posterior* is uneven, but flattened, and displays a slightly depressed triangular portion, into the asperous angle of which is implanted the short sesamoid ligament.

The *superior* or *larger extremity* consists of two shallow articular cups, laterally, with a deeper transverse articular groove running between them, in which play the condyles and middle eminence of the lower extremity of the cannon bone. Behind, at the sides of the cups, are two tuberosities, to which are fixed the crucial ligaments.

The inferior extremity is bi-convex or condyloid; consisting of two equal, articular, semi-cylindroid convexities, parted by a transverse shallow depression, running from before backward, but more completely separated by a little pit behind. The asperous prominences on the sides are for ligamentous attachment.

Connection. With the cannon and coronet bones, and with the two sesamoids.

SESAMOID BONES. (OSSA SESAMOIDEA.)

Number—Two.—*Situated* at the back of the articulation formed by the pastern and cannon bones.

Form. Trapezoid; three of the sides presenting triangular faces, whose apices unite in one point, which is directed upwards, and whose bases form the fourth side; turned downwards.

Division. Into three sides, basis, and apex.

The anterior surfaces are excavated, smooth, and articulatory, and along their inward borders, which are opposed to each other, are bevelled off, by which, by the two together, a groove is formed for the reception of the middle eminence of the cannon bone; while the concavities extend the articulatory surface for the condyles of that bone. *The posterior surfaces* are convex and asperous, for the attachment of the suspensory ligament: the two together form a sort of channel between them, in which run the flexor tendons. *The lateral surfaces,* which are grooved as well as roughened, receive the branches of the suspensory ligament. *The bases* grow narrow as they approach each other: their surfaces are rendered uneven by the attachment of the long and short inferior and crucial ligaments.

Connection. These bones are *articulated* only with the large metacarpal; they are connected both with that and the pastern bone.

OF THE CORONET.

This part answers to the second phalanx of the human foot. It has for its base, the

CORONET BONE. (OS CORONÆ.)

Situation. Between the pastern and foot.

Figure. Nearly square; its breadth exceeding its longitudinal diameter only by about one fifth. It has four surfaces.

The superior surface is bi-concave—being divided by a simple transverse eminence into two ovoid concavities, into which are fitted the condyloid projections of the pastern bone: this eminence is bounded before and behind by small tubercular elevations; the posterior receives part of a ligament: the anterior, a portion of the extensor tendon. Laterally and posteriorly, the surface is extended by two projections, to which are fixed the lateral ligaments.

The anterior surface is convex, but irregular and asperous. Inferiorly, its sides present two remarkable depressions, into which are implanted the terminating branches of the tendo perforatus: above and between them, the bone is roughened by the attachment of the extensor tendon.

The posterior surface is slightly excavated, and is free from asperities. Superiorly, it presents a smooth lip of bone, between which and the flexor tendon exists a bursal connection.

The inferior surface, like the superior, is entirely articulatory: it closely resembles that of the pastern bone, only it is rather broader. In outline, it has the figure of a painted heart, whose apex is curved forward and upward: basis, backward and upward. It is bi-convex from before backward, consisting of two condyloid prominences, parted by a shallow transverse depression. It is adapted to a counterpart articulatory formation of the coffin bone.

Connection. With the pastern, coffin, and navicular bones.

OF THE FOOT.

The foot, or third phalanx, forms the resting, bearing, or terminating part of the limb. The coffin bone constitutes its osseous fabric; to which the navicular may be regarded as an appendage.

THE COFFIN BONE. (OS PEDIS.)

Situated within the hoof, which it nearly resembles in—

Form—Being in its outline semi-lunar: anteriorly and superiorly, convex; posteriorly and inferiorly, concave. Its shape, however, varies with the natural make and morbid changes in the form of the hoof.

Division. Into wall, sole, tendinous surface, articulatory surface, and wings.

THE WALL is the semi-circular prominent part in front, and corresponds to the wall or crust of the hoof. It is convex—most so anteriorly; it possesses a certain degree of declivity, which increases in degree, but decreases in extent, as we proceed from the front to the sides, the greatest elevation, as well as slant, of the wall presenting anteriorly; and it exhibits everywhere a furrowed and porous surface; the furrows, which run from above downwards, being most distinct inferiorly and laterally: and the holes or pores consisting of a large and small set, of which the large only are numerable or worthy of particular notice, the small ones being infinite, and numbers of them even imperceptible. *The foramina* (for the large are alone worthy of the name, the small being simply porosities) are regularly disposed in so far that we invariably find several of them ranged at nearly equal distances around the circumference of the wall, a little above its edge; and two others at or near the terminations of two grooves, which come from the wings, and run along the sides of the wall: five or six others also are commonly seen within the intermediate space, between the two latter. Through the foramina pass blood-vessels and nerves in and out of the interior of the bone. *The porosities* serve mostly for the fibrous attachment of the laminæ.

The inferior or *circumferent edge* of the wall is rather semi-oval than semi-circular. It is notched or serrated, particularly towards the sides, where, in places, the notches opposite to the foramina widen into gaps, in order to give passage to blood-vessels to the sole. This edge, in its natural and healthy state, maintains at every point the level of a plane surface. Superiorly, in the middle, the wall is surmounted by *the coronal process,* from whose sides sharp waving edges run to the wings, forming the boundaries between it and the articulatory surface.

THE SOLE exhibits a broad, uniform, concave surface, of the figure of a horseshoe, free from asperities, excepting towards the wings. Still, however, it possesses porosites, or at least shows the marks of the fibrous implantation of the sensitive sole. It is bounded, anteriorly and laterally, by the circumferent edge of the wall; posteriorly, by a sharp, uneven, semi-circular edge, which divides it from the tendinous surface.

THE TENDINOUS SURFACE has a semi-circular shape. It is placed immediately behind the sole, and exhibits, 1st. A rough depression in its fore and middle part, marking the insertion of the tendo perforans. 2dly. Two lateral grooves, passing obliquely inwards, and terminating each in a large foramen. 3dly. A porous space intermediate between the two former divisions, into which is fixed the inferior navicular ligament. The grooves lodge the trunks of the arteries and nerves of the foot, which pass through the foramina into the interior of the bone.

THE ARTICULATORY SURFACE occupies the superior part. It is half-moon-shaped. It presents two lateral cups, extending angularly backwards as far as the wings, with a broad eminence running transversely between them, which rises so gently as to be more perceptible to the finger than the eye. This eminence is terminated in front by the coronal process, having an incurvation backwards: behind it, the surface is bevelled off, to which part is opposed the navicular bone. The articular cavities for the coronet bone are deepened by the sharp, prominent edge running around their front and sides.

The alæ or WINGS consist of two bifid protuberances, stretching backwards from the body, beyond the limits of the articulatory surface. The lower and larger division of the ala, projecting directly backwards, is irregular and asperous: to it is attached the cartilage of the foot. The upper portions are tubercular and smooth on their surface: to these are fixed the first pair of the coffin ligaments. Between these divisions of the ala is a notch (which in the recent subject becomes a perfect foramen); through it passes the lateral artery, to be conducted by the groove leading from it to a foramen (afore mentioned) in the wall.

Connection. With the coronet and navicular bones, and with the hoof.

Particularities. The coffin is a bone of a soft, i.e., of a spongy, fragile texture; and its intrinsic stability is yet further reduced by the canals pervading its interior for the transmission of blood-vessels and nerves. The very reverse of this is the case with the pastern and coronet bones: they (particularly the latter) are remarkable for compactness and solidity of substance.

THE NAVICULAR OR SHUTTLE BONE.* (OS NAVICULARE).

Situation—At the back of the coffin-joint, into whose composition it enters.

Form—Semi-lunar: its lunated border, however, will not make above one third of a circle of such dimensions.

Division—Into two surfaces; two borders; and two extremities.

SURFACES.—*The superior* bears a corresponding aspect to the articulatory surface of the coffin bone, having two superficial lateral depressions, with an eminence imperceptibly rising between them. Dividing the entire articular surface, formed by the two bones, for the reception of the coronet bone, into five parts, the navicular forms about two divisions. *The inferior surface* is also articulatory; and also exhibits lateral depressions, but still more superficial than the superior, with an eminence across the middle, narrower and better marked than that above. Over this part plays the tendo perforans.

BORDERS.—*The lunated,* broadest in the middle, narrowing towards the extremities, consists, superiorly, of a smooth narrow slip of surface along the middle, which is adapted to the bevelled portion of the articulatory surface of the coffin bone; and, below, of a fluted porous part, from which a broad ligament runs to the coffin. *The straight border* is thin, compared to the opposite one; and is, superiorly, rough and porous, where the posterior ligament is attached; inferiorly, smooth and lipped, and continuous with the surface opposed to the tendon.

The extremities, directed, one outward, the other inward, are obtusely pointed; and are fixed by lateral ligaments to the coffin bone.

II.—THE HIND EXTREMITIES.

Situation. Connected with the posterior parts of the trunk, which they support.

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* Sainbel calls it "The Articular Bone."—Girard considers it as *a sesamoid bone.*—Our old farriers, in their profound ignorance, have mistaken it for a production of disease, and described it as "the *quittor* bone."

Division. Into haunch, thigh, hock, leg, pastern, coronet, and foot.

OF THE HAUNCH.

The superior part of the haunch is formed by the iliac portion of the os innominatum; its middle has for base the os femoris; below and in front, it is terminated by the patella.

ROUND BONE. (OS FEMORIS.)

Form. Long, cylindrical. *Magnitude*—The strongest and heaviest bone in the body; and one of the longest. *Direction*—Oblique; from above downward, and from behind forward.

Division. Into body and extremities.

Body.—Upper part, expanded; flattened, posteriorly; prominent, anteriorly; and having, projecting from its outer border, a broad, flat, semi-circular process, curved forwards, which is the small external trochanter: to it are fixed the faschia lata, tensor vaginæ, and gluteus externus. Nearly opposite to this, only somewhat higher, the inner border has an asperous, oblong, prominence, the internal trochanter, which receives the insertions of the psoæ and pectineus muscles. The lower half of the body is contracted, round, and smooth: and on its postero-external part presents a deep oval pit, with asperous surfaces, which give attachment to the gastrocnemii. About the middle of the body, behind, is the medullary foramen.

The superior extremity consists of two parts: a hemispherical, smooth, articulatory *head,* looking upwards and inwards, joined to the body by a thick, flattened *neck,* and exhibiting on its inner side a wide deep fissure, into which is fixed the round ligament; the head itself being adapted to the acetabulum in the os innominatum. The other portion is a larger irregular projection, rising posteriorly into a pyramidal eminence, at the root of which, behind, is a deep oval cavity: this process, the great external trochanter, presents a broad, uneven, asperous surface outwardly, which receives the implantation of the gluteal muscles; a waving roughened crest, superiorly, to which are attached the obturator muscles; and a concave smooth surface inwardly, to which is fixed the capsular ligament.

The inferior extremity presents for consideration a trochleal prominence and two condyles. The first, the pulley-like articulatory surface in front, consists of a broad semi-circular groove, bounded on either side by a prominence, of which the internal projects much more than the external: over this surface plays the patella. The condyles, most conspicuous posteriorly, much resemble each other, excepting that the external is the thicker, the internal the more projecting, of the two. They exhibit bold, convex, rounded articulatory surfaces, presenting inferiorly and posteriorly, which rest upon the tibia; on their sides are rough eminences for the attachment of the lateral ligaments; and between them is a deep asperous fossa, into which are implanted the inter-articular or crucial ligaments. At the base of the external condyle, below and in front of it, is a pit from which springs the tendon of the extensor pedis. From the condyles, posteriorly, proceed epicondyloid ridges, uniting them with the body of the bone.

Connexion. With the pelvis, above; with the patella and tibia, below.

Development. The extremities in the growing animal are epiphyses: prior to the adult period, however, they become consolidated with the body; and the inferior extremity earlier than the superior.

STIFLE BONE. (PATELLA.)

Situation. Upon the trochea lsurface of the inferior extremity of the round bone.

Outline. Quadrangular: convex externally; irregularly concave internally.

Division. Into three surfaces and four angles.

THE ANTERIOR SURFACE is convex, most prominent towards the middle, and in places porous and roughened by tendinous and ligamentous attachments.

THE POSTERIOR SURFACE is entirely articulatory, and unequally divided by an eminence running across it into two shallow concavities, which are adapted to the condyles of the round bone, the inner being the larger one.

THE SUPERIOR SURFACE—the space bounded by the superior and lateral angles—is uneven and roughened by the implantation of the tendons of the rectus and vasti muscles.

THE ANGLES are all blunt or rounded off. To the superior is fixed the tendon of the rectus; to the inferior and lateral, the ligamenta patellæ: between the superior and external lateral one is an eminence looking like a fifth angle: it gives attachment to the vastus externus.

Connection. By muscles and its capsular ligament, with the round bone; by its own four proper ligaments, with the tibia.

OF THE THIGH.

The bone correspondent to *the bone of the thigh*—the veritable *os femoris* of a man—in the horse enters into the formation of the part we call the haunch; while the tibia and fibula, the human leg bones, become of this quadruped the basis of the part we are in the habit of calling the thigh.

TIBIA.

Situation. Between the stifle and the hock.

Form. Long, straight, prismatic: larger superiorly than inferiorly.

Direction. Oblique; but contrariwise to the round bone.

Division. Into body, superior and inferior extremities.

The body exhibits three faces and three angles. *Two* of the *faces* are smooth, and are seen anteriorly; one looking outwards, the other inwards: the former covered by the extensor pedis, the latter by the skin. *The posterior face* is the broadest, and is strongly marked with several longitudinal muscular furrows. *The anterior angle* is rounded off, and below disappears altogether: the sides are sharpened and roughened by muscular attachment.

The superior extremity, more bulky and extensive than the inferior, exhibits—Superiorly, two irregularly ovoid flattened articulatory surfaces, which, by means of intervening cartilages, are accommodated to the condyles of the round bone: these are parted by a small sharp elevation and two asperous pits, into which latter are fixed the crucial ligaments. Anteriorly, a jutting pyramidal tuberosity, from which a rough ridge runs downward into the anterior angle of the body, while, above, it ends in a blunt asperous point, turned outwards. At the sides are the two lateral processes, the external the more projecting, for the lateral ligaments. Between the external lateral process and the tuberosity, is a groove for the passage of the tendon of the extensor pedis; and below this groove, a broad excavated portion of surface, from which arises the flexor metatarsi. The external condyle has on its side a small transversely oval excavation, marking the place of junction of the fibula.

The inferior extremity, flattened and spreading but little wider than the body itself, consists of two deep articular grooves, running obliquely from before backwards, and from without inwards, and of three sharpened projections: one, extended obliquely, forms the partition between the grooves; the others form the lateral processes, of which the internal is more prominent than the external, both being roughened exteriorly for the lateral ligaments. The external lateral process has a groove on its side, for the passage of the tendon of the peroneus.

Connection. With the round bone, above; the os calcis, below.

Development. The extremities, originally epiphyses, become apophoses prior to the adult period.

FIBULA.

This small and seemingly unimportant bone can be regarded but as an appendix to the tibia. It is a long, slender, pyramidal bone, affixed to the external side of the tibia by a cartilago-ligamentous substance, similar to that which binds the splint bones to the cannon.

Its superior part or *head* is bulky, flattened from side to side, and roughened—externally, by the attachment of the peroneus and the lateral ligament; internally, by its cartilago-ligamentous connection.

The inferior part, slender and tapering, extends about half way down the tibia, whence a ligament is continued from its termination to the lower extremity of that bone.

Connection. With the tibia.

OF THE HOCK. (TARSUS.)

As the knee of the horse answers to the wrist of man, and is therefore analogically regarded as the *carpus;* so, in like manner, the hock becomes the correspondent part to the instep, and is consequently considered under the technical appellation of *tarsus.* Six small bones enter into its composition: they are—the astragalus, os calcis, os cuboides, and the ossa cuneiforma: externum, medium, and internum.

THE KNUCKLE BONE. (ASTRAGALUS.)

Situation. Uppermost bone of the hock: the one which alone supports the tibia.

Form. Distinguished by its pulley-like formation.

Division. Into superior, inferior, and posterior surfaces.

The superior or *pulley-like surface* is entirely articulatory, and consists of two bold semi-circular prominences, with a deep capacious groove between them: the whole admirably adapted to the two grooves, parted by their middle projection, in the lower extremity of the tibia.—*The posterior surface,* extremely irregular, exhibits four polished places for articulation with the os calcis; and, between them, asperous porous interspaces for ligamentous attachment.—*The inferior surface,* smaller than either of the others, is irregularly flattened, and almost wholly articulatory; it is embraced by the superior part of the large cuneiform bone. From a pit at the foot of the pulley-like adaptation, takes its origin the extensor pedis accessorius.

OS CALCIS.

Situation. It forms the posterior projecting part, called the point of the hock.

Figure—Irregular. *Division*—Into body and tuberosity.

THE BODY is the broad or inferior part. It is irregularly convex externally, where it is joined with the tuberosity: concave and expanded internally, where it presents four surfaces for articulation with the astragalus, with asperous interspaces for ligament. The inferior part of the body has a narrow articulatory surface, by which it articulates also with the cuboid bone.

THE TUBEROSITY, the projecting part behind, is oblong, flattened on its sides, and exhibits a thick, tuberous termination, into which is implanted the tendons of the gastrocnemii. The external side is flattened and roughened by ligamentous connexion; the internal is smooth, and inclines to concavity, by which a space is left which gives passage to the tendon of the flexor pedis.

CUBOID BONE. (OS CUBOIDES.)

Situation. Outer part of the hock. *Form.* Oblong, from back to front. *Division.* Into external, internal, superior, and inferior surfaces.

The external surface, broad and irregularly curved, is roughened by ligamentous adherence.—*The internal surface,* irregularly excavated and asperous, exhibits three places of articulation: one, posteriorly, for the great cuneiform; the other two smaller, one anteriorly, one posteriorly, for the middle cuneiform bone. The superior surface has two articulations, with a little pit between them; one for the astragalus, a larger one for the os calcis. *The inferior surface* presents two articulatory places; one for the external splint bone, the other for the cannon bone.

THE LARGE CUNEIFORM BONE. (OS CUNEIFORME MAGNUM.)

Situation. Immediately underneath the astragalus.

Figure. Triangular: broadest side turned forwards; salient angle, backwards. Flat above and below.

Division. Into superior and inferior surfaces, sides, and angles.

The superior surface is entirely articulatory, with the exception of a little rough groove running to its middle from the outer side, which terminates in the medullary hole: it is adapted to the under part of the astragalus.—*The inferior surface* is very similar in appearance to the superior, except that it is flat, or rather inclines to convexity: it articulates with the middle cuneiform, and also, next the internal angle, with the small cuneiform.—*The salient* or *posterior angle* has on its external side a surface for articulation with the cuboid.

Connection. With the astragalus, cuboid, middle and small cuneiform bones.

THE MIDDLE CUNEIFORM BONE. (OS CUNEIFORME MEDIUM.)

Situation. Underneath the large cuneiform; upon the hind cannon bone.—*Figure* and *Division,* the same as the large bone. *Superior* and *inferior surfaces,* also similar: the former articulates with the large bone; the latter with the hind cannon bone. —*The salent angle,* behind, is sharper and more projecting: near its point, externally, is a small surface for articulation with the cuboid.

THE SMALL CUNEIFORM BONE. (OS CUNEIFORME PARVUM.)

Situation. Postero-internal part of the hock.- -*Figure.* small: irregular.

Connection. Superiorly, it articulates with the internal angle of the large cuneiform; anteriorly, with the same angle of the middle cuneiform; below, principally, with the internal hind splint bone; partly, also, with the hind cannon bone.

THE METATARSAL, HIND CANNON, OR SHANK BONE. (OS METATARSI MAGNUM.)

As the cannon bone of the fore leg is said to be a match for one of the longest metacarpal bones found in the human hand; so this bone, in comparative anatomy, is regarded as a fellow of one of the metatarsal bones which compose the foot, although it is, in the horse, *the bone of the hind leg.* It so nearly resembles the fore cannon bone, that the two, at first sight, appear to be precisely alike: there are differences, however, between them, and in particular three:—1st, The bone of the hind leg is longer by about one sixth part than the bone of the fore leg; 2dly, The body of the former is rounder and more prominent anteriorly than that of the latter; 3dly, The superior articulatory surfaces are different; one being such as is adapted to the middle and small cuneiform and cuboid bones; the other accommodates the inferior row of the bones composing the knee.

THE PASTERN, SESAMOID, CORONET, COFFIN, and NAVICULAR BONES of the hind extremity, so closely resemble their fellows in the fore, that the description already given of the latter, will be found to answer here.

APPENDAGES TO THE HEAD;

To wit, the os hyoides and the teeth.

THE OS HYOIDES

Consists of a frame-work of small bones, connected together by ligament, situated between the larynx and the root of the tongue.

Division. Into five pieces: body, and four horns.

THE BODY has the precise shape of a spur; consisting of a semi-circular portion, from the middle of the convex side of which projects a straight part, corresponding to the *neck* of the spur: this (latter) part, also called the *appendix*, is surrounded by the root of the tongue, to the fleshy fibres of which both its sides and extremity afford original attachment. *The branches*, or sides of the spur, are directed backwards, embracing between them the superior border of the thyroid cartilage. *The curved part*, from which the branches and neck spring, is broader and thicker than elsewhere, and has, laterally, two small articulatory knots with which the short horns are connected.

THE HORNS are four in number—two long, and two short. *The short*, or *inferior horns*, ascend obliquely from their articulatory connections with the body, and terminate in two oblong smooth extremities, which form similar joint-like connections with the long horns. They are flattened on the sides, and their anterior borders are sharper than their posterior. They give attachment to a pair of the muscles of the tongue.—*The long*, or *superior horns*, constitute two long, flattened, thin bones, extending backwards, in a horizontal direction, from the summits of the inferior horns, with which they are articulated. Each horn presents—two smooth polished *surfaces*, viz. an internal and an external side; two *borders*, an anterior and a posterior, the latter surmounted by a prominent crest; and two *extremities*: the supero-posterior has a cartilaginous junction with the hyoideal process of the petrous portion of the temporal bone; the infero-anterior, with the short horn.

This bone gives attachment to the stylo-hyoideus and hyoideus magnus, and also to the pharynx.

Connection. With the temporal bone, larynx, pharynx, tongue, and some of the muscles of the neck.

Development. In the young animal the body itself is separable into three pieces.

THE TEETH:

The instruments for the abscission and manducation of food.

Number. Forty; disposed in pairs; twenty in each jaw.

Conformation. Conoid or oblong; infixed within distinct alveoles formed in the maxillæ; whence we distinguish, in each tooth, a part without and a part within the socket: to the former portion we give the name of *body*, and that of *face* to the wearing surface of it; the latter is called the *root*, and the pointed extremity of it, the *fang*.

Structure. The tooth is composed of two hard substances, distinct from each other in aspect as well as nature; viz. a dense, hard, solid *bone*, which is organic; and a still whiter and harder part called *enamel*, which is inorganic. It is only the body of the tooth which is coated with enamel; the root is quite destitute of it: the former owes its polished whiteness to it. Upon the face it is variously disposed, according to the form of the tooth, from which it sinks, more or less deeply, into the heart of all teeth excepting the tusks; forming thereby small funnel-shaped enamellated cavities, called the *infundibula*, whose mouths, named *the pits*, are indicated by the black marks upon the faces.

The tooth is essentially formed of bone, the enamel being no more than a covering or defence to it. Within the bone is a *cavity*, corresponding in shape and dimensions to the tooth itself. This, *the cavity of the tooth*, contains the *pulp*, inclosed within *the membrane of the tooth*: these parts are amply furnished with blood-vessels and nerves, which gain admission through the points of the fangs.

Distribution. Into three classes: 1st, the *Incisors*, or cutting teeth; 2d, the *Molares*, or grinding teeth; 3d, the *Canini*, or tusks.

THE INCISORS, twelve in number, are ranged in parabolic curves in the anteriormost parts of the jaws.—*Form*, a bent cone, of which the face is the basis; the fang, the apex. *Face*, elliptical. *Pit* of the same figure, and single. *Fang*, single, conical. The teeth in the upper jaw are somewhat larger than those in the lower. The forms, but more particularly the faces, of these teeth undergo alteration as age advances.

THE MOLARS, twenty-four in number, are implanted, in four rows, into the sides of the jaws—twelve in the upper, and twelve in the lower maxilla, six on each side; equal in magnitude to four or five incisors united together.—*Figure*, oblong, quadrangular, excepting the first and last, which are triangular. *Faces*, presenting two transverse ridges and two pits: those of the triangular teeth have an additional eminence. *Infundibula*, two in each tooth, which imperfectly divide the *cavity*, by extending through it down to the fangs, into chambers. *Fangs*: an upper molar possesses three, excepting the first and last teeth, which have, occasionally, but two each. The lower molars have but two fangs.

THE CANINE TEETH, OR TUSKS, are four in number, two in each jaw, having isolated stations in the interspaces at the sides of the body of the maxilla, between the lateral incisors and the first molars.—*Form*, a double cone, slightly incurvated, whose bases are joined together in one body: during growth the inner side is slightly concave and fluted. *Cavity* extends uninterruptedly through the whole length of the tooth. *Fang*, single and perforated. No infundibulum. Characteristic of the male: in the female, either imperfect or undeveloped.

Development of the Teeth. The teeth with which the young animal is provided, are, at certain intervals of age, cast off and replaced by others: hence the distinction of these two sets into *temporary* and *permanent teeth*. *The temporary teeth* are twenty-four in number—twelve incisors, and twelve molars. The temporary incisors differ from the permanent—1st, in being smaller and whiter; 2dly, in having *necks* or contractions where the root joins the body; 3dly, in their fangs being slenderer and more pointed. The temporary molars differ from the permanent set—1st, in number; 2dly, in being, individually, smaller and whiter; 3dly, in the eminences upon the faces being sharper.

OF THE ARTICULATIONS OR JOINTS OF THE SKELETON.

TRUNK.

Articulations between the occiput, atlas, and axis.—The condyles of the os occipitis are embraced by the smooth excavations forming the inner sides of the atlas: these articulary surfaces are covered with cartilage, and the two bones are fastened together, by—1st, *lateral ligaments*, passing from the coronoid processes of the occiput to the fore parts of the body of the atlas, to be fixed to the roots of its transverse processes; 2d, *The suspensory ligament of the head*, fixed to the body of the atlas, between its anterior articular processes and the upper border of the occipital hole; 3d, *The capsular* or *synovial membrane*, attached to the body of the occiput, around the roots of the condyloid processes, and to the body and anterior articular processes of the atlas. It detaches a process to the membranous envelope of the odontoid projection, by which all communication is cut off between the joints formed by the first and second vertebræ.

The axis articulates with the atlas, but is also connected with the occiput. It has—1st, *The superior ligament*, passing from the spine of the axis to the inferior part of the bony ring of the atlas; 2d, *The inferior ligament*, broad, connecting their inferior spinous projections together; 3d, *The three odontoid ligaments:*—two *long*, passing from the sides of the odontoid process to the inner sides of the occipital condyles; the *short* and broad one, running from the point of the process, along a bony canal, to the antero-inferior part of the atlas; 4th, *Capsular membrane*, including the articulatory surfaces, which are encrusted with cartilage, of the first and second vertebræ, is attached around the posterior articular processes of the atlas and the anterior of the axis, around the odontoid process, and also to the odontoid ligaments.

In the ordinary movements of the head, all the cervical vertebræ, more or less, participate: it is only in the nodding motion, or sudden *chuck* of it, that the occipital joint is especially called into action. When the nose is earried to one side, the odontoid process revolves upon its own axis within the cavity of the atlas.

COMMON ARTICULATIONS OF THE VERTEBRÆ. All the vertebræ, excepting the atlas and last lumbar, articulate one with another, before and behind, through the apposition of their bodies, and the adaptation of their articulatory processes. They are bound together by—1st, *The inferior vertebral ligament,* consisting of bands of ligamentous fibres running obliquely along the inferior surfaces of the bodies of the vertebræ, expanding as they approach, and taking root in each intervertebral substance; 2d, *The superior vertebral ligament,* situated within the vertebral canal.* It pursues the same course along the inner surfaces of the upper portions of the rings which the inferior ligament does below, maintaining the whole more firmly together; 3d, *Inter-transverse ligaments,* binding together the transverse processes; 4th, *Inter-spinous ligaments,* between the spinous processes, but found only in the back and loins; 5th, *Capsular membranes,* inclosing the smooth cartilaginous surfaces of the articulatory processes; 6th, *The intervertebral fibro-cartilages,* forming the principal bond of union between the vertebræ (so strong a one, that rather than this substance will part from its attachments, the bone itself will give way), consist of so many dense, concentric, fibrous substances, interposed between the bodies of the vertebræ, to the surfaces of which they are most firmly and inseparably inherent. In form, they correspond to the bones, but in thickness and volume they differ in each vertebral region. The fibres are found to cross and intercross one another, and to be so disposed as to leave in the centre spaces, which are filled with a soft, pulpy, elastic tissue, which adds to facility of motion; 7th, *Ligamentum Nuchæ* vel *Subflavum,* an elastic ligamentous substance, reaching from the occiput to the coccyx. It arises from the occipital tuberosity, and there consists of a cylindrical chord. It is continued backward along the superior border of the neck, and stretches broader and broader as it proceeds, in order to reach down to the spinous processes, to all of which (with the exception of the first) it is fixed. It is broadest at the dip made by the spine in front of the withers. As it approaches the tallest dorsal spine, it narrows, and, after having passed the sixth or seventh, again becomes a chord, or rather a band, whose greatest breadth is crosswise. It passes onward, covering and connecting the remaining superior spines of the back, and also those of the loins, sacrum, and coccyx, growing upon the last bone gradually smaller and smaller, and ultimately vanishing upon its extremity. Being highly elastic, it will admit of all the motions the spine is susceptible of; while it has a continual tendency to maintain or recover its original or natural form.

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* It cannot be demonstrated without sawing through the bony arches.

ARTICULATIONS OF THE THORAX.—*The vertebral extremity of the rib* forms three distinct and separate joints with the spine, and is further maintained by two ligaments: 1st. *Capsular membrane of the head,* in its attachment surrounds and includes the whole of the head; but sends off a process, internally, by which the surface opposed to one vertebra is formed into a synovial cavity, distinct from that which is adapted to the other vertebra, next to it. This part of the union is strengthened by some ligamentous fibres which spring from the summit of the head; 2d, *Capsular membrane of the tubercle,* surrounds the process at its articulation with the transverse process of the vertebræ; 3d, *External ligament,* fixing the neck of the rib to the spine, externally; 4th, *Internal ligament,* a similar one, internally.

The cartilages of the true ribs, which are attached immediately to the sternum, are received into the cups in the lateral borders of that bone, and maintained there by—1st, *Ligamentous expansions,* radiating from the surfaces, both superior and inferior, of the sternum to their extremities; 2d, *Capsular membranes,* inclosing the extremities within their sockets.

The several portions of the sternum are united, one to another, by fibro-cartilaginous interpositions; and their union is strengthened by the ligamentary expansions upon the surface, internal as well as external. The anterior bone is surmounted by a cartilage of considerable breadth, which extends in a curvature upwards, not unlike the form of the keel of a ship; hence it has got the name of the *cariniform cartilage.*

ARTICULATIONS OF THE PELVIS.—*The sacro-vertebral articulation,* formed between the last lumbar vertebra and the base of the sacrum, consists—1st, of an inter-vertebral substance in the middle, similar to what exists in the spine; 2dly, of two superior transverse ligaments, affixed to the transverse processes; and, 3dly, of two inferior transverse ligaments, which run from the fourth and fifth transverse processes of the loins to the crista of the ileum.—*The sacro-iliac articulations* are formed by the interposition of fibro-cartilaginous substances between the transverse processes of the sacrum and the venters of the ileum, resting upon them; and is strengthened by ligamentary bands passing from the posterior spines and borders of the ileum to the transverse processes of the sacrum.—*The sacro-sciatic ligaments* are broad expansions stretched across the sacro-sciatic notch. They are fixed to the transverse processes of the sacrum and those of the two or three anteriormost bones of the coccyx and to the posterior parts of the ileum and ischium, and also to the tuberosity of the latter bone. Towards the anterior part of the notch, the ligament exhibits an oval opening, through which pass the sciatic blood-vessels and nerves.—*The obturator ligament* is the fibro-membranous expansion stretched like a drum-head across the obturator foramen: through its anterior part is a hole for the transmission of the obturator artery and vein. *The symphysis pubis* is formed by the junction of the two ossa innominata, by means of a fibro-cartilaginous substance adherent to the opposing surfaces.—*The sacro-coccygeal articulation,* formed between the sacrum and coccyx, is the same as a common vertebral joint.

FORE EXTREMITY.

THE SHOULDER-JOINT* is formed between the head of the humerus and the glenoid cavity of the scapula: their adaptation (as dried bones) appears incomplete, in consequence of the comparatively disproportionate magnitude of the ball to the socket: this is in some degree compensated for, however, by the projecting border of the cartilage with which the glenoid cavity is lined. The bones are maintained in apposition by—*The capsular membrane,* which is found very loose when denuded of the surrounding adherent muscles, bagging about the bones, in order that it may not, in the least, restrain their freedom of motion: it is inserted around the rough margin of the glenoid cavity, and around the neck of the humerus. Its internal surface is synovial; its exterior is clothed by firmly adherent muscles, to which the chief strength of the articulation is owing; viz., its outer and anterior parts by the antea and postea spinati; its inner and posterior parts by the subscapularis and teres minor.

THE ELBOW-JOINT* is constituted of the condyles of the humerus moving in the concavities upon the superior extremity of the arm-bone, the surfaces of which are covered by cartilage. The joint is maintained by—1st, *The capsular membrane,* which is thin, infixed around the condyles, including their cartilaginous surfaces, and the hollow behind them, and around the edges of the articulatory parts of the arm-bone; also to the olecranon process, to the lateral ligaments, and to the tendinous roots of the flexor muscles of the leg. 2d, THE LATERAL LIGAMENTS.

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* These well-understood and familiar appellations are preserved in preference to the adoption of those of a new nomenclature, viz., *scapulo-humeral, humero brachial,* &c., articulations.

The internal, implanted above, into a depression in the side of the internal condyle of the humerus, and below where it becomes bifid, into the border of the inner articular cavity of the radial portion of the bone, and also into the body of the bone, about three inches below the first insertion. *The external*, shorter and stronger, runs from a similar depression on the external condyle to a tubercle on the upper and outer part of the radial bone. In the young subject, the ulnar portion of the arm-bone is united to the radial by a fibro-cartilage; but this gradually undergoes conversion into bone as the adult period approaches.

KNEE-JOINT.—This includes four distinct articulations: one betwaen the arm-bone and the upper row of the carpal bones; a second, between the upper and under rows of the carpal bones themselves; a third, between the under row and the three metacarpal bones; a fourth, situated posteriorly, between the trapezium and the cuneiform bone.. They have all their own proper capsular membranes, which are attached around the borders of their cartilaginous surfaces, and consequently have no communication one with another. The knee-joint altogether is further maintained by—1st, *The lateral ligaments;* the *external,* passing on the outside from a tubercle on the arm-bone to the head of the external metacarpal bone; the *internal,* divided into two portions proceeding together from a similar tubercle on the inner side of the arm-bone, the longer to be fixed to the head of the internal splint-bone, the shorter to the inner and fore part of the large metacarpal bone. Besides these, there are two *annular ligaments,* one, *the anterior,* traversing the front of the knee, being attached on the sides, and confining down the extensor tendons; the other, *the posterior,* passing across, behind, from the scaphoid and cuneiform bones to the trapezium, inclosing the flexor tendons..

THE FETLOCK-JOINT is composed by the apposition of the inferior condyloid extremity of the cannon bone to the upper biconcave surface of the pastern bone, and by the addition, posteriorly, of the sesamoid bones, which are also fitted to the condyles of the cannon. Its binding parts are—1st. *The capsular membrane,* which is infixed into the bone around the borders of the cartilaginous surfaces, and in front is inseparably united with the extensor tendon. 2d. *The internal lateral ligaments:* the *long* one passing from a little projection on the side of the large metacarpal bone to the pastern; the *short* one, passing underneath the former, from a depression immediately below the eminence to the pastern, behind the insertion of the long ligament. 3d. THE SEVEN SESAMOID LIGAMENTS:—*a, The suspensory ligament* * (so called, I imagine, because the sesamoid bones seem to be *suspended* by it) is, perhaps, the strongest in the whole body, and is remarkable for its high degree of elastic property. It takes root, superiorly, in a projection at the upper and back part of the cannon, whence it passes, inclosed within a cellular sheath, between the splint bones, filling up their interspace. Opposite to about the terminations of these small bones, it splits into two divisions, which, diverging in their descent, become implanted into the lateral and posterior parts of the sesamoid bones, and into the fibro-cartilaginous substance uniting them. From the places of implantation, two lateral slips are continued from it downward and forward to join the extensor tendon. Between the suspensory ligament and the joint, enveloped in adipose membrane, are some large *bursæ mucosæ*. In composition and texture, this *ligament* possesses peculiarities: it has a sanguineous tinge interiorly, which is not perceptible in other ligaments or in tendons; and its fibres, which are very coarse, are disposed in layers. But its chief peculiarity consists in its exhibiting an intertexture of delicate, pinky, *fleshy* fibres, which appear to be the uniting medium of the ligamentous fasciculi. *b, The long inferior ligament* runs from the bases of the sesamoid bones, along the back of the pastern bone, to the upper extremity of the coronet bone, where it expands over the posterior part of the pastern joint. *c, The short inferior ligament* arises, by two portions, also from the bases of the sesamoid bones, where it is in part concealed from view by the former: it is implanted, a little lower down than the long one, into a well-marked angular asperity on the back of the pastern bone. *c, Two external lateral ligaments* are extended from the outer projecting angles of the sesamoid bones; one to the cannon bone, the other to the pastern. *d, Two crucial ligaments,* situated underneath the interior ligaments. They run, decussating each other, from the bases of the sesamoid bones to the upper and posterior or projecting parts of the pastern bone.

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* Bourgelat has regarded it as a tendon—"*le tendon suspenseur du boulet;*" Girard as a muscle—"*M. Tarso-phalangien.*"

Pastern-joint.—The condyloid eminences, terminating the inferior extremity of the pastern bone, fit into corresponding depressions upon the upper end of the coronet bone, the opposing surfaces being covered with cartilage. The articulation is furnished with—1st, Capsular membrane infolding the smooth cartilaginous ends of the bones, and firmly inherent into their borders: it is also interwoven with the extensor tendon, which passes over it in front, and behind becomes inseparably united with the inferior sesamoid ligaments. 2d, *Long lateral ligaments* rooted in rough surfaces on the sides of the pastern, whence they proceed to the coronet bone. 3d, *Short lateral ligaments,* broader and stronger than the former, are attached anteriorly to them, to the same bones, above and below. The long inferior sesamoid ligament protects this articulation behind, and the extensor tendon forms a broad defence to it in front: indeed, both these parts are so knitted in texture with the capsular membrane, that they appear to form the principal strength of it.

Coffin-joint.—The condyloid prominences constituting the inferior extremity of the coronet bone, are received into a bi-concave hollow formed by the upper surfaces of the coffin and navicular bones, although in an inconsiderable degree by the latter. The articulation is secured by—1st, *The capsular membrane,* which inwraps the cartilaginous surfaces, and becomes inserted around their boundaries. In front, it is interwoven with the extensor tendon; behind, it is greatly strengthened by connexion with the tendo perforans. 2d, *Three pairs* of ligaments of the coffin bone. *a, First pair* pass from the superior edges of the alæ of the coffin bone upon the sides of the coronet bone, and are fixed about its middle. *b, Second pair* are stretched from the extremities of the alæ, also to the coronet bone, and are inserted below and behind the first. *Third pair* spring from the sides of the coronal process, and run to be fixed to the cartilages. 3d, *Four ligaments,* two single and one pair, belonging to the navicular bone. *a, Superior ligament,* extending from the upper and posterior part of the bone to the tendo perforans. *b, Inferior ligament,* a very broad one, occupying the entire lower edge of the bone, and thence passing into the coffin bone, just above the insertion of the long flexor tendon. *c, The two lateral ligaments,* fixing the lateral extremities of the shuttle to the sides of the coronet bone.

The coffin ligaments are slight in comparison to those of the pastern and fetlock, because the coffin bone, from its situation *within* the hoof, is not liable to dislocation.

SECTION II.

MUSCULAR SYSTEM.

OF THE MUSCLES.

The fleshy parts of the body prove on dissection to be naturally divisible into numerous compact masses, assuming various forms and sizes, constituting so many distinct and separate *muscles,* whose number may be estimated at about 312. The majority of the muscles possess *tendons* or sinews, which are to be regarded as component parts of (rather than appendages to) them. The symmetry of the entire body is preserved by each half presenting (as well as bones) muscles corresponding in every essential particular; hence they are described as *pairs*, of which we reckon 151: the remaining ten being *single* muscles.* The following Table exhibits the classification of the muscles into *regions*, indicative of their situation and relative connexion: it also displays the respective nomenclatures of the English and French veterinary schools; the former, met with in the works of Snape, Stubbs, and Blaine, will be found to have been borrowed from human anatomy; the latter arose with Chaussier, and has been introduced very happily into veterinary anatomy by Girard.

I.—MUSCLES COMMON TO HEAD AND TRUNK. No. 1.

Cuticular Region.

English names. *French names.*

II.—MUSCLES OF THE HEAD. No. 92.

1st. Auricular Region. No. of Muscles 9.

Attollentes et Adducentes Aurem	3	Temporo-auricularis Externus Zygomatico-auricularis Temporo-auricularis Internus
Anterior Conchæ		Scuto-auricularis Externus
Posterior Conchæ		Scuto-auricularis Internus
Retrahentes Aurem	3	Cervico-auricularis Externus Cervico-auricularis Medius Cervico-auricularis Internus
Abducens *vel* Deprimens Aurem		Parotido-auricularis
		Mastoido-auricularis.

2d.—Palpebral Region. No. 2.

3d. Ocular Region. No. 8.

Levator Palpebræ Super. (Internus)	Orbito-palpebralis
Attollens *vel* Levator Oculi	Rectus Superior Oculi
Deprimens *vel* Depressor Oculi	Rectus Inferior Oculi
Abdunces *vel* Abductor Oculi	Rectus Externus Oculi
Adducens *vel* Adductor Oculi	Rectus Internus Oculi
Obliquus Superior *vel* Trochlearis	Obliquus Magnus Oculi
Obliquus Inferior Oculi	Obliquus Parvus Oculi
M. Septimus Oculi Suspensorius, *vel* Retractor Oculi	Rectus Posterior Oculi.

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* This computation does not include the Muscles of the Internal Ear.

† Stubbs considers the tendinous expansion of this muscle as distinct, under the name of "Epicranius."

4th. Anterior Maxillary Region. No. 12.

English names.	*French names.*
Zygomaticus	Zygomatico-labialis
Levator Labii Superior. Alæq. Nasi	Super-naso-labialis
Dilatator Naris Lateralis	Super-maxillo-nasalis Magnus
Nasalis Longus Labii Super.	Super-maxillo labialis
Caninus, *vel* Levator Anguli Oris	Portion of the Alveolo-labialis
Buccinator	Alveolo-labialis
Depressor Labii Inferioris	Maxillo-labialis
Levator Menti	Mento-labialis
Dilatator Narium Anterior	Naso-transversalis
Nasalis Brevis Labii Superioris	Super-maxillo-nasalis Parvus
Depressor Labii Superioris	
Orbicularis Oris	Labialis, Anterior et Posterior.

5th. Posterior Maxillary Region. No. 5.

Temporalis	Temporo-maxillaris
Masseter	Zygomatico-maxillaris
Stylo-maxillaris	Stylo-maxillaris
Pterygoideus Internus	Spheno-maxillaris.
Pterygoideus Externus	

The remaining Regions of the Head are comprehended within

THE SUBMAXILLARY SPACE.

6th. Hyoideal Region. No. 6.

Digastricus	Portion of the Stylo-maxillaris
Mylo-hyoideus	Mylo-hyoideus
Genio-hyoideus	Genio-hyoideus
Hyoideus Magnus	Kerato-hyoideus Magnus
Hyoideus Parvus	Kerato-hyoideus Parvus
Stylo-hyoideus	Stylo-hyoideus.

7th. Glossal Region. No. 4.

Hyo-glossus Longus	Kerato-glossus
Hyo-glossus Brevis	Hyo-glossus
Genio-hyo-glossus	Genio-glossus
Lingualis	Lingualis.

8th. Pharyngeal Region. No. 5.

Hyo-pharyngeus	Kerato-pharyngeus
Palato-pharyngeus	Pterygo-pharyngeus
Constrictor Pharyngis Anterior	Hyo-pharyngeus
Constrictor Pharyngis Medius	Thyro-pharyngeus
Constrictor Pharyngis Posterior	Crico-pharyngeus
	Aryteno-pharyngeus.

9th. Laryngeal Region. No. 7.

Hyo-thyroideus	Hyo-thyroideus
Crico-thyroideus	Crico-thyroideus
Crico-arytenoideus Posticus	Crico-arytenoideus Posticus
Crico-arytenoideus Lateralis	Crico-arytenoideus Lateralis
Thyro-arytenoideus	Thyro-arytenoideus
Arytenoideus	Arytenoideus
Hyo-epiglottideus	Hyo-epiglottideus.

10th.—Palatine Region. No. 2.

English names.	*French names.*
Tensor Palati	Stylo-staphyleus
Circumflexus Palati	Staphyleus.

III.—MUSCLES OF THE TRUNK. No. 113.

a.—MUSCLES OF THE NECK. No. 40.

1st. Humero-Cervical Region. No. 2.

Rhomboideus Longus *vel* Minor	Cervico-acromialis
Levator Humeri	Cervico-subscapularis.

2d. Lateral Cervical Region. No. 4.

Splenius	Cervico-mastoideus
Complexus Major	Dorso-occipitalis
Trachelo-mastoideus	Dorso-mastoideus
Spinalis Colli	Dorso-spinalis.

3d. Superior Cervico-occipital Region. No. 5.

Complexus Minor	Axoido-occipitalis Longus
Rectus Capitis Posticus Major	Axoido-occipitalis Brevis
Rectus Capitis Posticus Minor	Atloido-occipitalis Parvus
Obliquus Capitis Superior	Atloido-mastoideus
Obliquus Capitis Inferior	Axoido-atloideus.

4th. Inferior Cervical Region. No. 6.

Portion of the Levator Humeri	Mastoido-humeralis
Sterno-maxillaris	Sterno-maxillaris
Sterno-thyro-hyoideus	Sterno-hyoideus Sterno-thyroideus
Subscapulo-hyoideus	Subscapulo-hyoideus
Scalenus	Costo-cervicalis
Longus Colli	Subdorso-atloideus.

5th. Inferior Cervico-occipital Region. No. 3.

Rectus Capitis Anticus Major	Trachelo-suboccipitalis
Rectus Capitis Anticus Minor	Atloido-suboccipitalis
Obliquus Capitis Anticus	Atloido-styloideus.

b.—MUSCLES OF THE THORAX. No. 37.

1st. Dorso-scapular Region. No. 3.

Trapezius	Dorso-acromialis
Latissimus Dorsi	Dorso-humeralis
Rhomboideus Brevis *vel* Major	Dorso-Subscapularis.

2d. Pectoral Region. No. 3.

Pectoralis Transversus	Sterno-aponeuroticus Sterno-humeralis
Pectoralis Magnus	Sterno-trochineus
Pectoralis Parvus	Sterno-scapularis.

3d. Costal Region. No. 3.

English names.	*French names.*
Serratus Magnus	Costo-subscapularis Dorso-costalis Lumbo-costalis
Intercostales Externi	Intercostales Externi
Intercostales Interni	Intercostales Interni.

4th. Sternal Region. No. 3.

Lateralis Sterni	Costo-sternalis
Sterno-costales Externi	Sterno-costales.
Sterno-costales Interni	

5th. Dorso-costal Region. No. 3.

Superficialis Costarum	Dorso-costalis
Transversalis Costarum	Trachelo-costalis
Levatores Costarum	Transverso-costales.

6th. Dorsal Region. No. 3.

Longissimus Dorsi	Ilio-spinalis
Spinalis Dorsi	
Semi-spinalis Dorsi	Transverso-spinalis Dorsi.

7th. Diaphragmatic Region. No. 1.

Diaphragma	Diaphragma.

c.—MUSCLES OF THE ABDOMEN. No. { in the Male 36. in the Female 33.

1st. Lumbar Region. No. 6.

Semi-spinalis Lumborum	
Intertransversales Lumborum	
Sacro-lumbalis	Sacro-costalis
Psoas Magnus	Sublumbo-trochantineus
Iliacus	Iliaco-trochantineus
Psoas Parvus	Sublumbo-pubialis.

2d. Abdominal Region. No. 4.

Obliquus Externus Abdominis	Costo-abdominalis
Obliquus Internus Abdominis	Ilio-abdominalis
Transversalis Abdominis	Lumbo-abdominalis
Rectus Abdominis	Sterno-pubialis.

3d. Anal Region. No. 2.

Sphincter Ani	Sphincter
Retractor Ani	Ischio-analis
	Ischio-perinealis.

4th. Genital Region (in the Male). No. 4.

Cremaster	Ilio-testicularis
Erector Penis	Ischio-subpenialis
Triangularis Penis	Ischio-urethralis
Accelerator Urinæ	Perineo-urethralis.

Genital Region (in the Female). No. 2.

English names.	*French names.*
Erector Clitoridis	Ischio-clitorideus Sacro-clitorideus
Sphincter Vaginæ	Perineo-clitorideus.

5th. Coccygeal Region. No. 4.

Erector Coccygis	Sacro-coccygeus Superior
Depressor Coccygis	Sacro-coccygeus Inferior
Curvator Coccygis	Sacro-coccygeus Lateralis
Compressor Coccygis	Ischio-coccygeus.

IV.—MUSCLES OF THE EXTREMITIES. No. 106.

ANTERIOR EXTREMITIES. No. 48

a.—MUSCLES OF THE SHOULDER. No. 12.

1st. External Scapular Region. No. 2.

Antea-spinatus	Super-acromio-trochitereus
Postea-spinatus	Sub-acromio-trochitereus.

2d. Internal Scapular Region. No. 1.

Subscapularis	Subscapulo-trochineus.

3d. Posterior Scapular Region. No. 2.

Teres Major	Subscapulo-humeralis
Teres Minor	Superscapulo-trochiterius Minimus.

4th. Anterior Humeral Region. No. 3.

Coraco-humeralis	Coraco-humeralis
Flexor Brachii	Coraco-radialis
Humeralis Externus	Humero-radialis Obliquus.

5th. Posterior Humeral Region. No. 4.

Triceps Extensor Brachii	Caput Magnum *vel* Primum	Scapulo-olecranius
	Caput Medium *vel* Secundum	Humero-olecranius Externus
	Caput Parum *vel* Tertium	Humero-olecranius Internus
Anconeus		Epicondylo-olecranius.

b.—MUSCLES OF THE ARM AND FORE-LEG. No. 12.

1st. Anterior Brachio-Crural Region. No. 4.

Extensor Metacarpi Magnus	**Epitrochlo-premetacarpeus**
Extensor Pedis	**Epitrochlo-prephalangeus**
Extensor Suffraginis	**Radialis-prephalangeus**
Extensor Metacarpi Obliquus *vel* Parvus.	**Radialis-metacarpeus Obliquus.**

2d. Superficial Posterior Brachio-crural Region. No. 4.

English names.	*French names.*
Flexor Metacarpi Externus	Epitrochlo-carpeus
Flexor Metacarpi Medius	Epicondylo-carpeus
Flexor Metacarpi Internus	Epicondylo-metacarpeus
Flexor Accessorius Sublimis	Ulnaris (Accessorius).

3d. Deep Posterior Brachio-crural Region. No. 4.

Flexor Pedis Perforatus	Epicondylo-phalangeus
Flexor Pedis Perforans	
Flexor Accessorius Profundus	Radialis (Accessorius)
Lumbrici, Anterior et Posterior	Lumbricales.

POSTERIOR EXTREMITIES. No. 58.

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a.—MUSCLES OF THE HAUNCH. No. 20.

1st. Gluteal Region. No. 3.

Gluteus Externus	Ilio-trochanterius Medius
Gluteus Maximus	Ilio-trochanterius Magnus
Gluteus Minimus	Ilio-trochanterius Parvus.

2d. Pelvi-trochanterian Region. No. 5.

Pyriformis	Sacro-trochantereus
Obturator Externus	Subpubio-trochantereus Externus
Obturator Internus	Subpubio-trochantereus Internus
Gemini	Ischio-trochantereus.

3. Anterior Ilio-femoral Region. No. 4.

Tensor Vaginæ	Ilio-aponeuroticus
Rectus	Ilio-rotuleus
Vastus Externus	Trifemoro-rotuleus
Vastus Internus	
Crureus	
Rectus Parvus	Ilio-femoralis.

4th. Internal Ilio-femoral Region. No. 6.

	Sartorius	Sublumbo-tibialis
	Gracilis	Subpubio-tibialis
	Pectineus	Superpubio-femoralis
Triceps Adductor	Adductor Brevis	Subpubio-femoralis
	Adductor Longus	
	Adductor Magnus	Ischio-tibialis Externus.

5th. Posterior Ilio-femoral Region. No. 2.

Biceps Abductor		Ischio-tibialis Medius *vel* Posterior
Semitendinosus	Adductor Tibialis	Ischio-tibialis Internus.
Semimembranosus		

b.—MUSCLES OF THE THIGH AND HIND LEG. No. 9.

1st. Anterior Femoro-crural Region. No. 3.

Extensor Pedis	Femoro prephalangeus
Peroneus	Peroneo-prephalangeus
Flexor Metatarsi	Tibio-prematarseus.

2d. Superficial Posterior Femoro-crural Region. No. 3.

English names.	*French names.*
Gastrocnemius Externus	Bifemoro-calcaneus
Gastrocnemius Internus	Femoro-phalangeus
Plantaris	Peroneo-calcaneus.

3d. Deep Posterior Femoro-crural Region. No. 3.

Popliteus	Femoro-tibialis Obliquus
Flexor Pedis	Tibio-phalangeus
Flexor Pedis Accessorius	Peroneo-phalangeus.

I.—CUTANEOUS MUSCLES.

Panniculus Carnosus.—*Musculus Subcutaneus.*

A muscle peculiar to quadrupeds.

Situation. Subcutaneous; and so uniformly and generally spread over the surface of the body, that it has been regarded as one of the common teguments. It not only clothes the broad sides of the trunk, but it extends forward upon the shoulder, neck, face; and, backwards, upon the haunch and stifle.

Division. On account of its extensiveness, into three portions:—cervical, thoracic, and abdominal.

The Cervical Portion originates in some pale disgregated *fasciculi*, descending upon the side of the head; one parcel coming from the lateral parts of the mouth, another from the root of the ear and parotid gland, a third and larger one from the aponeurosis of the masseter; all running to the angle of the jaw, and there collecting themselves into a fleshy band, which, after descending a little way lower down, again becomes resolved into separate fasciculi, and dispersed and spread over the side of the neck. The fleshy fibres, however, are principally confined to the infero-lateral regions: the superior portion consisting principally of an aponeurosis, partly cellular and partly tendinous, which is extended and fixed to the ligamentum nuchæ. At the bottom of the neck some fasciculi are found running and attaching themselves to the spine of the scapula; others, paler and less distinct, take a downward course, passing over the shoulder-joint, where many become intermingled with and lost in the adipose membrane thereabouts; while others, again, continue still lower, and vanish upon the faschia of the arm.

The Thoracic Portion consists of a broad layer of fleshy fibres, extending from a little above the middle of the scapula in a direct line down upon the arm, into the faschia of which it is (together with the cervical portion) inserted; while, above, by means of an aponeurotic expansion, it is continued to be attached to the spine.

The Abdominal Portion forms a broad fleshy expansion;

abstractedly viewed, ovoid in outline; clothing the false ribs and lateral parts of the abdomen; whose fibres, generally, run in a longitudinal plane, from before backwards, from the shoulder to the flank: as they approach this latter part, they converge, and finally become collected into a broad, thick, muscular band, which is included within the fold of skin forming the border of the flank, and ends upon the front of the haunch, interwoven with the faschia covering that part, by which it is fixed to the patella. Anteriorly, the abdominal is connected with the thoracic portion by an aponeurotic intervention; along its superior border, the faschia covering the back and loins attaches the muscle to the spine; inferiorly, it becomes gradually indistinguishable from the faschia superficialis abdominis, with which it is blended, and through which it gets an attachment to the pubes. The spur-vein is seen ramifying, superficially, upon this portion of the muscle.

Relations. The strongest fibres of the panniculus are exhibited by its abdominal portion: the palest and weakest are seen upon the face. Its cervical portion is in many places intimately blended with the levator humeri; and also with the pectoral muscles. The thoracic part envelops the trapezius, rhomboidei, latissimus dorsi, and spinati muscles; the abdominal portion covers the external oblique muscle and its aponeurosis.

Attachments. Besides those already mentioned, it is loosely and partially connected, by cellular substance, with the several muscles and bones and ligaments which it immediately covers; but everywhere intimately and generally with the skin.

Direction. Upon the head its fibres ramify in an arborescent form; upon the neck they take an oblique course; upon the shoulder they run in a perpendicular direction; upon the abdomen, in a horizontal line.

Action. The contractions of the panniculus throw the skin into folds or corrugations, transversely in the direction of its fibres; so that the one form right angles with the other. The chief points from which it acts, are the lower jaw, the scapula and head of the humerus, the patella, and the pubes. By suddenly and repeatedly wrinkling his skin, the horse (unprovided with hands for the purpose) effects the dislodgement of insects which annoy him, and likewise of any irritating or noxious substance, such as thorns or prickles, dirt, hayseeds, &c. This power also enables him to resist, to a certain degree, the gripe or bite of an adversary. And so habitual does this cutaneous action become, that, although perfectly and fully at the command of the will, it often appears to take place involuntarily, or at least unheeded by the animal: this is particularly remarkable at the time that a horse is grazing or feeding, and is the while annoyed by flies. M. Girard conceives that it must give additional power of action to many muscles by operating as a brace or bandage to them; his words are—"Il concourt à augmenter la force des muscles sur lesquelles il exerce une pression un peu forte."

II.—MUSCLES OF THE HEAD.

1.—AURICULAR REGION.

We shall consider these muscles in four classes—the Attollentes, the Muculi Proprii Conchæ, the Retrahentes, and the Abducentes.

1. ATTOLLENTES ET ADDUCENTES AUREM.

ATTOLLENS MAXIMUS.—*Temporo-auricularis Externus.*

Situation. Subcutaneous, upon the temple, at the inner side of the ear.

Figure. Broad, very thin, triangular.

Attachment. By cellular membrane to the temporal faschia; to a white tendinous (divisional or median) line extending in the direction of the sagittal suture; and to the superior and posterior parts of the triangular cartilage, reaching from the vertex to the pit behind the orbit.

Direction. From within outward; convergent in approaching the ear.

Structure. Fleshy and cellular; fibres pale and slender; and in their disposition aponeurotic.

ATTOLLENS ANTERIOR.—*Zygomatico-auricularis.*

Situation. Subcutaneous; in front and to the other side of the former.

Attachment. Anteriorly, to the posterior extremity of the zygoma; along its middle, to the temporal muscle; posteriorly, to the front of the triangular cartilage.

Relations. Externally, the skin; internally, the temporalis.

ATTOLLENS POSTERIOR.—*Temporo-auricularis Internus.*

Situation. Underneath the attollens maximus.

Form. Thin, triangular; much smaller than the maximus.

Attachments. Inwardly, to the sagittal suture or ridge; internally, to the temporalis, by cellular tissue; outwardly, to the posterior part of the concha.

Relations. Externally, the maximus; internally, the temporalis.

Structure. Principally fleshy; in part aponeurotic, posteriorly.

Action of the Attollentes.—These muscles all co-operate in the erection or cocking of the ears. Acting in pairs, the maximi will approximate; the anteriores will depress them; the posteriores elevate them. But, as the triangular cartilage is more particularly their seat of action, in order to produce the same effects on the concha, the aid of others will be required, next to be described.

2. MUSCULI PROPRII CONCHÆ.

These muscles attach the triangular cartilage to the concha.

ANTERIOR CONCHÆ.—*Scuto-auricularis Externus.*

Situation. Antero-internal side of the root of the ear.

Form. Two short, thin, narrow fleshy slips.

Attachment. To the outer side and posterior angle of the triangular cartilage, and to the antero-internal part of the concha.

Relations. Externally, skin; internally, cartilage of the ear.

Direction. From behind, forwards; and from within, outwards.

POSTERIOR CONCHÆ.—*Scuto-auricularis Internus.*

Situation. Deep-seated, at the inner side of the root of the ear.

Form. Two fleshy bands, thicker than the last described.

Attachment. To the inner side of the triangular cartilage; to the superior angle of the same; and to the posterior part of the root of the concha.

Direction. Downwards, backwards, and outwards.

Structure. Fleshy; the larger slip only possessing a few tendinous fibres at its conchal attachment.

Action of the Musculi Conchæ.—The anterior muscle will assist in the erection of the ear; and present the aperture forwards, by drawing round the concha and maintaining it against the triangular cartilage. The posterior muscle will have directly the reverse operation: it will rotate the ear the contrary way; so that the aperture may look backwards and collect sounds from the rear.

3. RETRAHENTES AUREM.

Cervico-auriculares, Externus et Internus.

Situation. Behind the ear, upon the side of the poll.

Form. Broad, thin, membraniform.

Attachment. Posteriorly, to the vertex, ligamentum nuchæ, and obliquus capitis superior. Anteriorly, the external portion is attached to the dorsum conchæ, about one third of its extent, upwards: the internal portion, to the root of the concha, and to the annular cartilage.

Action. To retract the ear; to draw it down upon the poll: also to rotate the ear, turning the hollow part backwards.

4. ABDUCENS *vel* DEPRIMENS AUREM.

Parotido-auricularis.

Situation. Below, and to the outer side of the root of the ear.

Form. Broad, thin, membraniform.

Attachment. To the surface of the parotid gland by dense cellular membrane; and to the outer and fore part of the concha, just below its orifice.

Relations. Externally, with the panniculus and skin; internally, with the parotid gland.

Direction. From below upwards; inclining a little forwards.

Structure. Fleshy, and more substantial than the attollentes.

Action. To abduct the ear, and assist in depressing it.

2.—PALPEBRAL REGION.

LEVATOR PALPEBRÆ SUPERIORIS—CORRUGATOR SUPERCILII.

Fronto-superciliaris.

Situation. Above the orbit.

Figure. Short, thin, narrow, pyramidal.

Attachment. Blended with the aponeurotic expansion upon the forehead, above the orbital arch; and inserted into the superior part of the upper eyelid, nearer to its inner than outer angle.

Relations. Internally, with the skin; externally, with the orbital arch; inferiorly, blended with the next muscle.

Direction. Oblique: from above downwards, and from within outwards.

Structure. Superiorly, aponeurotic; inferiorly, pale and delicately fleshy.

Action. To draw up the upper eyelid, and particularly the inner part of it.

ORBICULARIS PALPEBRARUM.—*Musculus ciliaris.*

Situation. Within the eyelids: in front of the base of the orbit.

Figure. Obliquely oval; slit in its long diameter.

Attachment. To the orbital portion of the ossa unguis et frontis; to the palpebral ligament; and to the skin of both lids.

Relations. Externally, with the skin; internally, with the membrana conjunctiva; superiorly, with the former muscle; inferiorly, with the levator labii; towards the margins of the lids, with the tarsi; at the inner canthus, with the lachrymal sac.

Structure. Fleshy; disposed in little packets or fasciculi.

Action. To approximate or shut the eyelids.

3.—OCULAR REGION.

LEVATOR PALPEBRÆ SUPERIORIS INTERNUS.

Orbito-palpebralis.

Situated—Superiorly, between the eyeball and the orbit.

Form. Flat, thin, fan-shaped: broad and expanded in front; narrow and tapering behind.

Attachment. To the inner and upper part of the parieties of the optic foramen; and whole breadth of the border of the upper lid.

Relations. Superiorly, with the fibrous lining of the orbit, and the lachrymal gland: inferiorly, with the levator oculi and sclerotica.

Direction. Oblique: from behind, forwards; from below, upwards; and from within, outwards.

Structure. Posterior attachment, tendinous: anterior, aponeurotic; intermediate part, fleshy, pale, and delicate.

Action. To raise the upper eyelid.

LEVATOR OCULI.—RECTUS SUPERIOR OCULI.
DEPRESSOR OCULI.—RECTUS INFERIOR OCULI.
ABDUCTOR OCULI.—RECTUS EXTERNUS OCULI.
ADDUCTOR OCULI.—RECTUS INTERNUS OCULI.

Situation. Within the orbit, at respective and equal distances one from another, along the superior, inferior, and lateral parts of the eyeball.

Form. Elongated, curved, conoid: broad parts turned forwards.

Attachment. To the circumferent parts of the optic foramen; and to four opposite points, equidistant one from another, of the sclerotic, where it covers the front of the eyeball.

Relations. Externally, with the fibrous lining of the orbit; internally, with the sclerotic coat; in the middle, with the retractor oculi. The levator oculi has also, above it, the levator palpebræ internus.

Direction. Oblique: from within outwards, in the direction of the visual axis; the levator, at the same time, winding upwards; the depressor, downwards; the abductor, to the outer side; the adductor, to the inner side.

Structure. Posterior attachments tendinous and fleshy; anterior, aponeurotic; intermediate parts, fleshy.

Action. The levator will turn the sight of the eyeball upwards; the depressor, downwards; the abductor, outwards; the adductor, inwards. All four muscles acting simultaneously will draw the globe backwards, within the orbit. The combined action of any two of them, will give the sight an oblique or intermediate direction.

OBLIQUUS SUPERIOR *vel* MAGNUS OCULI-TROCHLEARIS.

Situation. Inner and upper part of the cavity of the orbit.

Form. Elongated, cylindroid; somewhat narrowed, posteriorly; anteriorly, curved at an acute angle towards the opposite side.

Attachment. To the border of the optic foramen, and to the upper and outer part of the sclerotic, near to the attachment of the abductor.

Relations. Superiorly, with the orbital parietes and pathetic nerve; inferiorly, with the adductor and supra-orbital branch of the ophthalmic nerve.

Direction. Horizontal, but somewhat curved; inclining from within outwards until it reaches the fore part of the cavity, where it becomes reflected outwards and downwards, with an inclination backwards.

Structure. Posterior attachment tendinous and fleshy; anterior, aponeurotic; middle part, fleshy. At the inner canthus, the fleshy part passes through a broad fibro-cartilaginous loop or pulley, which is fixed to the posterior part of the frontal orbital process.

OBLIQUUS INFERIOR *vel* PARVUS OCULI.

Situation. Under the eyeball; antero-inferior part of the orbit.

Figure. Broad, thick, cylindroid: ocular attachment broadest.

Attachment. To a little depression in the os unguis, behind the lachrymal opening; and to the inferior and outer side of the sclerotic, close to the junction of the white with the transparent part of the globe.

Relations. Inferiorly, with the floor of the orbit; superiorly, with the aponeurotic tendon of the depressor; internally, with the lachrymal sac.

Structure. Fleshy, included within a fibrous sheath.

RETRACTOR *vel* RECTUS POSTERIOR OCULI.

Situation. Behind the eyeball.

Figure. That of a hollow cone, with its base turned forwards.

Attachment. To the edge immediately surrounding the optic foramen; and to the posteriar third of the entire superficies of the globe of the eye.

Relations. Around its sides are the four straight muscles of the eye, and in the interspaces a quantity of adipose matter: through its middle runs the optic

Direction. Radiated: the fibres diverging from the optic foramen as a centre, and spreading upon the surface of the globe.

Structure. Posterior attachment, tendinous and fleshy: remainder, fleshy.

4.—ANTERIOR MAXILLARY REGION.

ZYGOMATICUS.—*Zygomatico-labialis.*

Situation. Along the middle of the side of the face.

Figure. Very thin, flattened, elongated.

Attachment. Posteriorly, to the anterior part of the zygoma, and cellular tissue clothing the masseter; anteriorly, its fibres grow faint and vanish imperceptibly in approaching the angle of the mouth.

Relations. Externally, with the skin; internally, with the caninus; inferiorly, with the panniculus carnosus.

Direction. Horizontal, from behind forwards.

Structure. Fleshy, except at its posterior attachment.

Action. To assist in retracting the angle of the mouth.

LEVATOR LABII SUPERIORIS ALÆQUE NASI.

Super-naso-labialis.

Situation. Upon the side of the face, above the preceding muscle.

Figure. Broad, thin, elongated, bifurcated anteriorly.

Attachments. Posteriorly, to the subcutaneous surfaces of the nasal and frontal bones, reaching as far backward as the level between the orbital arches; anteriorly, by one division to the lateral parts of the skin of the nose and the false nostrils; by the other division, to the side of the upper lip and angle of the mouth.

Relations. Externally, with the skin; the superior division, with the dilatator naris lateralis: internally, with the nasalis longus labii superioris, pes anserinus, and the superior labial artery.

Direction. Rather oblique, from behind forwards, inclining downwards.

Structure. Posteriorly, a broad and extended aponeurosis; anteriorly, fleshy.

Action. To assist in the retraction of the upper lip and angle of the mouth, and in the dilatation of both the true and false nostrils.

Remark. Stubbs describes the aponeurotic expansion of this muscle under the name of "epicranius."

DILATATOR NARIS LATERALIS.—*Super-maxillo-nasalis magnus.*

Situation. Upon the side of the face.

Figure. Flat, pyramidal, base presented forwards.

Attachments. Posteriorly, to the fore end of the zygoma, and to the superior maxilla for a short space in front of it; anteriorly, it spreads upon the side of the nostril and the supero-lateral parts of the upper lip.

Relations. Externally, with the skin and the inferior division of the preceding muscle; internally, with the superior division of the same muscle, the caninus, the superior maxillary bone, and the superior labial blood-vessels and nerves.

Direction. Horizontal, diverging as it proceeds forwards.

Structure. A slender tendon attaches it to the bone, below which it is fleshy.

Action. To dilate the nostril and retract the upper lip.

NASALIS LONGUS LABII SUPERIORIS.—*Super-maxillo-labialis.*

Situation. Upon the upper part of the side of the face.

Figure. Elongated, pyramidal; base turned backwards: external surface, convex; internal, flat.

Attachments. Posteriorly, to a slight bony depression at the junction of the superior maxillary and malar bones, a short distance from the lower margin of the orbit; anteriorly, along the middle of the anterior part of the upper lip.

Relations. Externally, with the skin and the levator labii superioris alæque nasi, and the angular vein; internally, with the superior maxilla, pes anserinus, and false nostrils: the united tendon crosses, in front, the dilatator naris anterior, and at the border of the lip enters the substance of the labial gland.

Direction. Horizontal, the fleshy fibres gradually converging from their origin to their termination in the tendon.

Structure. It has a few tendinous fibres at its origin; otherwise, it is fleshy as far forward as the false nostrils, where it ends in a cylindroid tendon, and which here passes through a sort of cellular sheath, by which it is retained in its proper place. In turning over the front of the nose it grows flat, and at the peak formed by the apices of the nasal bones forms a junction with its fellow coming from the opposite side. The two unite and form a single flat tendon, which expands a little in descending, and ultimately disappears in the fleshy substance of the lip.

Action. To raise and corrugate the upper lip, and in some degree assist in the dilatation of the false nostrils.

CANINUS *vel* LEVATOR ANGULI ORIS.

Portion of the alveolo-maxillaris.

Situation. Fore part of the side of the face.

Figure. Broad, flat, triangular.

Attachments. Superiorly, to the broad depression upon the side of the fore angle of the superior maxillary bone; inferiorly, to the alveolar processes of the lower jaw, and the bone in front of them; internally, to the buccal membrane; anteriorly, to the side of the lip and angle of the mouth.

Relations. Externally, with the zygomaticus, inferior division of the levator labii superioris alæque nasi, dilatator naris lateralis, panniculus carnosus, and skin; internally, with the masseter, buccal membrane, and two anterior upper molar teeth.

Direction. Transverse and penniform; the superior fibres diverge from their maxillary attachment; those below run obliquely, forwards and downwards.

Structure. Fleshy.

Action. To render the buccal membrane tense, and also to assist in elevating the angle of the mouth and side of the lip.

BUCCINATOR.—*Alveolo-labialis.*

Situation. In the space between the jaws.

Figure. Broad, flat, approaching the triangular.

Attachments. Posteriorly, to the border of the lower jaw in the space between the last molar tooth and the root of the coronoid process, and to the tuberosity of the superior maxilla; superiorly and inferiorly, to the outer walls of the alveolar cavities for the molar teeth; anteriorly, to the angle of the mouth; and internally, to the buccal membrane.

Relations. Externally, with the masseter, caninus, panniculus, and skin, and with the facial artery and vein and parotid duct; internally, with the buccal membrane; postero-inferiorly, with the buccal nerve, artery, and varicose vein; antero-inferiorly, with the depressor labii inferioris and inferior labial blood-vessels; postero-superiorly, with the temporal vein.

Direction. Longitudinal, from behind forwards.

Structure. With the exception of its posterior or narrow extremity, which contains some slips of tendon, and a few tendinous fibres which are visible about the angle of the mouth, it is entirely fleshy.

Action. To aid in tightening the buccal membrane, and retract the angle of the mouth.

DEPRESSOR LABII INFERIORIS.—*Maxillo-labialis.*

Situation. Along the side of the lower jaw.

Figure. Elongated, flattened, pyramidal, base turned backwards.

Attachments. Posteriorly, blended with the buccinator, to the tuberosity of the superior maxilla, and the superior border of the inferior maxilla, behind it salveoli; anteriorly, infero-lateral part of the interior of the lower lip.

Relations. Externally, with the panniculus and skin, crossed also by the facial artery and vein and parotid duct; internally, with the inferior maxilla and buccinator; also with the inferior labial blood-vessels, which run between it and the buccinator.

Direction. Horizontal, the fibres very gradually converging.

Structure. Two slender tendons attach it to the jaws, and another connects it with the lip, in the glandular substance of which the latter expands, splits, and disperses its fibres.

LEVATOR MENTI.—*Mento-labialis.*

Situation. Under the chin.

Figure. Broad and (though rather irregularly) quadrilateral.

Attachments. Superiorly, to the alveolar processes, and the antero-inferior and lateral parts of the inferior maxilla; inferiorly, its fibres are lost sight of amid the adipose and glandular substance forming the prominence of the chin.

Relations. Superiorly, with the bone; inferiorly, with the membrane lining the lip; anteriorly, with the teeth; posteriorly, with the prominence of the chin.

Direction. Oblique, from before backwards, and from above downwards; the lateral fibres making a curvature forwards.

Structure. Fleshy.

Action. To draw forward and raise the prominence of the chin, and with it the under lip.

DILATATOR NARIS ANTERIOR.—*Naso-transversalis.*

Situation. In front of and between the nostrils.

Figure. Transverse parallelogram.

Attachments. In the middle, to the bony peak formed by the apices of the ossa nasi; on the side, to the anterior surface of the alæ or broad cartilages of the nose.

Relations. Externally, with the skin and the united tendon belonging to the nasales longi labii superioris; internally, to the broad and also to the narrow cartilages of the nose, and to the triangular space between them; superiorly, with the ossa nasi; inferiorly, with the glandular substance of the lip.

Direction. Transverse.

Structure. Fleshy, except at its attachment to the os nasi.

NASALIS BREVIS LABII SUPERIORIS.

Super-maxillo-nasalis parvus.

Situation. Behind the external nares.

Figure. Narrow, thin, forming two sides of a triangle.

Attachments. Inferiorly, to the superior and anterior maxillary bones, and to the suture uniting them; superiorly, to the os nasi; in the middle to the horn or *cornet* of the nose and the skin of the false nostrils: it forms, in fact, a fleshy investment to the angular bony boundary of the false nostrils.

Relations. Externally, with the levator labii superioris alæque nasi, the tendon of the nasalis longus labii superioris, and the skin; internally, with the membrane of the nose.

Direction. Transverse, inclining forwards.

Structure. Fleshy.

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DEPRESSOR LABII SUPERIORIS.

Situation. Side of the upper jaw.

Figure. Broad, thin, irregular.

Attachment. Inferiorly to the alveoli of the lateral and middle incisores, extending thence along the side of the jaw as far as the tusk; superiorly, it is confounded with the glandular substance of the upper lip, and is also connected with the inferior nasal cartilages.

Relations. Anteriorly, with the labial gland, and at the side, with the nerves descending from the pes anserinus; posteriorly, with the front of the jaw; superiorly, with the cartilages of the nose; inferiorly, with the incisor teeth.

Direction. Oblique, from before backwards, and from below upwards.

Structure. Fleshy.

Action. To draw down the side of the lip, and with it the nasal cartilage, and thereby have some effect in dilating the nostril.

ORBICULARIS ORIS.—*Labialis.*

Situation. Within the border of the lips, of which it constitutes the principal thickness.

Figure. It forms two semi-ovals, directed backwards, united at the commissures of the lips.

Attachments. To the glandular substance and skin of the lips, and more particularly at the commissures, where the fibres coming from both lips cross one another, and become confounded with those of other muscles inserted thereabouts.

Relations. Externally, with the skin; internally, with adipose tissue, the labial glands, and the membrane of the mouth.

Direction. Semi-circular, in the horizontal line.

Structure. Consists of two bands of fleshy fibres, the upper one of which is broader, thicker, redder, and stronger than the lower.

Action. To approximate the lips and retain them in contact; also to assist in the dilatation of the nostrils.

5.—POSTERIOR MAXILLARY REGION,

Comprising the muscles whose office it is to move the lower jaw.

TEMPORALIS.—*Temporo-maxillaris.*

Situation. Upon the parietal and temporal bones.

Form. Convex, externally; concave, internally: broad, above; narrow and convergent, below.

Attachment. Superiorly, to the vertex and the anterior occipital bone; to the convex surface of the parietal; to the squamous plate and zygomatic process of the temporal bone; and to a small portion of the frontal: inferiorly, to the coronoid process of the inferior maxilla.

Relations. Externally, with the attollentes aurem and the zygoma; internally, with the cranial bones; postero-externally, with the ear; anteriorly, with a volume of fatty substance lodged at the back of the orbit.

Direction. From behind, forwards; and from above, downwards: the fibres taking a curvilinear course.

Structure. Covered by a dense aponeurotic expansion, denominated the *temporal faschia;* the broad part of the muscle is fleshy, but is intersected horizontally through its middle by a layer of tendon. Below, it is tendinous in its attachments to the sharp edges of the coronoid process; but fleshy around the sides of it.

Action. To raise the lower against the upper jaw; and, thereby, when the mouth is opened, to shut it again. It is one of the principal agents in manducation.

MASSETER.—*Zygomatico-maxillaris.*

Situation. It forms the prominence of the cheek.

Form. Broad, thick, semi-oval: superior and anterior sides, rectilinear; postero-inferior border, curvilinear.

Attachment. Superiorly, to the whole of the zygomatic ridge, and lower border of the arch, reaching as far back as the mastoid process; inferiorly, to the roughened border surrounding the angle of the jaw, and to the contiguous parts of the external surface.

Relations. Externally, with the panniculus carnosus, cellular tissue, and branches of the portio dura; internally, with parts of the superior and inferior maxillæ, buccinator, mass of yellow fat filling the intermaxillary vacuity, posterior and anterior masseter arteries and veins; superiorly, with the temporal artery and vein; posteriorly, with the parotid gland; anteriorly, with the parotid duct, anterior maxillary artery and vein.

Direction. Oblique: from above, downwards; and from before, backwards.

Structure. Of its exterior, the superior two thirds is aponeurotic; internally, it is composed of several distinct fleshy layers, separated by aponeurotic intersections.

Action. In co-operation with the former muscle, to elevate the lower jaw, and maintain it in approximation against the upper.

STYLO-MAXILLARIS.

Situation. Behind the lower jaw.

Figure. Pyramidal: has turned downwards and forwards.

Attachment. Superiorly and posteriorly, to the styloid process of the occipital bone: inferiorly and anteriorly, to the angle of the lower jaw.

Relation. Externally, with the parotid gland, temporal and occipital branches of the jugular vein, and the arteries piercing the gland; internally, with the membrane bounding the guttural cavities; superiorly, with the stylo-hyoideus.

Direction. Oblique: from behind, forwards; and from above, downwards.

Structure. Tendinous, at its occipital attachment; remainder fleshy, intersected with layers of tendon, and having aponeurotic stripes along its surfaces. The posterior division of the digastricus is inseparably united with the inferior border.

Action. To draw the jaw backward, and at the same time to depress it: it therefore assists in opening the mouth, and so far is an antagonist to the two former muscles.

PTERYGOIDEUS INTERNUS—*Spheno-maxillaris.*

Situation. The same relative position upon the inner side of the jaw to what the masseter has upon the outer, filling up the excavation there in the bone.

Form. Broad and flat; terminating, inferiorly, in a semicircular border, from which it narrows, upwards.

Attachment. Superiorly, to the pterygoid process, and crus of the sphenoid bone, to the palate bone, and to the tuberosity of the superior maxillary bone; inferiorly, to the fossa which it occupies, and around the angle of the jaw.

Relation. Externally, with the branch of the jaw, and posterior maxillary nerve and blood-vessels; internally, with the digastricus, hyoideus, stylo-pharyngeus, the os hyoides, the larynx, the anterior portion of the parotid gland, the submaxillary vessels, and the ninth and recurrent nerves: anteriorly, with the mylohyoideus and gustatory nerve; posteriorly, with the parotid gland, guttural cavities, and the next muscle: superiorly, with the base of the cranium; inferiorly, with the stylo-maxillaris and the skin.

Direction. Divergent, from above, downwards.

Structure. Fleshy, plenteously intersected with tendon.

Action. To raise the jaw. If one act alone, the jaw, in being closed, will be drawn to one side; the alternate action of the two produces the lateral movement of the jaw which is so effectual in comminuting the food.

PTERYGOIDEUS EXTERNUS.

Situation. Above and behind the former.

Form. Short, thick, cylindrical.

Attachment. Anteriorly, to the ala and crus of the sphenoid; posteriorly, to the roughened depression upon the inner side of the jaw, at the root of the condyle.

Relation. Anteriorly, inferiorly, and internally, with the preceding muscle, and the posterior maxillary nerve; superiorly, with the orbit; posteriorly, with the articulation of the jaws; externally, with the neck of the jaw.

Direction. Oblique: from behind, forwards; and from without, inwards.

Structure. Fleshy, with slight tendinous intersections.

Action. To assist in the elevation of the jaw; and, at the same time, to draw it forwards: it is the antagonist, in particular, of the stylo-maxillaris.

6.—HYOIDEAL REGION.

The muscles in this region, and those remaining to be described, belonging to the head, are comprehended within the *intermaxillary space*—between the branches of the lower jaw.

DIGASTRICUS.—*Portion of the Stylo-maxillaris.*

Situation. Along the inner side of the lower jaw.

Form. Broad and flattened at the extremities; cordiform in the middle.

Attachment. Posteriorly, to the styloid process of the occipital bone; anteriorly, to the side of the jaw, midway between the angle and the symphysis.

Relation. Externally, with the jaw and pterygoidei; internally, with the larynx, os hyoides, and submaxillary gland: inferiorly, with the submaxillary vessels and the skin.

Direction. Oblique: from behind, forwards and downwards; from before, upwards and backwards.

Structure. It consists of two fleshy bellies united by an intermediate tendon, which passes and plays through a sort of pulley formed by the tendon of the hyoideus.

Action. Not very apparent; implicated, seemingly, with that of the hyoideus.

MYLO-HYOIDEUS.

Situation. Spreading along the side of the jaw.

Figure. Broad, thin, half-penniform.

Attachment. Outwardly, to the roots of the alveolar processes and the side of the jaw, extending forwards to the symphysis: inwardly, to the body of the os hyoides.

Relation. Outwardly, with the jaw; inwardly, with the sublingual gland, genio-hyoideus, and gustatory and ninth pair of nerves.

Direction. Oblique: from above downwards, inclining outwards.

Structure. Fleshy: united to its fellow (of the opposite side) through the medium of a tendinous line, which extends from the end of the spur process of the os hyoides to the symphysis of the jaw.

Action. To draw the os hyoides forwards and upwards; and, thereby, raise the tongue within the mouth.

GENIO-HYOIDEUS.

Situation. Above the preceding muscle.

Figure. Half-penniform: extremities, narrow; middle part, broad.

Attachment. Anteriorly, to the jaw, near the symphysis; posteriorly, to the spur process of the os hyoides.

Relation. Inferiorly and externally, with the mylo-hyoideus; superiorly, with the genio-hyo-glossus; internally, with its fellow.

Direction. Oblique: from before, backwards; and from without, inwards.

Structure. Tendinous at the extremities: intermediate part, fleshy.

HYOIDEUS MAGNUS.—*Kerato-hyoideus Magnus.*

Situation. Antero-superior part of the neck.

Form. Fusiform: flattened upon its sides.

Attachment. Posteriorly, to the postero-inferior part or angle of the corner of the os hyoides; anteriorly, to a little tubercle arising from the middle and inferior part of the semicircular portion of the same bone.

Direction. Oblique: from behind, forwards; and from above, downwards.

Relation. Below, with the stylo-maxillaris, digastricus, and parotid gland; above, with the corner of the os hyoides, ninth pair of nerves, and lingual vessels: externally, with the pterygoideus internus; internally with the larynx and recurrent nerve.

Structure. Tendinous and fleshy at its posterior attachment; ending in a slender tendon, anteriorly.

Action. To draw the body of the os hyoides still nearer to the side of the jaw, and thereby assist in the dilatation of the glottis.

HYOIDEUS PARVUS.—*Kerato-hyoideus Parvus.*

Situation. Above and rather before the preceding muscle.

Form. Small, flat, triangular.

Attachment. To the body and appendix of the os hyoides, filling up the triangular space between them.

Action. To approximate these parts.

STYLO-HYOIDEUS.

Situation. Infero-anterior part of the neck.

Figure. Quadrilateral.

Attachment. Posteriorly, to the front of the styloid process of the occipital bone; anteriorly, to the angle of the hyoideal cornu.

Relation. Externally, with the parotid gland; internally, with the guttural membrane: inferiorly, with the stylo-maxillaris; posteriorly, with the obliquus capitis superior.

Structure. Fleshy, with tendinous intersections.

Action. To retract, and at the same time elevate, the cornu of the os hyoides.

7.—GLOSSAL REGION.

The muscles of this region form, collectively, the substance of the tongue: their number and variety account for the well-known mobility of that organ.

HYO-GLOSSUS LONGUS.—*Kerato-glossus.*

Situation. Along the base and side of the tongue.

Form. Long, narrow: flattened upon its sides.

Attachment. Posteriorly, to the cornu of the os hyoides, a short distance from its junction with the appendix; anteriorly, infero-lateral parts of the tongue.

Relations. Externally, with the mylo-hyoideus; internally, with the hyo-glossus brevis: inferiorly, with the gustatory nerves.

Structure. Thin, weak, aponeurotic, at its posterior attachment: remainder, fleshy.

Action. To draw the tongue within the mouth; and at the same time, depress it.

HYO-GLOSSUS BREVIS.—*Hyo-glossus.*

Situation. Similar to the preceding muscle.

Form. Broad, flat, thin, quadrilateral, half-penniform.

Attachment. Externally, to the side of the body of the os hyoides; internally, to the base of the tongue.

Relations. Externally, with the mylo-hyoideus and hyo-glossus longus; internally, with the genio-hyo-glossus.

Direction. Obliquely transverse.

Structure. Entirely fleshy.

Action. To assist the former muscle in the retraction of the tongue; and to depress, in particular, the base of it.

GENIO-HYO-GLOSSUS.—*Genio-glossus.*

Situation. Inferior part of the tongue.

Form. Broad, thin, half-penniform.

Attachment. Inferiorly, to the inner part of the jaw, near its symphysis: superiorly, to the under part of the tongue; and also to the appendix of the os hyoides.

Relations. Externally, with the genio-hyoideus, hyo-glossus, sublingual gland, and branches of the gustatory nerve; internally, with its fellow; inferiorly, with the genio-hyoideus; superiorly, with the tongue.

Direction. From below, upwards; and from before, backwards.

Structure. Fleshy; with the exception of the anterior half of its inferior border, where it is hemmed by a slender tendon which connects it more firmly to the jaw. Its surfaces are in part covered with adipose substance.

Action. To project the tongue within the mouth, and draw it down: if one muscle act alone, the organ will be drawn to one side.

LINGUALIS.

The internal substance of the tongue consists of masses of fleshy fibres, taking various directions, and having interwoven with them a considerable quantity of yellow adipose tissue: anatomists consider these as a distinct pair of muscles. They take their attachments at the root of the tongue, from the body and appendices of the os hyoides, where they are separable and distinct portions; and proceed downwards, between the hyo-glossi longi, and above the genio-hyo-glossi, to be buried and constituted in the substance of that organ. They receive the insertions of all the other glossal muscles.

Action. To contract the tongue lengthwise, and to draw it within the mouth.

8.—PHARYNGEAL REGION.

HYO-PHARYNGEUS.—*Kerato-pharyngeus.*

Situation. Infero-lateral and posterior part of the pharynx.

Form. Flat, thin, quadrilateral.

Attachment. Infero-posteriorly, to the superior border of the cornu of the os hyoides; supero-anteriorly, to the side of the pharynx.

Relations. Externally, with the pterygoideus internus; internally, with the larynx.

Action. To dilate the bag to receive the food.

PALATO-PHARYNGEUS.—*Pterygo-pharyngeus.*

Situation. Upon the side of the pharynx.

Form. Broad and thin: irregular in figure.

Attachment. Superiorly, to the pterygoid process of the sphenoid, and to the palate bone: inferiorly, to the pharynx—its fibres intermixing and confounding themselves with those of the hyo-pharyngeus and stylo-pharyngeus.

Direction. The reverse of the former muscle: viz., from above, downwards; and from before, backwards.

Action. To assist in the dilatation of the pharynx.

STYLO-PHARYNGEUS.

Situation. Postero-lateral part of the pharynx.

Attachment. Posteriorly, to the styloid process of the temporal bone, and outer side of the cartilage of the Eustachian tube: anteriorly, to the side of the pharynx.

Structure. Tendinous at its origin: remainder, fleshy.

Action. To assist in dilatation, by drawing the side of the bag in a direction upwards and backwards.

CONSTRICTOR PHARYNGIS ANTERIOR.—*Hyo-pharyngeus.*

Situation. Antero-superior part of the pharynx.

Attachment. Inferiorly, antero-internal part of the cornu of the os hyoides; superiorly, to a tendinous line uniting it with its fellow along the mesio-anterior part of the pharynx.

CONSTRICTOR PHARYNGIS MEDIUS.—*Thyro-pharyngeus.*

Situation. Behind the former muscle.

Attachment. Inferiorly, lateral parts of the thyroid cartilage:

superiorly, to a tendinous line running along the superior part of the pharynx.

CONSTRICTOR PHARYNGIS POSTERIOR.—*Crico-pharyngeus.*

Situation. Postero-superior part of the pharynx.

Attachment. Inferiorly, its fibres are confounded with those of the muscular coat of the œsophagus: superiorly, to the lateral parts of the cricoid cartilage.

Relations of the three Constrictors. Superiorly, with the guttural pouches; inferiorly, with the membranous parietes of the pharynx, with the os hyoides, and the thyroid and cricoid cartilages; laterally, with the anterior portions of the parotid gland.

Structure of them. Fleshy.

Action of them. To constrict or contract the cavity of the pharynx in the act of deglutition.

9.—LARYNGEAL REGION.

Comprehending eight pairs and one single muscle.

HYO-THYROIDEUS.

Situation. Upon the side of the larynx.

Form. Quadrilateral: flat and thin.

Attachment. To the inferior border of the semi-circular portion of the os hyoides; and to a broad eminence upon the postero-inferior part of the side of the thyroid cartilage.

Action. To elevate the thyroid cartilage, and with it the larynx altogether; or, to depress the os hyoides.

CRICO-THYROIDEUS.

Situation. Upon the postero-lateral part of the larynx.

Form. Flat; triangular.

Attachment. To the borders and side of the cricoid cartilage; and to the posterior border of the thyroid, filling up the vacuity between the two cartilages.

Action. To approximate the two cartilages.

CRICO-ARYTENOIDEUS POSTICUS.

Situation. Upon the upper part of the larynx.

Attachment. To the entire upper surface of the cricoid cartilage, and to the posterior angle of the arytenoid cartilage.

Structure. Fleshy; and furnished with two small tendons, which are fixed to the arytenoid.

Action. To draw the arytenoid cartilage backwards.

CRICO-ARYTENOIDEUS LATERALIS.

Situation. Postero-lateral and superior parts of the larynx, between the thyroid and cricoid cartilages.

Attachment. To the anterior border of the cricoid cartilage; and to the side of the posterior angle of the arytenoid.

Action. To draw the arytenoid cartilages assunder, and thus dilate the glottis.

THYRO-ARYTENOIDEUS.

Situation. Upon the side of the larynx, between the thyroid cartilage and the lining membrane.

Attachment. To the inner surface of the thyroid, and the triangular ligament; and to the side of the arytenoid cartilage.

Action. To enlarge the glottis by separating the arytenoid cartilages.

ARYTENOIDEUS.

Situation. Upon the superior part of the larynx.

Attachment. To the superior or excavated parts of the two arytenoid cartilages; running across from one to the other.

Action. To contract the glottis, by approximating these cartilages.

HYO-EPIGLOTTIDEUS.

Situation. Between the epiglottis and semi-circular part of the os hyoides.

Figure. Fusiform. A single muscle.

Attachment. To the hollow part opposite to the neck of the os hyoides; and to the broadest part of the epiglottis: enveloped within a doubling of the laryngeal membrane, and clothed in adipose matter.

Structure. Pale fleshy fibres, mingled with fatty matter at its hyoideal attachment, and fixed to the epiglottis by a very small tendon.

Action. To retract the epiglottis still further from the aperture, and thus increase the dimensions of the latter.

10.—PALATINE REGION.

Including one pair, and a single muscle.

TENSOR PALATI.—*Stylo-staphyleus.*

Situation. Upon the supero-lateral part of the pharynx.

Form. Slender, elongated; tapering towards either extremity.

Attachment. Posteriorly, to the styloid process of the temporal bone, by means of a tendon common to it and the stylo-pharyngeus; anteriorly, by means of a cartilaginous loop (acting a pulley), through which its tendon passes, to the styloid

making a sudden turn outward,

around this process, it becomes ultimately fixed to the postero-lateral part of the soft palate.

Direction. From behind, forwards.

Relations. Inwardly, with the stylo-pharyngeus and palato-pharyngeus; outwardly, with the pterygoideus internus.

Structure. Fleshy, in the middle; aponeurotic externally: terminating, anteriorly, in a long, flat, slender tendon, which plays within a cartilaginous pulley.

Action. To stretch or dilate the palate.

CIRCUMFLEXUS PALATI.—*Staphyleus.*

Situation. Infolded within the vellum palati.

Form. Collected into fasciculi, posteriorly: broad, thin, and expanded, anteriorly.

Attachment. Anteriorly, to the semi-oval border formed by the union of the palate bones; posteriorly, to the palate; within the substance of which its fibres are intermingled with those of the stylo-pharyngeus and tensor palati.

Structure. Fleshy, posteriorly; aponeurotic, anteriorly. A single muscle.

III. MUSCLES OF THE TRUNK.

The trunk comprises the *neck*, the *thorax*, and the *abdomen.*

a.—MUSCLES OF THE NECK.

1.—HUMERO-CERVICAL REGION.

RHOMBOIDEUS LONGUS.—*Cervico-acromialis.*

Situation. Supero-lateral part of the neck.

Form. That of an elongated flattened pyramid, having its apex turned forwards.

Attachment. Superiorly and anteriorly, to the entire length of the side of the ligamentum colli, reaching as far forward as the second cervical vertebra: posteriorly and inferiorly, to the superior costa and cartilage of the scapula.

Relations. Externally, with the panniculus; internally, with the ligamentum colli; inferiorly, with the splenius; posteriorly, it passes under the anterior angle of the scapula, uniting its fibres with those of the rhomboideus brevis.

Direction. Longitudinal; following the curve of the neck.

Structure. Anterior end tendinous: remainder, fleshy.

Action. To assist in raising the scapula, and at the same time to draw the bone forwards.

LEVATOR HUMERI.—*Cervico-subscapularis.*

Situation. Antero-inferior and lateral parts of the neck.

Form. Flattened, elongated: broadest and thickest at its posterior and inferior parts.

Attachment. Superiorly and anteriorly, to the tubercle of the occiput, to the mastoid process of the temporal bone, to the transverse process of the atlas, and those of the second, third, and fourth cervical vertebræ; laterally, from the ligamentum nuchæ and faschia covering the side of the neck; inferiorly and posteriorly, loosely to the head of the humerus, to the scapular faschia, to the muscles about the point of the shoulder, and ultimately to a ridge upon the body of the humerus, which arises from its greater tubercle.

Relations. The jugular vein runs along its antero-inferior border, and is covered by it for three fourths of its length downwards. The subcutaneous branches of the cervical nerves pierce its substance and ramify upon its surface. Superiorly and posteriorly, it is opposed to the splenius; inferiorly and anteriorly, to the sterno-maxillaris; on its outer side, to the panniculus; on its inner side, to the rectus capitis anticus major, and to the scalenus. Its antero-inferior margin is thin and expanded, and clips inward, forming a thin fleshy partition between the carotid artery and jugular vein.

Direction. Longitudinal: sloping with the neck.

Structure. Anteriorly it is split into two portions, both thin and aponeurotic at their extremities. Its middle part is thick and entirely fleshy, but upon the arm becomes aponeurotic.

Action. To raise the shoulder and arm, and at the same time draw them forwards: or, these parts being fixed, to turn the neck, and head also, to one side; or, should both act, under such circumstances, the head will be depressed.

Remark. Professor Girard considers the fleshy expansion between the artery and vein as a distinct muscle, and names it the subscapulo-hyoideus: and so it would seem most natural to regard it.

2.—LATERAL CERVICAL REGION.

SPLENIUS.—*Cervico-mastoideus.*

Situation. Occupying the whole of the superior and lateral parts of the neck.

Form. Irregularly quadrangular; the supero-lateral portion being acute and extended: thick in substance and flattened upon the sides.

Attachment. Superiorly, to the ligamentum colli, reaching as far forward as the occiput, and as far backward as the fourth or fifth dorsal spine: inferiorly, to the transverse processes of all the cervical vertebræ, and to the mastoid process of the temporal bone.

Relations. Internally, with the aponeurosis of the panniculus upon the side of the neck, with part of the levator humeri near the head, and with part of the serratus magnus near the shoulder; along its inferior border runs the levator humeri; and internally, with the complexus major, obliquus capitis inferior, and transversalis colli: which last-mentioned muscle is in places inseparably embodied with it.

Structure. Superior attachments, tendinous and fleshy; inferior ones, fleshy; excepting that separate flattened tendons fix it to the atlas and head: the intermediate parts are thick and substantial, and fleshy.

Direction. Oblique; downwards and forwards: the anterior fibres incline more to a longitudinal course.

Action. Both muscles acting simultaneously, they will firmly erect the head and neck: one acting by itself, will incline these parts to one side.

COMPLEXUS MAJOR.—*Dorso-occipitalis.*

Situation. Deep-seated; underneath the former muscle.

Form. An extended triangle: broad, posteriorly; narrow, anteriorly; flattened; thick in substance, in the middle.

Attachments. Posteriorly, to the spines of the four or five anterior dorsal vertebræ; also to the transverse processes of the same: anteriorly, to the tubercle of the occiput.

Relations. On the outer side with the splenius; on the inner side, with the ligamentum colli, with the complexus minor, and also with the posterior cervical artery and vein, and the 3d, 4th, and 5th cervical nerves. Its posterior or aponeurotic part is included between the longissimus and spinalis dorsi: its tendon fixed to the occiput is subcutaneous.

Direction. Longitudinal: the fasciculi coming from the cervical vertebræ inclining upwards and forwards.

Structure. The dorsal portion is aponeurotic. Its fleshy belly is intersected by narrow slips of tendon; and near the head ends in a flat tendon.

Action. This muscle will forcibly erect the head, and have the effect of protruding the nose; or, going beyond this, it will conduce to that appearance called the *ewe neck*; in which (latter) operation it co-acts with the splenius.

TRACHELO-MASTOIDEUS.—*Dorso-mastoideus.*

Situation. Deep-seated: underneath the vertebral attachments of the splenius.

Figure. Long; cylindroid; bifid.

Attachments. Posteriorly, to the transverse processes of the two foremost vertebræ of the back; to the oblique processes of the six hindermost cervical: anteriorly, in union with the tendon of the splenius, into the mastoid process of the temporal bone.

Relations. Externally, with the splenius; internally, with the spinalis colli; posteriorly, it is included between the spinalis and longissimus dorsi; anteriorly, it is inseparably united with the splenius.

Direction. Along the neck.

Structure. Tendinous, where it is attached to the back; fleshy from thence to its union with the splenius, where it ends in the tendon common to it and that muscle.

Action. To erect the head, or to draw it on one side.

SPINALIS COLLI.—*Dorso-spinalis.*

Situation. Deepest seated upon the side of the neck, lying within the interval between the oblique and spinous processes.

Figure. A near approach to a parallelogram.

Attachment. Inferiorly, to the oblique processes of all the cervical vertebræ, except the first and second; also to that of the first dorsal: superiorly, to the spines of all the cervical vertebræ, excepting that of the atlas.

Relations. On the outer side, with the complexus and trachelo mastoideus; on the inner, with the ligamentum colli and the vertebræ of the neck.

Structure. More tendinous than fleshy at its attachments; intersected with layers of tendon elsewhere.

Action. To aid in the erection of the head, but more particularly in the constrained flexion of the neck backwards.

3.—SUPERIOR CERVICO-OCCIPITAL REGION.

COMPLEXUS MINOR.—*Axoido-occipitalis Longus.*

Situation. Upon the poll.

Figure. Long, slender, fusiform.

Attachment. To the spinous process of the vertebra dentata; and at the other end inseparably united with the tendon of the complexus major.

Relations. Superiorly, with the complexus major; inferiorly, with the next muscle: on the inner side, with the ligamentum colli.

Structure. The posterior part consists of pale delicate fasciculi: the anterior is tendinous.

Action. To assist the complexus major in its operation.

RECTUS CAPITIS POSTICUS MAJOR.—*Axoido-occipitalis Brevis.*

Situation. Underneath, and rather to the outer side of the former muscle.

Attachment. To the spine of the vertebra dentata: and to a scabrous depression in the occiput, below its tubercle.

Relations. Superiorly, with the complexus minor; inferiorly, with the next muscle: to the outer side, with the obliquus capitis superior.

Action. To pull the head backwards; in doing which, it will assist in the protrusion of the nose.

RECTUS CAPITIS POSTICUS MINOR.—*Atloido-occipitalis Parvus.*

Situation. Underneath the preceding muscle.

Figure. Quadrilateral.

Attachment. To the superior part of the atlas, and to the occiput.

Relations. Superiorly, with the preceding muscle; inferiorly, with the capsular ligament of the occipital joint; on the outer side, with the obliquus superior; on the inner, with the ligamentum colli.

Structure. Entirely fleshy; consisting of pale delicate fibres.

Action. To chuck up the head suddenly; and, at the same time, to save the capsular ligament from being pinched between the occiput and atlas.

OBLIQUUS CAPITIS SUPERIOR.—*Atloido-mastoideus.*

Situation. Upon the side of the poll.

Figure. Nearly square.

Attachment. To the superior border of the transverse process of the atlas: and to a ridge extending, laterally, from the tubercle of the occiput to the mastoid process of the temporal bone.

Relations. Externally, with the tendon of the splenius; internally, with the capsular ligament of the axoido-occipital articulation; and on the inner side, with the rectus major and ligamentum colli.

Structure. Fleshy, with one or two tendinous intersections.

Direction. Oblique; upwards and forwards.

Action. Both muscles operating, they will draw back the head, and at the same time elevate it: one alone acting, will turn the head to one side.

OBLIQUUS CAPITIS INFERIOR.—*Axoido-atloideus.*

Situation. Deep-seated; upon the supero-anterior and lateral parts of the neck,

Figure. A near approach to a parallelogram.

Attachment. To the side of the spine of the vertebra dentata; and to the supero-posterior part of the body of the atlas.

Relations. On the outer side, with the tendon of the splenius: on the inner, with the ligamentum colli and complexus minor: superiorly, with the complexus major; inferiorly, with the capsular ligament of the articulation formed between the first and second vertebræ.

Structure. Thick, and almost entirely fleshy.

Action. When both muscles act, the atlas (and the head along with it) will be elevated. But their alternate action, a sort of rotatory motion is given to the head.

4.—INFERIOR CERVICAL REGION.

STERNO-MAXILLARIS.

Situation. Inferior part of the neck.

Form. Elongated; cylindroid; flattened above and below.

Attachment. Posteriorly, to the cariniform cartilage of the sternum: anteriorly, to the angle of the lower jaw.

Relations. Externally, with the cellular faschia of the neck, panniculus and levator humeri; internally, with the next muscle, trachea, and carotid artery; along its superior margin, with the jugular vein; along its inferior border (the posterior half) with its fellow; from which it gradually diverges to the head, leaving the trachea and next muscle exposed in the interspace formed by the divergence. Its tendon passes between the parotid and submaxillary glands.

Direction. Longitudinal: curving with the neck.

Structure. Tendinous and fleshy at the sternal end, and intimately united with its fellow. About three fourths of the extent of the neck upwards, it terminates in a flat tendon.

Action. To inflex the head towards the breast. If one muscle act alone, it will, at the time of this inflection, incline the head to one side. The pair will also assist in opening the mouth

STERNO-THYRO-HYOIDEUS

Situation. Above the preceding muscle.

Form. Elongated, slender, cylindroid; flattened above and below; trigastric; but unequal in its divisions.

Attachment. Posteriorly, to the cariniform cartilage of the sternum, above the preceding muscle: anteriorly, to the spur process of the os hyoides: also, by a detached slender tendon, to the lower border of the thyroid cartilage.

Relations. Inferiorly, with the sterno-maxillaris; superiorly, with the trachea, and on the left side with the œsophagus likewise: along its outer border, with the recurrent nerve; along its inner, or mesian line, with its fellow.

Structure. Sternal end, tendinous and fleshy, and united in one belly; at the other end, there are two fleshy bellies; and the three are connected contiguous to the trachea, about the middle of the neck, by an intermediate, short, and slender tendon.

Action. To draw the os hyoides, and along with it, the larynx, downwards and backwards.

SUBSCAPULO-HYOIDEUS.

Situation. Continued from the levator humeri, and spread over the antero-superior parts of the neck.

Form. A broad, thin, elongated band; thicker and broader anteriorly than posteriorly.

Attachment. In connection with the levator humeri, to the inner surface of the scapula; anteriorly, to the middle of the body of the os hyoides.

Relations. Its course lies between the carotid artery and the jugular vein, between which it forms a fleshy partition; having on its outer side, the sterno-maxillaris; on its inner, the sterno-thyro-hyoideus; and at its anterior termination, becoming embedded between the submaxillary glands.

Structure. The scapular end consists of a thin flattened tendon: the remaining part is fleshy. It forms altogether a sort of fleshy involucrum for the next muscle.

Action. It will draw the os hyoides downwards and backwards.

SCALENUS.—*Costo-cervicalis.*

Situation. Postero-inferior part of the neck.

Form. Pyramidal: base cut slantwise and turned downwards.

Attachment. Posteriorly, to the middle of the first rib; anteriorly, to the bodies and transverse processes of the 5th and 6th cervical vertebræ.

Relations. Along its upper margin, with the transversalis colli; along its lower, with the sterno-maxillaris: on the outer side, with the levator humeri; on the inner, with the trachea; and on the left side, also with the œsophagus. In the interspace between one scalenus and the other, run the carotid artery, par vagum, great sympathetic nerve, and, lower down, the jugular vein. The cervical nerves going to form the axillary plexus cross the scalenus in their descent; and the axillary artery and vein turn round the first rib immediately beneath its postero-inferior extremity.

Structure. Constituted of two or three cylindroid divisions, lying one upon the other: its base is tendinous as well as fleshy: its cervical attachments are mostly fleshy.

Action. It will aid in the depression of the neck; and may also have some effect, the neck being fixed, in inspiration, by having a tendency to draw the rib forwards.

LONGUS COLLI.—*Subdorso-atloideus.*

Structure. Deep-seated: extending along the inferior part of the neck, and thence for some distance along the back.

Form. Complicated: made up of many semi-cylindroid fasciculi running obliquely one into the other: altogether, broad in the middle and tapering at either extremity.

Attachment. Posteriorly, to the bodies of the six anteriormost dorsal vertebræ: anteriorly, to the bodies, transverse processes and inferior spines, of all the cervical vertebræ, excepting those of the first; it being fixed by a strong tendon to the body *only* of the atlas.

Relations. On the outer side it has, posteriorly, the scalenus; anteriorly, the rectus anticus major: below it, lies the trachea; above it, the vertebræ.

Structure. The dorsal portion is pretty uniform, and is principally fleshy; the cervical part is convoluted, and the fibres are intersected with alternate layers of tendon. The anterior end is entirely tendinous; the other part has also a tendon fixing it to the 6th cervical vertebra. The fasciculi run from one cervical transverse process to the other.

Action. Its many and extensive attachments, and the proximity of the points on which it acts, render it a muscle of considerable power and effect in the flexion of the neck: the rainbow curve, and the constrained inflexion of the head towards the breast, are chiefly attributable to its full and forcible contractions.

5.—INFERIOR CERVICO-OCCIPITAL REGION.

RECTUS CAPITIS ANTICUS MAJOR.—*Trachelo-suboccipitalis.*

Situation. Deep-seated: antero-lateral part of the neck.

Form. Pyramidal: base turned forwards.

Attachment. Posteriorly, to the transverse processes of the

2d, 3d, 4th, 5th, and 6th cervical vertebræ: anteriorly, to the cuneiform process of the occipital bone.

Relations. Superiorly, with the vertebræ longus colli, and following muscle: inferiorly, with the œsophagus on the *left* side, and with the trachea and larynx on the *right*, and also with the membrane of the fauces. The carotid artery runs along its inferior border.

Structure. Posteriorly, consisting of slender fleshy fasciculi, including two or three long slips of tendon: anteriorly, it is fleshy, intersected by a broad flat tendon.

Action. To bend the head: one acting only, will incline it, at the time of depression, to one side.

RECTUS CAPITIS ANTICUS MINOR.—*Atloido-suboccipitalis.*

Situation. Deep-seated: at the back of the cavity of the fauces.

Form. Short, slender, cylindroid.

Attachment. Posteriorly, to the lower part of the body of the atlas: anteriorly, the same as the foregoing muscle.

Relations. Inferiorly, with the preceding muscle: superiorly, with the capsular ligament of the occipital joint.

Structure. Pale and entirely fleshy.

Action. To assist the major.

OBLIQUUS CAPITIS ANTICUS.—*Atloido-styloideus.*

Situation. To one side, at the back of the fauces.

Attachment. Posteriorly, close to the rectus minor, to the body of the atlas: anteriorly, to the postero-inferior part of the coronoid process of the occipital bone.

Relations. Above, with the occipital articulation; below and to the inner side, with the rectus major anticus; to the outer side, with the parotid gland.

Action. The same as that of the former muscle.

MUSCLES OF THE THORAX.

1.—DORSO-SCAPULAR REGION.

The muscles included in this region form three of the principal agents concerned in the motions of the scapula.

TRAPEZIUS.—*Dorso-acromialis.*

Situation. Upon the side of the withers.

Figure. A right-angled triangle; with the base turned upwards, and the right side forwards, in a parallel line with the spine of the scapula.

Attachment. Superiorly, to the spinous processes of the 3d, 4th, 5th, and 6th dorsal vertebræ, and to the ligament and faschia investing them; inferiorly, to a small tubercle upon the spine of the scapula.

Relations. Superiorly, it covers the rhomboideus brevis; in its course, downward, it passes over the posterior costa of the scapula; and also the postero-superior angle of the latissimus dorsi: inferiorly, it lies upon the aponeurosis enveloping the dorsum scapulæ.

Direction. Perpendicular; excepting the posterior fasciculi, and they slant forward, in their course downward.

Structure. Superior attachments, aponeurotic; below, it ends in a flat triangular tendon; the intermediate parts are entirely fleshy.

Action. To elevate the scapula: and, when the *posterior* fasciculi prevail, to incline the bone at the same time, backwards.

LATISSIMUS DORSI.—*Dorso-humeralis.*

Situation. Upon the supero-lateral part of the chest, behind the scapula.

Form. Flat, thick: an extended triangle, presenting its base towards the spine.

Attachment. Superiorly, to the spinous processes of the dorsal vertebræ, and to the ligamentum colli (vel potius, *dorsi*) investing them; stretching as far forwards as the highest point in the withers, and as far backwards as the lumbar spines, to some of which it is also connected: inferiorly, to the inner and upper part of the body of the humerus.

Relations. Superiorly, with the trapezius, rhomboideus, brevis, and posterior angle of the scapula; inferiorly, with the triceps extensor brachii: externally, with the panniculus; internally, with the ribs and serratus magnus.

Direction. Oblique: downwards and forwards; the fibres converging in their course.

Structure. Superior part, a broad and extended aponeurosis; inferiorly, it ends in a long, flattened, thin tendon: the intermediate parts are entirely fleshy.

Action. To flex the humerus, by drawing it backwards and elevating its inferior extremity.

RHOMBOIDEUS BREVIS.—*Dorso-subscapularis.*

Situation. Upon the side of the withers: deeply seated.

Form. Flat and square. Thin, superiorly; thick, inferiorly.

Attachment. Superiorly, to the four or five anterior dorsal spinous processes, and to the ligament clothing their summits: inferiorly, to the inner part of the superior costa of the scapula, and of the cartilage surmounting it.

Relations. Externally, with the trapezius and cartilage of the scapula; internally, with the vertebræ and ribs: anteriorly, it is connected with the rhomboideus longus; posteriorly, it is crossed by the latissimus dorsi.

Structure. Fleshy: enveloped in a cellular expansion.

Action. To elevate the scapula.

2.—PECTORAL REGION.

These muscles form the *breast,* or what is vulgarly and absurdly called the *bosom.*

PECTORALIS TRANSVERSUS.—{ *Sterno-aponeuroticus.* *Sterno-humeralis.*

Situation. Lateral, anterior, and inferior parts of the breast. The pair form the fleshy prominences seen directly from the front.

Form. An approach to a triangle whose apex has been cut off: broad and thick, superiorly; narrow, inferiorly.

Attachment. On the inner side, to a white tendinous line, and through the medium of that, to its fellow of the opposite side; also to the first four bones of the sternum: on the outer side, to the anterior part of the body of the humerus, and to the faschia covering the arm.

Relations. Superiorly, it is connected with the major and minor pectoral muscles; externally, it is covered by the skin; internally, opposed to the front of the elbow joint; anteriorly, to the levator humeri.

Direction. Transverse; incurvating downwards.

Structure. Inner attachments, tendinous as well as fleshy; outer, wholly aponeurotic: intermediate part, fleshy.

Action. To adduct the arm; also to keep it close to the chest during its flexion and extension: this muscle has, probably, more to do in enabling the arm to support weight than to give it motion.

PECTORALIS MAGNUS.—*Sterno-trochineus.*

Situation. Infero-lateral part of the thorax.

Figure. Trapezoid; flattened and thick in substance.

Attachment. Inwardly, to the 4th, 5th, and 6th pieces of the sternum, and to the cartilages connecting them; also to the ensiform cartilage, where, through the intervention of a white tendinous line, it becomes united with its fellow; still more posteriorly, to the aponeurosis of the external oblique muscle, and the cartilages of the false ribs: outwardly, it is attached to the lesser tubercle of the humerus and the inner part of the lower end of the scapula.

Relations. Externally, with the panniculus and triceps muscles; internally, with the aponeurosis of the external oblique, the serratus magnus, and the ribs: inferiorly, with its fellow, and in part concealed by the next muscle.

Direction. Longitudinal: inclining upwards.

Structure. Fleshy: only that its anterior end is in part aponeurotic.

Action. To draw the head of the humerus, and along with it the lower end of the scapula, backwards, throwing the latter more into the upright position.

PECTORALIS PARVUS.

Situation. Below the former muscle.

Attachment. Inwardly, to the side of the anterior half of the sternum, and to the cartilages of the first four ribs: outwardly, to the faschia covering the muscles in front of the scapula and shoulder-joint, extending nearly as high up as the place of origin of the antea-spinatus.

Relations. Superiorly and externally, with the preceding muscle; inferiorly, with the pectoralis transversus; internally, with the cartilages of the ribs; anteriorly, with the levator humeri.

Structure. Fleshy; excepting its inferior termination, which is aponeurotic. Its fleshy parts are formed into layers, one overlapping another.

Action. To assist the pectoralis magnus.

3.—COSTAL REGION.

Comprehending muscles which have, all of them, extensive attachments to the ribs.

SERRATUS MAGNUS.—
Costo-subscapularis.
Dorso-costalis.
Lumbo-costalis.

Situation. Between the shoulder and the side of the chest.

Figure. In outline, semi-circular: fibres radiating from a centre, and forming an indentated or serrated circumferent border.

Attachment. Anteriorly, to the bodies and transverse processes of the 4th, 5th, 6th, and 7th cervical vertebræ; posteriorly, to the eight anterior ribs, as low down as their cartilages, by as many fleshy digitations: outwardly, to the upper and inner part of the scapula, occupying the space between the origin of the subscapularis and the insertion of the rhomboidei.

Relations. Externally, with the scapula; internally, with the cervical portion of the longissimus dorsi, the cervical vertebræ, and the ribs; inferiorly, with the pectoral muscles; anteriorly, with the splenius: and superiorly, with the latissimus dorsi.

Direction. The fibres converge from their varions circumferent attachments, like the leaves of a fan, to one common focal point, which is its insertion into the scapula.

Structure. It is covered by a thin aponeurosis which is attached around, principally, to the ribs. The costal portion is fleshy and digitated; the cervical portion is also fleshy; but the part fixed to the scapula is mostly tendinous. The muscle is considerably thicker in the middle than around the circumference.

Action. It forms the principal agent of support to the trunk, maintaining it and the shoulder in close apposition. This pair of muscles are more or less concerned in all the motions of the scapula; and will become dilators of the chest whenever they are exerted while the limbs remain fixed points.

INTERCOSTALES EXTERNI.

Number. Seventeen on each side.

Situation. Filling up the intercostal spaces, outwardly: reaching from the articulations of the ribs with the transverse processes as far as the commencement of their cartilages.

Attachment. Anteriorly, to the external edge of the posterior border of one rib; posteriorly, to the internal edge of the anterior border of the rib immediately behind the former.

Relations. On the outer side, with the serratus, pectoral muscles, obliquus externus, and transversalis and superficialis costarum; on the inner side, with the intercostales interni; superiorly, with the levatores costarum.

Direction. Oblique; from before, backward; and from above, downward.

Structure. Thick layers of united fleshy fibres included between broad aponeurotic slips of tendon, and in places displaying tendinous intersections.

INTERCOSTALES INTERNI.

Number. The same as the preceding.

Situation. Underneath the externi; within the intercostal spaces reaching from the angles of the ribs to the sternum.

Attachment. To the antero-internal edge of the border of one rib; to the postero-internal edge of the rib immediately before it.

Relations. On the outer side, with the preceding muscles, and with the intercostal vessels and nerves; on the inner side, with the pleura.

Direction. Oblique: but the reverse of that of the former muscles; viz. from behind, forwards; and from below, upwards: in fact, their fibres decussate each other, like the strokes of an X.

Structure. They are thinner than the external intercostals; but are thicker in substance, themselves, near the sternum than in the vicinity of the spine: the reverse being the case with the external muscles. They are covered with very thin aponeuroses, which separate them from the externi. They are entirely fleshy in substance; but paler and more delicate in their texture than the former.

Action. The intercostal muscles (both external and internal) act upon the ribs to which they are attached, posteriorly: they pull the costal arches forwards, which has a tendency to throw them at the same time outwards; and thus becomes enlarged the caliber of the cavity of the chest.

4.—STERNAL REGION.

Comprising some small muscular slips in the vicinity of and attached to the sternum.

LATERALIS STERNI.—*Costo-sternalis.*

Situation. Upon the antero-inferior part of the outer surface of the thorax, bordering upon the sternum.

Figure. Long, flat, thin: trapezoid.

Attachment. Anteriorly, to the postero-inferior half of the first rib: posteriorly, to the superior three fourths of the cartilage of the third rib; whence its aponeurosis is extended to the cartilages of the fourth and fifth, and also to the sternum.

Relations. Externally and inferiorly, with the pectoral muscles; superiorly, with the serratus; internally, with the second rib and intercostal muscles.

Direction. Oblique; from above downwards, and from before backwards.

Structure. Its anterior attachment is by means of a short, flat tendon; its posterior is entirely aponeurotic. Both its surfaces are partially interspersed with tendinous expansions.

Action. To operate in the contraction of the chest by approximating the cartilages of the anterior ribs, and elevating, in some measure, the sternum.

STERNO-COSTALES.—(*Externi et Interni.*)

Several fleshy digitations, interspersed with slips of tendon, running from the cartilages of all the true ribs, excepting the first, to the sternum. Their fibres are taking the same course, and are continuous (in the intervals between the cartilages) with the intercostales.

Action. They seem to be for the purpose of contracting the dimensions of the thoracic cavity.

5.—DORSO-COSTAL REGION.

SUPERFICIALIS-COSTARUM.—*Dorso-costalis.*

Situation. Spread over the back.

Figure. Broad, thin, digitated, irregular.

Attachment. Superiorly, to the ligamentum nuchæ in its extension through the back and loins: inferiorly, to the posterior borders, below their angles, of the sixth and all the ribs behind it.

.Relations. Externally, with the panniculus; anteriorly, with the serratus; internally, with the transversalis costarum, and longissimus et spinalis dorsi; infero-posteriorly, with the obliquus externus abdominis.

Structure. Consisting of a thin aponeurosis, superiorly; from which originates eleven or twelve broad fleshy digitations: most of them (all the posterior ones) possessing thin tendinous coverings. The aponeurosis itself serves as a faschia to the muscles underneath it.

Direction. Downwards; with a slight inclination forwards.

TRANSVERSALIS COSTARUM.—*Trachelo-costalis.*

Situation. Upon the supero-lateral parts of the thorax.

Form. Elongated; half-penniform: broad in the middle, narrowing towards either extremity.

Attachment. Posteriorly, to the anterior borders of the ribs, near to the spine; and to the posterior edges of their angles: anteriorly, to the transverse process of the last cervical vertebra.

Relations. Externally and inferiorly, with the last muscle; internally, with the costal arches; superiorly, with the longissimus dorsi.

Direction. Longitudinal: inclining downwards.

Structure. Complicated. Consisting of two sets of tendons: one set embedded in fleshy fibres, and serving to strengthen its attachment superiorly; the others are external, distinct from the fleshy parts, are flat and elongated, broad in the middle, growing longer and more slender as they approach the extremities, and are fixed to the costal arches. A separate tendon extends to the cervical vertebra in front.

Action. To elevate the ribs, and thus produce some enlargement of the cavity of the thorax.

LEVATORES COSTARUM.—*Transverso-costales.*

Number. About fifteen.

Situation. Deep-seated; upon the back.

Figure. Flattened; conoid: base turned downwards.

Attachment. Superiorly, to the transverse processes of the dorsal vertebræ: inferiorly, to the anterior borders of the ribs, in the spaces between their tubercles and angles.

Relations. Externally, with the longissimus dorsi; internally, with the ribs.

Direction. Oblique: from before backwards, and from above downwards.

Structure. Consisting of bundles of fleshy and tendinous fibres, having a similar arrangement to, and looking like the *heads* or beginnings of, the external intercostals. Their superior ends are interwoven with small compact tendons, whence proceed tendinous slips, which intersect their fleshy bellies. Their inferior parts are enveloped in aponeuroses, which become thin and vanish upon their surfaces. The middle bundles are thickest and longest: the anterior ones are but scanty; and the three or four foremost ribs are entirely destitute of them.

Action. To assist in the elevation of the ribs.

6.—DORSAL REGION.

Including muscles connected with the vertebræ of the back.

LONGISSIMUS DORSI.—*Ilio-spinalis.*

Situation. Upon the supero-lateral parts of the back and loins.

Figure. Broad, thick, and elongated.

Attachment. Posteriorly, to the crista of the ileum, to the side of the sacrum, to the spinous and transverse processes of all the lumbar vertebræ, and to the spinous processes of the six posterior dorsal: anteriorly, to the angles of the twelve posterior ribs, to the transverse processes of all the dorsal vertebræ, and to those of the three or four hindermost cervical.

Relations. Externally and inferiorly, with the superficialis costarum; internally, with the ribs and vertebræ; superiorly, with the spinalis dorsi.

Direction. Longitudinal; inclining downwards, as well as forwards.

Structure. This muscle (one of the longest and, at the same time, most bulky muscles in the body) is constituted of a dense and strong aponeurosis; a thick, long, and uniform fleshy belly; and several broad and flat tendons intimately connected with the fleshy parts. The aponeurosis completely invests the lumbar portion of the fleshy belly; with the fibres of which it is so intimately adherent, that the two are inseparable by the knife from one another. From this, the aponeurosis is continued upwards, to be fixed to the spines of the vertebræ; and forwards, to be spread over the dorsal division of the muscle, upon which it grows thin and less expansive, and, about opposite to the withers, altogether vanishes. The fleshy part (which in its course adheres closely to the articulations of the vertebræ with the ribs) is pretty uniform in its breadth until it arrives at the withers, opposite to where it divides into three tails or portions, of a flattened pyramidal form, and so disposed that one, more or less, overlaps another. Of these, the inferior division is the direct continuation of the common fleshy belly: from it proceed six or seven flat tendons, which go to be fixed to the ribs at their articulations with the transverse processes. The middle division sends off three broad thin tendons, to be fixed to the three last transverse processes of the neck. The superior division is a small conical slip, ending in a slender tendon, which is attached to the same process of the fourth cervical vertebra. These tendons are all embedded in, and intermediately connected by, continuous fleshy parts, which adhere to the costal articulations at the withers, and to the oblique processes and sides of the bodies of the three posteriormost vertebræ of the neck.

Action. It will incline to a state of flexion the fore quarters upon the hind; or the hind upon the fore; according as the one or the other are made the fixed points. It is a principal agent in the acts of kicking, and rearing, and leaping. If one act by itself, the fore or hind parts of the body will be inclined to one side. The pair will also assist in the erection of the neck.

SPINALIS DORSI.

Situation. Deep-seated upon the withers.

Form. Thick, elongated, pyramidal: base turned downwards.

Attachment. Posteriorly, through the medium of the aponeurosis of the longissimus dorsi, to the spinous processes of several of the posterior dorsal vertebræ: anteriorly, to the spines of the six or seven anterior dorsal vertebræ, and to those of the three or four posterior cervical.

Relations. Externally and superiorly, with the trapezius, behind, and complexus major, in front; internally, with the ligamentum nuchæ; and, inferiorly, it is inseparably united with the last muscle.

Direction. Longitudinal.

Structure. The broad and thick part is covered by a broad patch of inseparably adherent aponeurosis, which grows thin and less apparent posteriorly; but, anteriorly, ends in a broad tendon, which pierces the fleshy termination of the belly, and becomes fixed to the spine of the last cervical vetebra.

Action. To flex or writhe the back upon the withers; and to aid in the erection of the neck.

SEMI-SPINALIS DORSI.

Situation. Deep-seated, upon the back.

Form. Half-penniform: elongated; curving with the spine.

Attachment. Posteriorly, to the sacrum, underneath the posterior spine of the ileum; to the articular processes of the lumbar vertebræ, and the transverse of the dorsal: anteriorly, to the lumbar spines, and those of the back; extending forwards to the withers.

Relations. Deeply buried underneath the longissimus et spinalis dorsi, and lying close upon the lateral parts of the spine of the back and loins.

Direction. Oblique, from below upwards, and from behind forwards: the obliquity of the packets increasing from behind to the front.

Structure. Consisting of a regular series of small fleshy packets, intersected with broad thin portions of tendon, which increase in length with the dorsal spines. The posterior packets are mostly fleshy in substance; but the anterior present several long flat tendons, distinct from the other parts, which are fixed to the spines of the withers.

Action. To co-operate with the longissimus dorsi in producing a more complete flexion of the back.

DIAPHRAGMATIC REGION.

Containing only the single muscle from which it takes its name.

DIAPHRAGMA.

Situation. It forms the fleshy and tendinous partition dividing the cavity of the chest from that of the abdomen.

Form. Broad, circular; flattened from before backwards; anterior surface, convex; posterior, concave: bifurcate, superiorly; having two elongations or appendices extended backwards, and terminating in pointed extremities.

Division. The broad circular portion is sometimes distinguished as the *greater* muscle; while the *appendices* or *crura* are said to form the *lesser*.

Attachment. The greater muscle is attached by fleshy digitations to the cartilages of the eighth pair of ribs, and to those of all the posterior ribs, with the exception of the last two; also to the ensiform cartilage. Of the appendices, the right, the longer one, is attached to the bodies of all the lumbar vertebræ; the left, or shorter one, has separate tendinous attachments to the first and second of these vertebræ. The two appendices form a union and decussation opposite to the seventeenth dorsal vertebra; and afterwards, again bifurcate. The greater and lesser muscles form a conjunction through the medium of the cordiform tendon.

Relations. The anterior or convex surface is covered by the pleura; is opposed to the bases of the lungs, and in part to the sides of the chest; and is connected, next to the spine, with the superior mediastinum and its important contents; next to the sternum, with the pericardium and inferior mediastinum. The posterior or concave surface is covered by peritoneum; and is, together with the crura, connected, superiorly, with the psoæ muscles and quadratus lumborum; infero-posteriorly, with the kidneys, renal capsules, pancreas and duodenum; on the right side, with the liver; on the left, with the stomach and spleen.

Direction. The fibres of the larger muscle all converge in radii, and run to the cordiform tendon, as to a common centre: those of the appendices run longitudinally.

Structure. It is made up of fleshy and tendinous parts. The fleshy parts are those forming the circumferent portions of the large muscle, and the principal bulk of the crura or appendices. The tendinous parts consist of a thin circular expansion occupying the middle of the larger muscle, and uniting that with the lesser. Through the muscle are to be seen three remarkable openings: a superior one, in the interspace between the crura, for the aorta; one, a little lower, formed by the decussation of the crura, for the œsophagus; and a third, or lower one, perforating the cordiform tendon, for the vena cava posterior.

Action. The diaphragm is the principal if not the sole agent in inspiration: it acts in opposition to the abdominal muscles, which are the chief expiratory powers. By the contraction of its radiated fibres, aided by that of the crura, the cordiform tendon is transformed to a plane surface, and the dimensions of the chest from before backwards thereby considerably augmented. Its capacity, however, is again contracted in consequence of the muscle resuming its concavo-convex form, from the reaction of the abdominal muscles and consequent pressure against it of the abdominal viscera. There are occasions, however, in which these opponent respiratory agents co-operate to one and the same effect; such is the case of the expulsion of urinary and fæcal matters; and also in the act of parturition.

MUSCLES OF THE ABDOMEN.

LUMBAR REGION.

The muscles included within this region constitute the fleshy parts of the loins. They are six pairs in number, altogether; and two of them are placed externally; the other four, internally.

SEMI-SPINALIS LUMBORUM.

Consisting of regular layers of fleshy fibres, similarly distributed in the loins to what those of the semi-spinalis dorsi are in the back; and continued along the sacrum. They are covered by thin tendinous faschiæ, extended from transverse to spinous process.

INTER-TRANSVERSALES LUMBORUM.

Small muscular slips running from the sharp border of one transverse process to that of the next to it; and included between two strong and tense inter-transverse ligaments.

Action. To approximate those processes.

SACRO-LUMBALIS.—*Sacro-costalis.*

Situation. Deep-seated, in the loins: above the psoæ.

Form. Flat, thin; border, semicircular.

Attachment. Posteriorly, to the transverse process of the last lumbar vertebra, and to the body of the sacrum; anteriorly, to the other transverse processes of the loins; and to the last rib.

Relations. Superiorly, it is opposed to the transverse processes of the loins; inferiorly, to the psoas magnus.

Structure. A strong and flattened tendon attaches it to the sacrum, which curves forwards, but disappears before it reaches the last rib: the other parts consist of pale disgregated fibres, intermixed with thin, curvilinear slips of tendon.

Action. To co-operate with the inter-transversales lumborum in approaching the transverse processes; and, at the same time, to draw back and render fixed the last rib.

PSOAS MAGNUS.—*Sub-lumbo-trochantineus.*

Situation. Postero-lateral parts of the spine; and superior part of the inlet of the pelvis.

Form. Elongated; fusiform; thicker in the middle than at the extremities; anterior extremity, flattened, extended and pointed.

Attachment. Anteriorly, to the inner surfaces of the last two ribs, close to their vertebral articulations; to the body and trans-[illegible] he last dorsal vertebra, and to the same of all the lumbar vertebæ: posteriorly, to the small internal trochanter of the os femoris.

Relations. Anteriorly and externally, with the diaphragm; posteriorly and externally, with the iliacus; inferiorly, with the kidney and peritoneum; on the inner side, with the psoas magnus and lumbar vertebræ; behind, with the quadratus lumborum.

Structure. Anterior attachments, fleshy. The posterior end is included within an aponeurosis, which itself terminates in a flat tendon, into which are concentrated and inserted the fibres of the iliacus.

Action. To bend the haunch upon the pelvis, by drawing it forward, as in progression. Supposing it to act while the hind quarters remain stationary and fixed points, it will produce that appearance, by flexing the spine, called "roach-back," or "sticking up the back."

ILIACUS.—*Ileo-trochantineus.*

Situation. Occupying the iliac fossa, and thence extended along the internal part of the haunch.

Form. Thick; triangular; base turned forwards.

Attachment. Anteriorly and superiorly, to that part of the crista of the ileum which has no bearing upon the sacrum; and to the anterior spinous process, venter, and inferior edge of the bone: posteriorly and inferiorly, to the small internal trochanter, along with the psoas magnus.

Relations. Inferiorly, with the crural arch; superiorly, with the psoas magnus and sartorius; on the outer side, with the iliac fossa, tensor vaginæ, rectus, and ileo-femoral articulation; on the inner, with the iliac faschia and peritoneum. The anterior crural nerve and profunda artery and vein cross its lower termination.

Structure. Enveloped entirely internally, and in part externally, by a faschia derived from the crural arch. It is altogether fleshy excepting its lower part, which joins in inseparable union with the tendon of the psoas magnus.

Action. To flex or advance the haunch.

PSOAS PARVUS.—*Sub-lumbo-pubialis.*

Situation. Along the inner side of the preceding muscle.

Figure. Elongated, slender, fusiform.

Attachment. Anteriorly, to the heads of the 16th, 17th, and 18th ribs; to the bodies of the three posterior dorsal, and to those of all the lumbar vertebræ; posteriorly, to the brim of the pelvis, midway between the anterior spine and the symphysis pubis.

Relations. Anteriorly, with the diaphragm and the renal ; on the inner side, with the crus of the diaphragm, rior aorta, and vena cava, and the iliac vessels; on the outer side, with the iliacus.

Direction. Longitudinal.

Structure. Anterior attachments, fleshy; with tendinous chords intermixed: posterior half, a long flattened tendon, which arises out of the middle of the fleshy parts and broadens in its passage backwards.

Action. To draw the pelvis forwards. When one acts by itself, the same part will be inclined to one side. Or, the pelvis being made a fixture, it will have effect in arching or flexing the spine.

2.—ABDOMINAL REGION.

An intervening stratum of cellular substance attaches the abdominal portion of the panniculus carnosus to a glistening expansion of tendon, situated underneath it, which is the aponeurosis of the external oblique muscle. This cellular substance being removed, several white lines, marked upon the subjacent tendon, come into view. The principal of these is one which runs along the middle of the belly, extending from the ensiform cartilage to the pubes: it takes the name of *linea alba;* and denotes the line of junction and demarcation between the abdominal muscles on one side and those of the other. About midway between its two terminations, this line has a perforation, the *umbilicus* or navel, through which passes the umbilical chord. At some short distance from the sides of the linea alba are two curved or waving lines, called the *lineæ semilunares:* they mark the line of union between the fleshy and tendinous fibres of the external oblique muscle. Traversing the interspaces between the linea alba and lineæ semilunares, at short intervals from one another, are several transverse lines, named the *lineæ transversales:* they are produced (as will hereafter be discovered) by the tendinous intersections across the *straight* muscles; and are, in some subjects, but obscurely marked.

There are four pairs of *abdominal muscles:*—two pairs of *oblique* muscles; one pair of *transverse;* and one pair of *straight* muscles. Three of these pairs are ranged in strata, one upon another, and have sheets of tendon connected with them, which take the name of *aponeuroses.*

OBLIQUUS EXTERNUS ABDOMINIS. (*Costo-abdominalis.*)

Situation. Upon the inferior and lateral parts of the belly.

Figure. Broad, thin; quadrilateral.

Attachment. Anteriorly, by fleshy digitations, to the posterior borders of the fourteen hinder ribs, below their middles; posteriorly, by tendinous fibres, to the two anterior thirds of the crista ilei, and to the anterior spinous process; superiorly, to the faschia lumborum; and inwardly, through the medium of its tendon, to the linea alba, throughout its entire extent.

Relations. Externally, with the panniculus carnosus and pectoralis magnus: internally, with the hinder ribs and their cartilages, and with the obliquus internus and rectus; anteriorly, it digitates with the serratus magnus.

Direction. Oblique: from before, backward; and from above, downward. The anterior fibres deviate but little from the horizontal line; in regard to the others, their obliquity increases from before backwards.

Structure. The entire muscle is covered by a dense tendinous expansion, named the *aponeurosis of the external oblique muscle,* which adheres to the fleshy parts through the connection of a delicate cellular tissue, intercepted in places by small slips of tendon. At the linea semilunaris, however, where the tendon commences, the aponeurosis contracts an almost inseparable adhesion to it, accompanying it, thus intimately united, to its termination. Towards the flank, the aponeurosis seems to degenerate into cellular texture.

The superior and outer parts of the muscle itself are fleshy and digitated; the inferior and inner parts are tendinous and aponeurotic. The fleshy part grows broader, but becomes thinner in substance, posteriorly.

Remarks. In the flank, the tendon splits into two portions, which separate, leaving a triangular space or opening between them, whose cavity is obscured by fat and cellular substance. One division of the tendon forms a strong band, which is extended and expended upon the inner side of the thigh; the other portion runs to the ileum, and thence is continued across to the pubes: corresponding in its arrangement and structure to the part called *Poupart's ligament* in human anatomy, though by no means well defined in the horse. The triangular aperture between these divisions of tendon, which opens into a sort of pouch, closed by the union of these tendons on the outer side, but open towards the pubes, is the *abdominal ring:* through it, in the male, passes the spermatic chord, from the abdomen into the pelvis; in the female, the round ligament passes through it. The aponeurosis is considerably strengthened at this part by some additional tendinous fibres, which run *transversely,* from the linea alba towards the ileum.

Action. This pair of muscles, in contributing largely to the formation of the abdominal parietes, laterally and inferiorly, give great support to the contained viscera. In action, they compress the bowels; and, in that manner, assist both in the evacuation of the fæces and urine, and also in the expulsion of the fœtus. At the same time, they will have the effect of diminishing the cavity of the chest, in the longitudinal direction, by forcing the abdominal viscera against the diaphragm, and driving that muscle forwards into the form of a convexity; and in the transverse as well, though not in the same degree, by compressing and retracting the ribs. But, in almost all their operations, they are concerned with the diaphragm; and, together with it, produce effects that can only be understood by studying their separate and combined actions.

OBLIQUUS INTERNUS ABDOMINIS.—(*Ilio-abdominalis.*)

Situation. Postero-lateral and inferior parts of the abdomen.

Form. Broad; thin; fan-shaped.

Attachment. Outwardly and posteriorly, to the spine of the ileum, from which the fleshy fibres radiate: inwardly, at the linea semilunaris, it becomes tendinous, and inseparably unites with the aponeurosis of the external oblique; along with which it is continued to the linea alba.

Relations. Externally, with the former muscle; internally, with the transversalis and rectus.

Direction. Radiated: the superior fasciculi being directed towards the cartilages of the ribs; the inferior, towards the linea alba: both decussating those of the external oblique.

Structure. Fleshy, from the ileum to the linea semilunaris: afterwards, to its termination, an expanded and loose-textured tendon.

Action. These muscles will aid the former in sustaining the weight of the viscera, as well as in compressing them: they will have a more partial effect in the expulsion of the fæces and urine, in consequence of being placed farther back than the preceding. In any effect the oblique muscles may have in turning the body to one side, the right internal oblique will co-operate with the left external oblique, and *vice versâ.*

TRANSVERSALIS ABDOMINIS.—(*Lumbo-abdominalis.*)

Situation. Inferior and lateral parts of the abdomen.

Figure. Broad; flat: quadrilateral; broader posteriorly than anteriorly.

Attachment. Anteriorly, to the inner surfaces of the cartilages of all the false ribs; superiorly, to the transverse processes of the lumbar vertebræ; posteriorly, to the anterior spinous process of the ileum: inwardly, to the entire linea alba.

Relations. On the outer side, with the internal oblique and straight muscles: on the inner side, with the faschia transversalis and peritoneum.

Direction. Transverse, directly across the abdomen.

Structure. Partly fleshy; partly tendinous: the two substances divided by the semilunar line, which leaves the tendinous part broad, posteriorly; the fleshy, anteriorly.

Action. These muscles will assist the oblique in supporting the burden of the viscera, and are more advantageously placed to effectually compress them: they are consequently doing more in the ultimate evacuation of the bowels.

RECTUS ABDOMINIS.—(*Sterno-pubialis.*)

Situation. Infero-median part of the abdomen.

Form. Elongated; flattened from above downwards: broader in the middle than at either extremity.

Attachment. Anteriorly, to the cartilages of the six or seven posterior true ribs: and to the sternum: posteriorly to the pubes, near its symphysis.

Relations. Anteriorly, it is placed between the pectoralis major and the cartilages of the ribs; externally, it has the united tendons of the external and internal oblique; internally, that of the transversalis: also, the internal pectoral and epigastric arteries; and the faschia transversalis and peritoneum.

Structure. Tendinous at its attachments: the anterior one is aponeurotic. The intermediate length is fleshy, but divided into portions by about a dozen transverse tendinous interlacements or intersections. Each muscle, by itself, is inclosed within a sheath, formed of the united tendons of the external and internal oblique muscles, inferiorly; and of that of the transverse muscle, superiorly. At the places where the tendinous bands exist, the sheath contracts firm adhesion to the muscle: and it is this union and structure that gives rise to the existence of the linea transversalis. The recti occupy about one third of the abdominal superficies.

Action. Their principal use appears to be that of bracing the middle parts of the belly; and, thereby, counteracting that tendency to relaxation which must exist from the constant dependence of the bowels. They can have but little effect in compressing the bowels; though they will take some part in contracting the cavity of the thorax, by drawing the sternum upwards and backwards.

Remark. A careful incision through some of the posterior fibres of the transversalis will disclose to view an expansion of faschia of considerable density and firmness of texture, which corresponds to a part in the human subject first described by Sir A. Cooper, and by him named the *faschia transversalis*. It may be traced as an entire lining to the muscles of the abdomen; and is, from the resistance it opposes (which is by no means inconsiderable), of essential service in sustaining the burden of the dependent viscera, in effecting which it reduces the demand for muscular action. Though it is an opening (removed a short distance, inwardly, from the external ring), called the *internal abdominal ring.*

3.—ANAL REGION.

Comprehends a pair of muscles, and a single one.

RETRACTOR ANI.—(*Ischio-analis.*)

Situation. On the side of the rectum, near its termination.

Figure. Long, slender, cylindroid.

Attachment. Inferiorly and anteriorly, to the sacro-sciatic ligament, and to the os innominatum, below and behind the acetabulum; superiorly and posteriorly, to the lateral parts of the rectum, close to its termination.

Relations. Externally, with the sacro-sciatic ligament; internally, with the sphincter ani.

Direction. Curving obliquely around the gut.

Structure. Its posterior attachment is aponeurotic: at the mesian line, inferiorly, where it meets its fellow, it terminates in a small flat tendon.

Action. To retract the anus; to withdraw it within the pelvis.

SPHINCTER ANI.

Situation. Encircling the termination of the rectum.

Figure. Oval; open in the middle.

Attachment. Superiorly, to the coccyx, whence it descends in two divisions; these diverge to include the gut between them, around which they proceed, and again meet and unite inferiorly.

Relations. Posteriorly with the skin; internally, with the intestine; anteriorly, with the retractor.

Direction. Circular.

Structure. Pale and fleshy: connected, superiorly, with a broad tendinous expansion, which attaches it to the coccyx.

Action. To close the anus, after the expulsion of the fæces, and to retain it closed.

4.—MALE GENITAL REGION.

CREMASTER.—(*Ilio-testicularis.*)

Continued from the faschia supurficialis abdominis upon the spermatic chord, and thence into the fibrous texture of the scrotum is a thin, cellular, fibrous expansion; and, underneath this, a layer of fleshy substance, which has, when contrasted with the surrounding white parts, a remarkably red aspect. This is the cremaster. Superiorly, at the internal ring, it has a tendinous origin from the internal oblique and transverse muscles; from which its fibres pass obliquely backward upon the chord, become reflected along with it through the external ring, and terminate, slantwise, in a digitated margin, just before the chord joins the testicle. From its digitations, several slender flattened tendons descend and expand upon the inferior surface of the tunica vaginalis, with the substance of which they become so interlaced and intermixed, that all further trace of them becomes lost.

Action. To retract the testicle (it has the power of withdrawing it as high as the abdominal ring), and to aid in its suspension

ERECTOR PENIS.—

Situation. Upon the ramus ischii, and crus of the corpus cavernosum.

Figure. Short, thick, conoid.

Attachment. Inferiorly, to the inner side of the infero-posterior part of the tuberosity of the ischium; superiorly, to the crus penis, enveloping a considerable portion of it.

Relations. On the outer side, with the flexors of the thigh; on the inner side, with the accelerator urinæ: internally, with the corpus cavernosum.

Direction. Oblique; from above, downwards; and from without, inwards.

Structure. Tendinous and fleshy at its ischial attachments; fleshy in other parts, excepting that its surfaces are in part aponeurotic.

Action. To promote the influx of blood into the penis at the time of erection, by elevating and protruding the organ, and to aid in retaining it in the state of erection.

TRIANGULARIS PENIS.—*Ischio-urethralis.*

Situation. Across the floor of the cavity of the pelvis, in front of the ischial arch.

Figure. Thin and expanded.

Attachment. On either side, to the ischial portion of the os innominatum; in the middle, to the prostate gland.

Relations. Inferiorly, with the ischium and pubes; superiorly, with the prostates, membranous part of the urethra, and bladder.

Structure. It consists of a broad expansion of pale fleshy fibres (loosely connected by cellular tissue), clothing the membranous portion of the urethra and the prostates.

Action. It will contract this part of the urethra; and, probably, have some effect in discharging fluids from the prostates.

ACCELERATOR URINÆ.—*Perineo-urethralis.*

Situation. Upon the bulb of the urethra, and around the under parts of the penis.

Form. Elongated; penniform.

Attachment. Incorporated with, and (may be considered as) forming part of the penis itself. Posteriorly, it springs from the middle and posterior part of the bulb of the urethra, where it is joined by other (scattered) fasciculi, arising on each side of the bulb from the perineum. It takes its course along the under part of the penis, and may be followed for some short distance upon the glans; the entire muscle, throughout its extent, forming a complete fleshy investment to the urethra.

Action. To compress the urethral canal, thereby aiding in the forcible discharge of the urine; but more particularly, it would seem, in the ejection of the seminal fluid.

FEMALE GENITAL REGION.

ERECTOR CLITORIDIS.—{ *Ischio-clitorideus.* *Sacro-clitorideus.*

This pair of muscles spring from the perineum, at which place their fibres are mingled with those of the sphincter ani. They run to be attached to the upper and back parts of the clitoris.

Action. To erect the clitoris, and thereby protrude it into the vagina, in the act of coition.

SPHINCTER VAGINÆ.—*Perineo-clitorideus.*

Consists of a broad bank of strong, red, fleshy fasciculi, encircling and clothing the orifice of the vagina; and spreading around the adjoining parts of the canal.

In action, the sphincter will contract (and has the power to close) the mouth of the canal.

COCCYGEAL REGION.

An anatomical knowledge of the muscles composing the tail is indispensable to the scientific performance of the operation of nicking.

In denuding them (in dissection) the skin will be found to grow soft and thin upon the under part of the tail, where there is no hair; but thick again and coarse as it approaches the tip, at which part it is also more closely adherent to the muscle, in consequence of the cellular substance there is interposed.

These muscles are divisible into four pairs; and most completely so at their origins at the root of the tail: in the course of their progress their nearest fibres unite together, and become blended one with another.

ERECTOR COCCYGIS.—*Sacro-coccygeus superior.*

Situation. Supero-lateral part of the tail.

Form. Elongated; pyramidal.

Attachment. Anteriorly and superiorly, to the transverse processes and spines of the sacrum; posteriorly and inferiorly, to the bodies and spines of the bones of the coccyx.

Relations. The muscle lies in the hollow formed by the sacrum on the inner side, and the ileum and sacro-sciatic ligament on the outer side.

Structure. Superior attachments, tendinous and fleshy; inferior, chiefly fleshy; though, here and there, slips of tendon pierce its belly and take root in the bone. The muscle, altogether, is remarkable for its tendinous appearance externally, and for being somewhat complex in its composition: consisting, exteriorly, of a flat tendon, from which slips are detached in its course along the tail, after a penniform manner, across its fleshy belly; while the interior part is fleshy, and grows pale and narrow in its course, and is everywhere closely adherent to the coccygeal bones. Towards the extremity of the dock, the tendons so predominate over the fleshy fibres, that it is through them alone that the muscle can be distinctly traced to its termination.

Action. To erect the tail. If one muscle act by itself, the tail at the time of elevation will be carried to one side. Some horses have such power of action with these muscles, that they can reflex the tail over the croup, or curve it to either side, around the quarter.

DEPRESSOR COCCYGIS.—*Sacro-coccygeus inferior.*

Situation. Infero-lateral part of the tail.

Form. Similar to that of the preceding muscle.

Attachment. Anteriorly and superiorly, within the pelvis, to the sacro-sciatic ligament, and to the body of the sacrum; posteriorly and inferiorly, to the inferior parts of the bodies of the coccygeal bones.

Relations. Superiorly, with the erector; inferiorly and externally, with the skin; internally, with the coccyx.

Structure. Like the preceding muscle, it has, exteriorly, a flattened tendon; but it is a much smaller one, and does not detach any lateral slips, until it has descended to near the middle of the coccyx. Its fleshy belly, on the whole, is more bulky than that of the erector; it grows contracted in passing out of the pelvis, but afterwards forms a rounded prominence along the under part of the tail. Its posterior attachments are made by strong and detached tendons, issuing from the broad one traversing its middle, which are concealed within the fleshy belly. Its tendons increase in number, but diminish in size, as the muscle proceeds backward: near the tip of the tail, they surpass in strength those of the erector. It is the principal one of these tendons which commonly project within the section made in the operation of nicking, and requires excision.

Action. To depress the tail and retain it against the rump. If one muscle act alone, it will at the same time incline the tail to one side; in which case it may co-operate with the erector of the same side. The power of action possessed by the depressors may be roughly estimated, by the force it requires with the hand to raise the docks of horses that are said to be "shy about the tail."

CURVATOR COCCYGIS.—*Sacro-coccygeus lateralis.*

Situation. Upon the side of the dock, between the two former.

Form. Smaller than either of the afore-described muscles; though it bears close similarity to them in the appearance and disposition of its fibres.

Attachment. Anteriorly, within the pelvis, to the lateral parts of the sacrum; and, commonly, to the fourth and fifth lumbar vertebræ; posteriorly, to the transverse processes of all the bones of the coccyx.

Relations. Superiorly, with the erector; inferiorly, with the depressor; externally, with the skin; internally, with the coccyx.

Structure. Anteriorly, it consists of two parts, which have been regarded as separate muscles: one portion accompanies the erector; the other the depressor. Posteriorly, it consists of tendinous and fleshy parts intimately and inseparably interwoven with each other.

Action. To curve or flex the tail laterally around the quarter. In switching off flies from the hind parts, these muscles are the principal ones called into action.

COMPRESSOR COCCYGIS.—*Ischio-coccygeus.*

Situation. At the side of the root of the tail.

Form. Broad and flattened.

Attachment. Anteriorly, to the sacro-sciatic ligament and to the ischium; posteriorly, to the transverse processes of the four or five uppermost bones of the coccyx.

Action. To assist in the depression of the tail; but, principally, to maintain it forcibly compressed against the rump.

MUSCLES OF THE EXTREMITIES.

Of the three hundred and odd muscles reckoned in the whole body, upwards of one hundred are to be found in the four extremities.

MUSCLES OF THE FORE EXTREMITIES.

In number, forty-eight; and they admit of being classed into two general divisions—those of the *shoulder*, and those belonging to the *arm* and *leg*. Both divisions are, more or less, invested by the scapular and humeral portions of muscles coming from the trunk; most of which give origin to aponeurotic expansions that descend and subsequently form the humeral and brachial *faschiæ*. Upon the outer and posterior sides we find the panniculus; upon the fore parts, the levator humeri, pectoralis parvus et magnus; upon the hind and inner parts, the pectoralis transversus; upon the internal side, the latissimus dorsi. Upon the shoulder the faschia is thin, weak, and transparent; and has (besides its connections with the various muscles mentioned) attachments to the superior costa and spine of the scapula, to the tubercles and projections of the humerus, and to the olecranon.

MUSCLES OF THE SHOULDER

Are twelve in number.

1.—EXTERNAL SCAPULAR REGION

Comprehends two muscles occupying the *dorsum scapulæ*. These are enveloped in distinct portions of dense faschia, from which septa are sent down between them, and to the inner surfaces of which, in many places, the fleshy fibres are inseparably adherent.

ANTEA-SPINATUS.—*Super-acromio trochiterius.*

Situation. Occupying the *fossa antea spinata scapulæ.*

Figure. Approaching that of an extended triangle; having its base thick and turned downwards, its apex thin and rounded off.

Attachment. Superiorly, to the surface of the fossa antea spinata; also to the spine and anterior costa of the scapula: inferiorly, to the summits of the greater and lesser tubercles of the humerus, and to the capsular ligament of the shoulder joint.

Relations. Externally, with the panniculus and skin; internally, with the bone: anteriorly and superiorly, with the levator humeri and pectoralis parvus; posteriorly and inferiorly, with the next muscle: below, with the shoulder joint.

Direction. Oblique; from above downward, and from behind forward.

Structure. Surface aponeurotic, with a tendinous intersection through its middle.

Attachment. Tendinous and fleshy: inferiorly, the fleshy part presents two terminations, united by an intervening expansion of tendon, which fills up the interspace between them. At the point of the shoulder is sent off a tendinous expansion, between which and the tendon of the biceps is interposed a bursa mucosa.

Action. To extend the humerus upon the scapula; at least, to approach that bone to the straight line.

POSTEA-SPINATUS.—*Sub-acromio-trochiterius.*

Situation. Occupying the fossa postea spinata.

Figure. Triangular; flattened: broader, but not so thick in substance as the preceding muscle.

Attachment. Superiorly, to the surface of the fossa postea spinata, and to the spine of the bone; inferiorly, to the outer side of the greater tubercle of the humerus, to a bony ridge extending down from it, and to the capsular ligament of the shoulder joint.

Relations. On the outer side, with the panniculus and skin, and also (superiorly) with the trapezius; anteriorly, with the foregoing muscle; posteriorly, with the teres minor and triceps; inferiorly, with the shoulder joint.

Structure. Superior attachments, aponeurotic as well as fleshy. Its middle presents several broad tendinous intersections, from the principal of which originates a flattened tendon, fixing the muscle to the tubercle. Below the tendon, is the tendinous and fleshy portion fixed to the ridge; and still lower is a distinct and separate fasciculus, procceding to a small tubercle upon the same ridge, which both Bourgelat and Girard regard as another muscle.

Action. To assist in the flexion of the humerus; and, at the same time, to roll it outwards.

2.—INTERNAL SCAPULAR REGION

Contains but one muscle.

SUB-SCAPULARIS.—*Sub-scapulo-trochineus.*

Situation. Occupying the *venter scapulæ.*

Form. Triangular; broad, flattened, thin in substance.

Attachment. Superiorly, to the surface of the venter scapulæ, and to the anterior and posterior costæ; inferiorly, to the lesser tubercle of the humerus, and to the capsular ligament of the shoulder joint.

Relations. Externally, with the bone; internally, with the serratus; anteriorly, with the pectoralis parvus; posteriorly, with the teres major.

Direction. Fan-like; the fibres converging from above to one and the same point below.

Structure. Superior attachments partly tendinous, but mostly fleshy; surface, partly aponeurotic; middle intersected by tendinous septa: its fleshy fibres, inferiorly, everywhere invest the capsular ligament, there being interposed between these parts a bursa mucosa.

Action. To assist in the extension of the shoulder joint, and to turn the os humeri inwards.

3.—POSTERIOR SCAPULAR REGION.

TERES MAJOR.—*Subscapulo-humeralis.*

Situation. Behind and below the subscapularis.

Form. Elongated; flattened: about two inches in breadth.

Attachment. Superiorly, to the posterior angle of the scapula, and also to the posterior costa: inferiorly, to the inner and upper part of the body of the humerus.

Relations. Externally and posteriorly, with the triceps; anteriorly, with the subscapularis and posterior costa of the scapula; internally, with the pectoralis magnus and latissimus dorsi.

Structure. Scapular attachment, fleshy and tendinous; belly, fleshy; surfaces, in part aponeurotic; inferior termination, an aponeurotic tendon.

Action. To assist in flexing the shoulder joint; and to incline the humerus inwards.

TERES MINOR.—*Superscapulo-trochiterius.*

Situation. Upon the outer and posterior part of the shoulder, below and behind the postea-spinatus.

Form. Elongated; trilateral; flattened.

Attachment. Superiorly, to the posterior costa of the scapula: inferiorly, to the ridge descending from the tubercle of the humerus; and to the faschia a little above and to the outer side of the end of the arm.

Relations. Anteriorly and superiorly, with the postea-spinatus; posteriorly and inferiorly, with the triceps: above with the scapula; below, with the humerus: externally, with the panniculus.

Structure. Mostly covered by a dense aponeurosis. Below, it is entirely aponeurotic, and spreads over the infero-external part of the shoulder.

Action. It will co-operate with the postea-spinatus.

4.—ANTERIOR HUMERAL REGION.

CORACO-HUMERALIS.

Situation. Infero-internal part of the shoulder.

Form. Pyramidal: base turned downwards; flattened from without inwards.

Attachment. Superiorly, to the coracoid process of the scapula: inferiorly, to the middle third of the antero-internal part of the body of the humerus.

Relations. Externally, with the pectoralis transversus and the ribs, also with the humeral blood-vessels and nerves; internally, with the body of the humerus; antero-inferiorly, with the flexor brachii; postero-superiorly, with the teres major and latissimus dorsi; superiorly, its tendon runs between the subscapularis and antea-spinatus.

Structure. A flattened tendon, about three inches in length, forms its superior attachment; from which extends a fleshy belly, partly aponeurotic upon its surfaces, and intersected in places through its substance by tendinous divisions. Its lower attachment is principally (but not entirely) fleshy.

Action. To extend the shoulder joint; and to incline the humerus inwards.

FLEXOR BRACHII.—*Coraco-radialis.*

Situation. Antero-inferior part of the shoulder.

Form. Cylindroid: flattened, superiorly, from before backwards; inferiorly, from side to side.

Attachment. Superiorly, to the coracoid process of the scapula; inferiorly, to the inner parts of the head and neck of the radius, to the capsular ligament of the elbow joint, and to the brachial faschia.

Relations. Anteriorly, with the faschia and skin; posteriorly, with the elbow joint and the humerus; externally, with the pectoralis transversus; internally, with the coraco-humeralis. Its tendon, superiorly, issues from the space between the terminating portions of the antea-spinatus; and the superficial brachial vein ascends to the outer side of it.

Structure. The muscle is fixed to the scapula by a broad, short, thick tendon, which runs within the groove between the tubercles of the humerus; its posterior surface (which much resembles cartilage in its texture) being hollowed and adapted to a cartilaginous eminence in the middle of that groove. At this part the tendon pierces the capsular ligament of the shoulder joint, from the internal cavity of which it is separated only by a reflection of synovial membrane. The anterior surface of the tendon exhibits a few pale fleshy fibres running upon it. The fleshy belly of the muscle is invested by an aponeurotic sheath, and appears as if it were made up of several very small cylindrical muscles, similarly invested, and afterwards joined together into one body. Its inferior attachments are wholly tendinous in one place, aponeurotic in another.

Action. To bend the arm, by carrying it forwards and upwards.

HUMERALIS EXTERNUS.—(*Humero-radialis obliquus.*)

Situation. Deep-seated upon the infero-external side of the shoulder.

Form. Oblong; twisted. • •

Attachment. Superiorly, to the entire postero-external parts of the neck and body of the humerus: inferiorly, to the supero-anterior part of the body of the radius, immediately below the attachment of the flexor brachii.

Relations. Externally, with the middle head of the triceps; internally and posteriorly, with the humerus; anteriorly, with the flexor brachii.

Direction. Curvilinear and oblique.

Structure. Fleshy; excepting a single tendinous intersection through its inferior part, which proceeds to its termination.

Action. To assist in the flexion of the arm.

5.—POSTERIOR HUMERAL REIGON,

Comprehends a mass of muscle, at the back of the humerus, of considerable bulk, and partially divisible into three portions; on which accounts, and from its having different attachments, it is found most convenient, and indeed is most usual, to consider the muscle (which altogether has the name of TRICEPS EXTENSOR BRACHII) under three distinct heads or divisions. These heads are distinguished by epithets correspondent to their magnitude and importance.

TRICEPS EXTENSOR BRACHII.

Having three divisions or *heads*: the first is the

CAPUT MAGNUM.—*Scapulo-olecranius.*

Situation. Infero-posterior part of the shoulder: occupying the angular interspace between the scapula and humerus.

Form. Broad; thick; triangular; flattened.

Attachment. Superiorly, to the whole of the posterior costa of the scapula: inferiorly, to the superior and posterior parts of the olecranon, and postero-internal part of the brachial faschia, immediately below that process.

Direction. Downwards and backwards; converging towards the olecranon.

Relations. Externally, with the faschia and skin, teres minor, and postea spinatus; internally, with the pectorales, magnus et parvus, and the teres major: anteriorly and inferiorly, with the caput medium and humerus; superiorly and posteriorly with the scapula, and the faschia and skin.

Structure. Even this large head itself may be dissected into two portions (to which Bourgelat and Girard have given distinct names): one is long, thin, and flattened, and aponeurotic at its attachments, but fleshy in its middle, and lies along the postero-internal border of the other, which constitutes the chief bulk of the entire muscle.

The scapular attachments are fleshy upon the outer side, tendinous upon the inner. The surfaces are in places aponeurotic. The belly or middle part is fleshy, with the exception of a thick tendinous intersection, which, together with the aponeurosis, ends in a broad, thick, flattened tendon, that is implanted into the olecranon.

CAPUT MEDIUM.—*Humero-olecranius Externus.*

Situation. Infero-external part of the shoulder.

Form. Oblong: flattened.

Attachment. Superiorly, to the outer side of the neck, and to the ridge extending from the outer tubercle upon the body of the humerus: inferiorly, to the postero-outer parts of the olecranon.

Direction. From above, downwards; and from before backwards.

Relations. Externally, with the postea-spinatus, teres minor, and faschia and skin; internally, with the humeralis externus and outer condyle of the humerus: anteriorly, with the faschia and skin; posteriorly, with the caput magnum.

Structure. Superior attachment, both fleshy and tendinous. Middle part, fleshy. Inferior attachment, fleshy and tendinous, and inseparably united in one common tendon with the caput magnum.

CAPUT PARVUM.—*Humero-olecranius Internus.*

Situation. Infero-internal part of the shoulder.

Form. Long and slender; and flattened.

Attachment. Superiorly, to the inner side of the body of the humerus, just above its middle: inferiorly, to the inner part of the apex of the olecranon.

Relations. Externally, with the caput magnum, teres major, and latissimus dorsi; internally, with the humerus.

Structure. Superior attachments, tendinous and fleshy; surfaces, slightly aponeurotic; inferior attachment by a thin flattened tendon.

Action of the Three Heads (considered as a single muscle)—To extend the arm.

ANCONEUS.—*Epicondylo-olecranius.*

Situation. Occupying the hollow space behind, between the condyles of the humerus.

Form. Short, thick, triangular: base turned downward.

Attachment. Superiorly, to the infero-posterior parts of the body of the humerus: inferiorly, to the antero-external part of the olecranon and to the capsular ligament of the elbow joint.

Relations. Posteriorly, with the triceps; anteriorly, with the humerus and the elbow joint.

Action. To assist the triceps in the extension of the elbow joint; and to prevent the capsular ligament from being pinched between the bones during that action.

MUSCLES OF THE ARM AND FORE LEG.

These muscles may be classed into two sets: those which extend the leg; viz., the *Extensors*; and those that bend it; viz., the *Flexors*. They are both included within and firmly bound by the brachial faschia; from which some fibres belonging to the superficial muscles derive their origin.

1.—ANTERIOR BRACHIO-CRURAL REGION.

This region includes all the extensors. The mass of them forms the prominence so perceptible upon the front of a well-formed arm. Collectively considered, they possess much less power than the flexors.

EXTENSOR METACARPI MAGNUS.—*Epitrochlo-premetacarpeus.*

Situation. Fore part of the arm.

Figure. Pyramidal: rounded superiorly; flattened inferiorly.

Attachment. Superiorly, to the outer and fore parts of the external condyle of the humerus; and also to the capsular ligament: inferiorly, to the antero-superior part of the os metacarpi magnum.

Relations. Anteriorly, with the faschia and skin; posteriorly, with the radius: externally, with the extensores pedis et obliquus; internally, with the flexor brachii and the skin. The superficial brachial vein ascends along its inner side.

Structure. Its superior attachment is principally fleshy; though it possesses some tendinous fibres which are inseparably united with the tendon of the next (to be described) muscle. The middle part has but few tendinous intersections. The surfaces are partly aponeurotic. Below the middle of its length arises a tendon, round at its origin, but gradually growing flat, and expanding in breadth towards its termination: it passes, at the knee, under the anterior annular ligament, within a synovial sheath, furnished with a bursa mucosa.

Action. To extend the leg.

EXTENSOR PEDIS.—*Epitrochlo-prephalangeus.*

Situation. Fore and outer part of the arm.

Form. Elongated; pyramidal: more flattened than, but not so thick as, the preceding muscle.

Attachment. Superiorly, to the fore part of the external condyle of the humerus, to the outer part of the head and superior external part of the body of the radius, and also to the capsular ligament of the elbow joint: inferiorly, to the front parts of the lower end of the os suffraginis, the os coronæ, and the coronal process of the os pedis; adhering in its course to the capsular ligament of the fetlock joint.

Relations. Anteriorly, with the faschia and skin: posteriorly, with the extensor obliquus and the radius: internally, with the preceding muscle: postero-externally, with the extensor suffraginis. Behind it, between the bone and it, run branches from the spiral artery and nerve.

Structure. The superior attachment is both tendinous and fleshy: that portion which is attached to the radius consists of a broad, thin, pale, fleshy fasciculus, running to unite itself to the main body of the muscle. It has but one or two, and those but partial, tendinous intersections. Its surfaces are aponeurotic. It becomes a single tendon nearly about the same place as the former muscle; but the tendon is smaller. It pursues its course under the annular ligament, through a cellular sheath furnished with a bursa; and continues down the leg, closely attached by cellular membrane to the cannon bone, broadening somewhat in its course, but widely expanding after it has passed over the fetlock; and in its expansion so completely covering and adhering to the pastern joints, that it seems to them, in front, to serve the purpose of capsular ligament.

Action. To extend the foot and pasterns; and at the same time to assist in the extension of the knee.

EXTENSOR SUFFRAGINIS.—*Radialis-prephalangeus.*

Situation. Postero-external part of the arm.

Form. Narrow; thin; elongated.

Attachment. Superiorly, to the postero-external and superior parts of the radius, and to the posterior (sharpened) border of the ulna: inferiorly, to the supero-anterior part of the os suffraginis, adhering to the capsular ligament of the fetlock joint.

Relations. Anteriorly, with the preceding muscle and the extensor obliquus; posteriorly, with the flexores, perforans et perforatus; internally, with the ulna and radius; externally, with the faschia and skin.

Direction. Half-penniform: from above downwards, and from behind forwards.

Structure. It may be denominated a *muscular slip,* whose superior attachments are tendinous and fleshy; anterior part aponeurotic; and posterior partly tendinous, but mostly fleshy. A little higher than the knee, it detaches a slender flattened tendon, which passes through a sheath, under the external lateral ligament, and then inclines forwards, and unites about half-way down the leg with the long extensor ligament.

Action. To assist in extending the fetlock, and also, in some degree, the knee; and to tighten the extensor ligament.

EXTENSOR METACARPI OBLIQUUS VEL PARVUS.—*Radialis-metacarpeus obliquus.*

Situation. Deep-seated: infero-anterior parts of the arm.

Figure. Triangular; flattened; somewhat curved.

Attachment. Superiorly, to the outer and infero-anterior parts of the body of the radius: inferiorly, to the supero-anterior part of the os metacarpi internum.

Relations. Anteriorly, with the extensor pedis, faschia and skin; posteriorly, with the radius, extensor metacarpi, and knee joint: to the outer side, with the preceding muscle; to the inner, with the extensor metacarpi.

Direction. Oblique and inclined to a curve, from above downwards, and from behind forwards.

Structure. It consists of a small fleshy slip beginning in a pyramidal point, but growing broader as it descends, and ending in a tendon which crosses under the extensor pedis, but over the extensor metacarpi. Its superior attachments are principally fleshy; its belly is palish, and aponeurotic upon its front surface.

Its tendon is slender and flattened, arising about midway down the arm, crosses just above the knee within a sheath to the inner side, and at its termination expands and becomes confounded with the general fibrous covering of the knee joint.

Action. To maintain the tendon of the extensor metacarpi in its place during action: it will also have some effect in extending the leg.

SUPERFICIAL POSTERIOR BRACHIO-CRURAL REGION.

FLEXOR METACARPI EXTERNUS.—*1*

Situation. Postero-external side of the arm.

Form. Elongated; and flattened from without inward.

Attachment. Superiorly, to the postero-inferior part of the external condyle: inferiorly (by one division of its tendon), to the os trapezium; (by the other) to the head of the outer small metacarpal bone.

Relations. Externally, with aponeurosis and skin; internally, with the flexor perforans: postero-internally, with the flexor accessorius sublimis, and next muscle; antero-externally, with the flexor accessorius profundus.

Structure. The superior attachment is mostly tendinous. The surfaces are partially aponeurotic. The fleshy belly has two wide tendinous intersections uniting below the middle of the arm to form a broad, flat, thick tendon, which at the knee bifurcates into a broad flattened division, and a long narrow round one: the latter is continued down at the back of the knee, in contact with the capsular ligament, enveloped within a tendinous sheath.

Action. To bend the leg.

FLEXOR METACARPI MEDIUS.—*Epicondylo-carpeus.*

Situation. Posterior part of the arm.

Form. Elongated; flattened.

Attachment. Superiorly, to the external condyle of the humerus; also to the olecranon: inferiorly, to the trapezium.

Relations. Posteriorly, with the faschia and skin; anteriorly, with the flexor perforans: externally, with the preceding muscle and flexor accessorius sublimis; internally, with the following muscle.

Structure. Superior attachment, tendinous; surfaces partially aponeurotic. Its belly has a single broad tendinous intersection, which terminates below in a thick flattened tendon, having its under surface slightly covered with fleshy fibres. The part attached to the olecranon is but a narrow thin fleshy slip.

Action. To bend the leg.

FLEXOR METACARPI INTERNUS.—*Epicondylo-metacarpeus.*

Situation. Postero-internal side of the arm.

Form. Longer, but not so broad as the preceding muscle.

Attachment. Superiorly, to the internal condyle of the humerus; adhering to the capsular ligament of the elbow joint. Inferiorly, to the head of the internal metacarpal bone.

Relations. Posteriorly and internally, with the faschia and skin; internally, with the last muscle; anteriorly, with the radius, and humeral blood-vessels and nerves.

Structure. Superior attachment, tendinous; in part, fleshy. Surfaces aponeurotic. Just above the knee it sends off a narrow flattened tendon, which passes through a tendinous theca.

Action. To bend the leg.

FLEXOR ACCESSORIUS SUBLIMIS.—*Ulnaris accessorius.*

Situation. Posterior part of the arm.

Form. Elongated; thick; fusiform.

Attachment. Superiorly, to the postero-internal part of the ulna, below the olecranon: inferiorly, to the tendon of the flexor perforans.

Direction. Oblique: from above downwards; and from without inwards.

Structure. Superior attachment tendinous in part, but mostly fleshy. Inferior surface, aponeurotic. A little above the middle of the arm it sends off a tendon which passes under the posterior annular ligament of the knee, and there unites itself to the tendon of the perforans.

DEEP POSTERIOR BRACHIO-CRURAL REGION.

The following muscles constitute the deep-seated flexors: they lie anteriorly to and are concealed by the superficial.

FLEXOR PEDIS PERFORATUS.—*Epicondylo-phalangeus.*

Situation. Deep-seated in the posterior part of the arm.

Form. This and the flexor perforans form one thick, compact, cylindroid fleshy mass; the tendons issuing from which are long and flattened, and adapted by convexity and concavity of surface to each other.

Attachment. Superiorly (and in common union with the following muscle), to the lower side of the internal condyle: inferiorly, to the upper and back part of the os coronæ.

Relations. Posteriorly, to the three flexores metacarpi and flexor sublimis; anteriorly, to the radius and flexor profundus. Along the antero-internal border run the radial blood-vessels and nerves.

Structure. The superior attachments of the mass of muscle (common to this and the perforans) are in part fleshy, but principally tendinous: the tendinous part being underneath and applied to the trochlea of the condyle, which in the motions of the joint it plays over. The mass is divisible (more or less completely) into three or four or more distinct portions, whose surfaces are partly aponeurotic, and whose interiors (with the exception of the one next the radius, which is commonly the most completely separable) are intersected with layers of tendon. Just above the knee it contracts its substance and becomes tendinous, forming two flattened tendons which pass down under the posterior annular ligaments. The posterior of these tendons, the tendo perforatus, is neither so broad nor so flat as the other; it presents a concave surface anteriorly, to embrace its companion in front. At the back of the fetlock joint, it expands so as more completely to cover the perforans, and sends off a crescentic process which surrounds that tendon. At this part also a tendinous theca includes both tendons, having attachments on each side to the sesamoids. Opposite to the small pastern joint, the perforatus splits into two divisions, having the perforans passing between them: the triangular interval left is occupied by a portion of membrane which is so attached as to form a circumscribed synovial bag.

Action. To bend the fetlock and pastern joints; and also to assist in the flexion of the knee.

FLEXOR PEDIS PERFORANS.—*Epicondylo-phalangeus.*

Situation, form, and *superior attachment.* The same as the preceding.

Inferior attachment, to the posterior concavity of the os pedis.

Structure. The fleshy origins and bellies of this muscle are confounded with those of the perforatus. As they approach the knee, however, they separate; and then the perforans runs immediately behind the perforatus. At the knee, like its fellow, it is wholly tendinous, and here indeed partakes somewhat of the nature of cartilage, as it passes through the same synovial bag as encloses its companion. Below the knee, these tendons assume different shapes; the perforans being cylindroid, the other flattened; and this admits of the adaptation of their surfaces to each other. In their passage down the leg, they are connected together and invested by cellular tissue: a loose cellular substance also connects them to the suspensory ligament and cannon bones. The perforans tendon at the back of the fetlock spreads again in breadth, and reassumes a cartilaginous texture, and is likewise (the same as at the knee) surrounded by a synovial sheath, formed principally by the tendo perforatus; from which it only emerges at the division of the latter. Opposite to the os coronæ it is destitute of any tendinous covering, and is invested by cellular membrane only. It next sinks into the substance of the frog, passing over the navicular bone, where it becomes cartilaginous, and adapted in shape to the posterior articular surface of that bone, a *bursa* or circumscribed synovial cavity existing between them. Finally, it ends in an expanded termination which is broadly implanted into the posterior concavity of the os pedis.

Action. To bend the foot. It will also assist in the flexion of the pastern, fetlock, and leg.

RADIALIS ACCESSORIUS.—*Flexor accessorius.*

Situation. Deep-seated, along the infero-posterior side of the arm.

Figure. Irregular; short; flattened: upper part, bifurcate.

Attachment. Superiorly, mesio-posterior part of the radius: inferiorly, its tendon joins that of the perforans.

Relations. Anteriorly, with the radius: posteriorly, with the bellies of the perforatus and perforans: internally, with the radial blood-vessels and nerves.

Direction. From above downwards, inclining in a sort of curve from without inwards.

Structure. It has two beginnings. One is pyramidal, elongated, and tendinous, and extends high up the radius: the other is triangular and fleshy, and is attached lower down. They both unite to form one fleshy belly, which is intermixed with slips of tendon, and finally ends in a single narrow flattened tendon.

Action. To assist the perforans.

LUMBRICI, ANTERIOR ET POSTERIOR.—*Lumbricales.*

Consist of two pairs of pale, delicate, small muscles, having long slender tendons.

The lumbrici posteriores are to be found invested in adipose membrane, adhering to the inner side of the tendo perforans, about one third of its length upwards from the fetlock. Hereabouts they are broad; but they grow narrow as they descend, assuming altogether a pyramidal figure; and they give off at the fetlock slender flattened tendons, which appear to unite to form the crescentic border of the cellular and tendinous sheath at that part inclosing the tendo perforans.

The lumbrici anteriores lie within the spaces left between the small metacarpal bones and the suspensory ligament, under cover of the flexor tendons. They are longer but thinner than the former, and may be classed among the half-penniform muscles. They adhere for some way down the leg to the small metacarpal bones, become tendinous about the middle of the cannon, turn round the tuberculous terminations of the small metacarpals, and vanish in the adipose substance in front of the limb connected with the extensor tendons.

Action. The use of these small muscles seems not to be known; at least, it is by no means well defined.

MUSCLES OF THE HIND EXTREMITIES.

The muscles of the hind extremity are invested and closely compacted together by a subcutaneous covering, in part tendinous and in part cellular in texture (according to the different structures in the vicinity from which we find it to be derived), to which we may give the name (analogically) of *faschia lata.* In front of the haunch it is derived from the panniculus and crural arch, and is both fibrous and cellular in composition; on the outer side of the haunch it is continued from the tensor vaginæ, a muscle that may be said to belong or have an exclusive relation to it; on the inner side, it is continuous with the faschia superficialis abdominis, faschia scroti et pubis, and is entirely cellular in structure; and posteriorly, it is connected with the faschia lumborum. The principal fixed points of attachment of this faschia are, the anterior spine of the ileum, the pubes, the coccyx, the trochanter minor externus, and the patella. Inferiorly, it spreads upon the muscles of the leg, giving them a compact investment, which portion of it may be denominated the *crural* or *tibial faschia:* it derives various fibrous additions from the tendons of the gracilis, sartorius, semi-tendinosus, triceps, &c., and finally vanishes in expansion over the hock. The external surface of the faschia is adherent to the skin, through the intervention of a delicate cellular tissue; there being included between them, besides more or less adipose matter, the subcutaneous blood-vessels, nerves, and lymphatics. Its internal surface is applied to the muscles themselves, and between several of them it sends down processes which take root in the bone. From the faschia itself in some places the muscular fibres appear to arise.

The use of the faschia lata appears to be, to give both power and effect to the muscles during the time of their action, by retaining them in their respective places and relative positions and keeping them closely and compactly braced together.

MUSCLES OF THE HAUNCH.

1.—GLUTEAL REGION.

Comprehending the three gluteal muscles, which compose the superior part of the haunch or quarter.

GLUTEUS EXTERNUS.—*Ilio-trochanterius Medius.*

Situation. Mesio-external part of the haunch.

Figure. Triangular: base presented upwards.

Attachment. Superiorly, to the antero-superior and inferior spines of the ileum, to the spine of the sacrum, and to the faschia lumborum; inferiorly, to the trochanter minor externus.

Relations. Externally, with the faschia and skin; internally, with the gluteus maximus; anteriorly, with the tensor vaginæ; posteriorly, with the biceps adductor.

Direction. Convergent, from the several superior attachments to the trochanter.

Structure. It is constituted of two fleshy divisions, having a broad interval between them filled by aponeurosis. The anterior or smaller division is tendinous superiorly, and internally its fibres are interlaced with those of the gluteus maximus. Inferiorly, both portions unite into one common, triangular, fleshy belly, which ends in an aponeurotic tendon; and from this are sent down processes to the tibial faschia.

Action. The same as the other glutei.

GLUTEUS MAXIMUS.—*Ilio-trochanterius Magnus.*

Situation. Anterior, middle, and external parts of the haunch.

Figure. Pentagonal; sides unequal: angles rounded; lowermost angle extended.

Attachment. Superiorly, to the spinous and transverse processes of the two or three last lumbar vertebræ, to those of the two or three uppermost sacral, and to the faschia lumborum; also to the crista of the ileum, its dorsum and posterior spine; lastly, to the sacro-sciatic ligaments. Inferiorly, to the trochanter major.

Relations. Externally, with the gluteus externus and skin; internally, with the dorsum ilei and gluteus internus; anteriorly with the tensor vaginæ; posteriorly, with the lumbar and sacral spines and biceps adductor.

Structure. This is a bulky muscle, coarse and dark-coloured in its texture; wholly fleshy, excepting some broad tendinous intersections, which, at the trochanter, become formed into a broad flat tendon, surrounded by fleshy fibres.

Action. The same as that of the next muscle.

GLUTEUS INTERNUS.—*Ilio-trochanterius Parvus.*

Situation. Deeply placed, underneath the preceding muscle.

Figure. Fan-shaped; its fibres describing two contrary curves.

Attachment. Superiorly, to the dorsum ilei, as high up as where the gluteus maximus ceases to be attached, and as far back as the border to which the sacro-sciatic ligament is fixed; inferiorly, to the (anterior protuberance upon the) trochanter major.

Relations. Externally, with the gluteus maximus: internally, with the ilio-femoral articulation.

Structure. Principally fleshy: inferior portion intersected at regular distances by layers of tendon, which at the trochanter become united together into one broad flat tendon, curiously grooved (in radii) upon its external surface.

Action of the Glutei. These muscles are extensors either of the os femoris upon the pelvis, or of the pelvis and loins upon the hind quarter. When the limb has been carried in advance under the body by the muscles of the anterior femoral region, and the toe firmly set down upon the ground, the glutei, by extending the haunch, will carry the trunk forward; thus, becoming potent agents in progression; and of them the maximus is by far the most powerful. In the acts both of rearing and kicking these muscles are thrown into violent and forcible contraction: in the former action, the limbs become the fixed points; in the latter, the trunk.

2.—PELVI-TROCHANTERIAN REGION.

These muscles are but small, and are all attached to the trochanter major.

PYRIFORMIS.—*Sacro-trochanterius.*

Situation. Supero-lateral parts of the pelvic cavity.

Figure. Conical: base turned forwards.

Attachments. Within the pelvis, to the transverse processes of the sacrum, and infero-internal part of the ileum: without the pelvis, to the hollow behind the trochanter major.

Relations. Superiorly and externally, with the pelvis; inferiorly and internally, with the peritoneum: along its inferior border run the obturator blood-vessels and nerves.

Structure. Composed of a fleshy belly, having its superior border tendinous; which border, after the muscle has passed through the sciatic notch, gives origin to a slender tendon that insinuates itself between the gemini to gain the trochanter.

Action. To assist in the extension of the haunch.

OBTURATOR EXTERNUS.—*Subpubio trochanterius Externus.*

Situation. Deep-seated, in the supero-internal part of the thigh.

Form. Quadrilateral, and putting on the appearance of a *double* muscle.

Attachments. Internally, to the external border of the obturator foramen, and to the external surface of the obturator ligament: externally, to the cavity behind the trochanter major, and to the upper portion of the ridge extending from the larger to the lessor trochanter.

Relations. Posteriorly, with the biceps abductor; superiorly, with the gemini and obturator internus; internally, with the adductor magnus.

Direction. Outward.

Structure. Attachments, both tendinous and fleshy; surfaces, striped with aponeurotic tendon.

Action. To assist in the extension of the haunch; and at the same time to rotate it outwards.

OBTURATOR INTERNUS.—*Subpubio-trochanterius Internus.*

Situation. Upon the lower side of the pelvic cavity.

Form. Circular border, having radiating fibres converging towards one common centre.

Attachments. Internally, to the internal border of the obturator foramen, and to the inner surfaçe of the obturator ligament: externally, to the root of the trochanter major.

Relations. Superiorly, with the peritoneum; inferiorly, with the obturator ligament.

Structure. From the foramen the fleshy fibres converge and form a belly which passes between the tuberosity and spine of the ischium, and then makes its appearance without the pelvis, in the vicinity of the hip joint.

Action. To approach the trochanter to the pelvis; the effect of which will be to turn the haunch outwards.

GEMINI.—*Ischio-trochanterius.*

Situation. Without the pelvis, at its postero-inferior part.

Form. Thin: flat; quadrilateral.

3.—ANTERIOR ILIO-FEMORAL REGION.

The muscles in this region form the fore and prominent part of the haunch.

TENSOR VAGINÆ.—*Ilio-aponeuroticus.*

Situation. Antero-external part of the haunch.

Figure. Broad; triangular; flattened.

Attachments. Superiorly, to the anterior spine of the ileum: inferiorly, to the faschia lata.

Relations. Anteriorly and externally, with the skin; internally, with the posterior end of the panniculus, with the adipose matter enveloped in the flank, and with the iliacus, rectus and vastus externus; posteriorly, with the glutei-maximus et externus.

Structure. Tendinous and fleshy at its superior attachment, from which it expands into a broad fleshy belly. About midway between the pelvis and stifle, it sends off a thin expansion of tendon, which becomes continued into and confounded with the faschia lata, largely contributing to it.

Action. To draw up and render tense the faschia lata; through whose interposition and connection it will also aid in the advancement and elevation of the haunch, and seemingly in the extension of the thigh.

RECTUS.—*Ilio-rotuleus.*

Situation. Forming the anterior prominence of the haunch.

Form. Elongated; cylindroid; fusiform; broader and thicker in the middle than at either extremity.

Attachments. Superiorly and anteriorly, to the dorsum of the ileum, above and rather in front of the acetabulum; inferiorly and posteriorly, to the supero-anterior part of the patella.

Relations. Its upper part lies between the iliacus and tensor vaginæ. The body of the muscle is bounded laterally by the two vasti; posteriorly, by the femoral bone; and anteriorly, by the faschia lata. It has also relations to the anterior crural nerve, and the femoral blood-vessels.

Structure. The superior attachment consists of a broad, flat, bifurcated tendon. The chief bulk is fleshy. The antero-inferior and lateral parts are covered by aponeurosis, which ends in a thick flattened tendon running to the patella.

Action. Similar to that of the vasti and crureus.

TRI-FEMORO ROTULEUS.

The three following muscles may either be considered under this name, as forming altogether a *triceps* muscle, or they may be viewed as three distinct muscles. The French anatomists prefer the former plan; but our English schools, the latter; and in accordance with their rules, I shall here consider them separately.

VASTUS-EXTERNUS.—(*Outer Division of the Tri-femoro-rotuleus.*)

Situation. Antero-external side of the haunch.

Form. Semi-oval: internal side, flattened; external, convex; thickest in the middle.

Attachment. Superiorly and anteriorly, to the root of the trochanter major, to the trochanter minor externus, and to the whole outward surface of the body of the femoral bone. Inferiorly and posteriorly, to the supero-external part of the patella.

Relations. On the inner side, with the preceding muscle; on the outer side, with the tensor vaginæ and faschia lata; posteriorly, with the femoral bone and biceps femoris.

Structure. Superior attachment, tendinous and fleshy: the other parts are fleshy, with the exception of a thin aponeurosis spread over its postero-external side.

VASTUS INTERNUS.—(*Internal Division of the Tri-femoro-rotuleus.*)

Situation. Antero-internal part of the haunch.

Form. Semi-ovoid: thicker in substance than the last muscle.

Attachment. Superiorly and anteriorly, to the neck of the femoral bone, to the root of the trochanter minor internus, and to the entire inner part of the body of the bone. Inferiorly and posteriorly, to the supero-internal part of the patella.

Relations. On one side with the rectus; on the other with the sartorius: posteriorly, with the femoral bone; anteriorly, with the faschia lata.

Structure. Covered by a thin aponeurosis; otherwise, fleshy. The aponeuroses proceeding from the vasti extend downward over the patella to be fixed to the tubercle of the tibia. Inferiorly, an aponeurotic tendon separates it from the crureus.

Relations. With the muscles and bone to which it lies contiguous.

Structure. Tendinous at its extremities; intermediate parts, fleshy; under part, aponeurotic.

Action of the two Vasti and the Crureus, considered as a Triceps or one entire Muscle.

In consequence of their connection, through the intervention of the patella and its ligaments, with the tibia, these muscles become direct extensors of the thigh; and their power as such is considerably enhanced by the peculiar construction of the stifle-joint, which enables them to act with the combined mechanical advantages of pulley and lever. In progression, they raise the thigh and advance it forwards under the body; and in that position, as soon as the limb has become a fixed point, they will assist in progressing the haunch.

INTERNAL ILIO-FEMORAL REGION,

Comprehends the muscles forming the prominent rotundity of the inner part of the haunch.

SARTORIUS.—*Sub-lumbo-tibialis.*

Situation. Antero-internal part of the haunch.

Form. Long, slender, pyramidal; anterior part broadest.

Attachment. Antero-superiorly, to the bodies of the posterior lumbar vertebræ, and to the brim of the pelvis midway between the symphysis pubis and the anterior spinous process of the ileum; inferiorly, to the supero-internal part of the tibia, and to the internal condyle of the femoral bone.

Relations. On the outer side, with the psoas magnus, vastus internus and gracilis; on the inner, with the faschia lata and skin. Along its posterior and outer border run branches of the femoral blood-vessels.

Structure. Fleshy and rather pale: except the extremities, which are aponeurotic. Its anterior aponeurotic end is so in-

PECTINEUS.—*Super-pubio-femoralis.*

Situation. Inner, upper, and anterior part of the haunch.

Form. Fusiform: thickest in the middle; upper extremity flattened.

Attachment. Superiorly, to the brim and anterior surface of the pubes, near the symphysis; and to the infero-anterior part of the same bone, near the acetabulum. Inferiorly, to a long ridge extending from the trochanter internus.

Relations. On the outer side, with the sartorius; anteriorly and internally, with the glacilis; posteriorly, with the adductors.

Structure. The superior attachment consists of a bifurcated tendon; the inferior is both tendinous and fleshy. Its fleshy belly is striped with aponeurosis.

Action. To flex the haunch, and at the same time adduct it.

ADDUCTORES FEMORIS.

Different anatomists pursue different modes of treating of these muscles; and all may be proved to be right or wrong, according to the light in which the dissector views the parts, and the artificial divisions which his knife may make of them. One considers the three adductors together, as a *triceps* muscle; another describes them as three separate muscles; while a third looks upon them as forming a single muscle and a *biceps*. The last mode of proceeding appears to me to be in the most strict accordance with nature, and therefore shall I adopt it here.

ADDUCTOR BREVIS. ADDUCTOR LONGUS. } *Sub-pubio-femoralis.*

Situation. Deep-seated, on the inder part of the thigh.

Attachment. Superiorly (both having one common attachment), to that part of the pubes included between the symphysis and the acetabulum; inferiorly, the short adductor is attached to the middle third of the body of the femoral bone; the long adductor to the lower third of the body of the same bone, and to its internal condyle.

Relations. On the outer side with the gracilis; and on the inner, with the trochanter minor internus. Along their anterior borders run the pectineus and sartorius. Posteriorly, lies the adductor magnus. Between these two adductors pass the femoral artery and vein.

Structure. One entire fleshy mass superiorly, split into two portions inferiorly, which at their insertions into the bone manifest tendinous fibres. Their surfaces exhibit aponeurotic patches and stripes.

Action. Will be considered with the next muscle.

ADDUCTOR MAGNUS.—*Ischio-tibialis.*

Situation. Postero-internal part of the haunch and thigh; forming the prominence behind termed "the *point* of the quarter."

Figure. Irregular. Superior extremity, narrow, pointed, and curved; from which it becomes broad, thick, and afterwards elongated. The posterior border is thick; the anterior is thin.

Attachment. Superiorly, to the spine of the sacrum and tuberosity of the ischium; inferiorly, to the lower third of the inner part of the body of the os femoris, to the internal condyle of that bone, and to the inner part of the head of the tibia.

Relations. Posteriorly and externally, with the faschia and skin; internally, with the biceps abductor and heads of the gastrocnemii: anteriorly, with the gracilis.

Direction. Longitudinal; inclining forwards in a curve.

Structure. Entirely fleshy, with the exception of the extremities. The upper extremity is prolongėd as high as the sacrum by means of aponeurosis, which forms part of the faschia lata. The inferior extremity is affixed to the condyle by a strong flattened tendon.

Action. That of the three adductors is to extend the os femoris upon the pelvis; so that they are opponents to the psoas magnus and iliacus, which flex the haunch: they are also powerful adductors of the whole limb. The great adductor will, moreover, assist in bending the thigh, and will rotate it inwards a little.

5.—POSTERIOR ILIO-FEMORAL REGION.

The muscles of this region occupy the outer and posterior side of the haunch.

BICEPS ABDUCTOR FEMORIS.—*Ischio-tibialis Medius* vel *Posterior.*

Situation. Postero-external side of the haunch and thigh; where, being superficial, its course is well marked in the living animal.

Attachment. Superiorly, to the lateral and posterior parts of the spine of the sacrum, and some of the upper pieces of the os coccygis; to the sacro-sciatic ligaments; to the tuberosity of the ischium, and to the faschia lata. Inferiorly, it is split into two portions, one of which is attached to the patella and its external ligament; the other (through the intervention of an aponeurotic expansion) to the ridge upon the upper part of the tibia, and to the faschia covering the leg.

Relations. Externally, with the faschia and skin; internally and superiorly, with the gluteus maximus; internally and inferiorly, with the gastrocnemii; anteriorly, with the external trochanters, major and minor, and with the body of the femoral bone; posteriorly, with the tuberosity of the ischium and semitendinosus.

Structure. Fleshy; surfaces, aponeurotic. Attached by a broad flat tendon to the tuberosity of the ischium; by a more slender one, to the trochanter minor externus; by a broad, flattened, and thick tendon, invested by some few fleshy fibres, to the patella and its ligament; and to the tibia and tibial faschia by a broad expanded aponeurosis. The inferior division is, at its upper part, united with the next muscle by intermixture of fleshy fibres.

Action. The two divisions of this muscle will operate differently. The anterior or superior one will assist the rectus and vasti in extending the thigh; but the posterior one will contribute towards its flexion. They will both co-operate in abducting the limb; also in rotating it inwards—the hock at the time turning outwards.

SEMI-TENDINOSUS. SEMI-MEMBRANOSUS. } ADDUCTOR TIBIALIS.

Ischio-tibialis Internus.

Situation. Posterior side of the haunch and thigh.

Attachment. Superiorly, to the postero-lateral part of the spine of the sacrum; to the two or three uppermost bones of the coccyx; and to the antero-inferior side of the tuberosity of the ischium. Inferiorly, to the superior and antero-internal part of the tibia; directly opposite to the attachment of the lower head of the biceps abductor and tibial aponeurosis.

Relations. Posteriorly, with the faschia and skin; anteriorly, with the tuberosity of the ischium, os femoris, and gastrocnemii; externally, with the biceps; internally, with the adductor tibialis.

Structure. This is a long cylindroid muscle, composed of two parts, one coming from the sacrum, the other from the ischium; both of which are united below the tuberosity. The superior attachments are both fleshy and tendinous. From the inferior proceeds an aponeurotic expansion, contributing towards the tibial faschia.

MUSCLES OF THE THIGH AND LEG.

These muscles are invested and confined down in their places by the crural or tibial faschia, which is in part an extension from the faschia lata, and in part a production from those femoral muscles whose tendons or aponeuroses descend upon the leg; such as the adductor magnus, biceps, and adductor tibialis. The muscles themselves (those now under consideration) being collected together into two packets or parcels, separate and distinct from each other, the crural faschia admits of an anterior and a posterior portion; one investing the muscles in the anterior crural region, the other in the correspondent posterior region. The former has for its principal places of attachment the patella; the upper and lower ends, tubercle, and spine of the tibia; and the anterior annular and lateral ligaments of the hock; in front of which it is continuous with the tendinous vaginæ, formed for the passage of the extensor tendons: on the outer side this faschia sends a broad process inward, between the extensor pedis and peroneus, which is fixed to the body of the tibia, inclosing the latter muscle in a complete sheath. Beyond this, the anterior faschia becomes continuous with the posterior.

The chief attachments of the posterior division of the faschia are, the condyles, and postero-inferior part of the body of the femoral bone; the postero-lateral parts of both extremities of the tibia, and the entire inner side of its body; the lateral ligaments of the hock; and the tendinous point of the os calcis.

1.—ANTERIOR FEMORO-CRURAL REGION.

Of the muscles situated in this region, two are extensors of the leg and foot, and at the same time aiders in the flexion of the hock: the other is a direct flexor of the hock. They are all three bound down to the tibia by a strong tendinous faschia.

EXTENSOR PEDIS.—*Femoro-prephalangeus.*

Situation. Superficial: anterior part of the leg.

Form. Elongated; fusiform: flattened from before backwards.

Attachment. Superiorly, to a roughened depression upon the antero-inferior part of the external condyle of the femoral bone. Inferiorly, to the coronal process of the os pedis, and to the superior edge of the bone in the interval between the lateral cartilages.

Relations. Anteriorly, with the faschia and skin, and the aponeurotic tendon of the biceps; postero-externally, with the peroneus; postero-internally, with the flexor metacarpi; postero-superiorly, with the capsular ligament of the stifle joint, the tendon passing through a groove upon the front of the tibia.

Structure. The muscle commences, superiorly, by a small flat tendon, which is common to it and the flexor metatarsi. Upon the tibia it becomes fleshy, exhibiting two or three thin tendinous intersections, together with aponeurotic surfaces. A little above the hock the fleshy belly ends in a flat tendon, which takes its course in front of the hock through a theca prepared for it, and upon the cannon (about one third of its length downward) enters into union with the tendon of the peroneus, and so intimately that the two tendons appear but as one until they have descended as low as the fetlock joint, over which they disunite and again run separately. As it passes the front of this joint, the extensor tendon expands itself, and continues to do so to its termination.

Action. In consequence of this tendon being bound down upon the hock by the sheath through which it passes, it will have effect in flexing that joint, at the same time that it is performing its own special function, the extension of the foot, as well as the pastern and fetlock joints.

⁂ Immediately beneath the bend of the hock, from the antero-superior part of the metatarsal bone, issues a thin layer of fleshy fibres, enveloped in cellular substance, and concealed in part by the tendon of the above muscle, with which (about one fourth of the length of the cannon downward) they form a union, and make some addition to its substance. In action, these supplementary fibres will brace the tendon; and are probably furnished to prevent it from being compressed by the flexion of the hock.

PERONEUS.—*Peroneo-prephalangeus.*

Situation. Antero-external side of the limb.

Form. Cordiform; elongated; flattened from before backwards.

Attachment. Superiorly, to the head of the fibula, continuing its attachment for the entire length of that bone. Inferiorly, the same as the foregoing muscle.

Relations. Externally, with the faschia and skin; internally, with the fibula; anteriorly, with the extensor pedis; posteriorly, with the flexor pedis.

Structure. Superior attachment, fleshy and tendinous, from which a fleshy belly descends nearly the whole length of the tibia: a slender tendon, in form a flattened cord, then commences, which passes through a distinct tendinous sheath, across the front of the hock, and upon the cannon bone forms a connection with the tendon of the flexor pedis.

Action. It will co-operate with the extensor pedis.

FLEXOR METATARSI. *Tibio-prematarseus.*

Situation. Antero-internal side of the limb.

Figure. Bifurcate at either extremity.

Attachment. Superiorly, in common with the extensor pedis, from the external condyle of the os femoris; and from a broad triangular excavation marked upon the superior and antero-external part of the tibia. Inferiorly, to the head of the large metatarsal bone, and to that of the internal small metatarsal bone.

Structure. The tendon by which the flexor pedis is attached, superiorly, enters afterwards into the composition of the present muscle, whose fleshy belly, although in intimate connection with the tendon, is placed behind it. In front of the hock, the fleshy part ends in a small cordiform tendon, which is enveloped by a flattened one that runs in front of it, and indeed forms quite a sheath for it. Having emerged from its sheath, however, it splits into two divisions, which are left with only cellular coverings.

Action. To flex the hock; in doing which it will have a tendency to turn the joint inwards.

2. SUPERFICIAL POSTERIOR FEMORO-CRURAL REGION.

The muscles contained in this region are all affixed to the os calcis, and thereby become extensors of the hock: one of them is continued afterwards down the leg, to be fixed both to the fetlock and pastern, and hence operates as a flexor of those parts at the same time.

GASTROCNEMIUS EXTERNUS.—*Bifemoro-calcaneus.*

Situation. Superficial; along the posterior part of the leg.

Figure. Elongated: flattened from before backwards; broad, thick, and bifurcated, superiorly; united and cordiform, inferiorly.

Attachment. Superiorly, to a roughened hollow just above the external condyle of the os femoris, to the inner condyle, and to a ridge extending from it: inferiorly, to the point of the os calcis.

Relations. Posteriorly, with the faschia and skin; anteriorly, with the condyles of the femur, gastrocnemius and plantaris, muscles of the deep posterior crural region, and the popliteal blood-vessels and nerves: externally, with the biceps; internally, with the adductor magnus and adductor tibialis.

Direction. Downward and backward.

Structure. The superior and middle parts are bulky, and consist principally of a fleshy belly, bifurcate, whose surfaces are partially covered by aponeurosis, discovering inferiorly a few tendinous intersections. A little below the back of the stifle, the bifurcations unite and form one entire fleshy belly, glistening in many parts with tendinous fibres. Midway between the hock and stifle the belly ends in a flattened tendon, partially divisible into two or three portions, and decussates with the tendon of the gastrocnemius internus, by which at the hock it is completely enveloped.

Action. To extend the hock.

GASTROCNEMIUS INTERNUS.—*Femoro-phalangeus.*

Situation. Postero-mesian part of the leg.

Form. Cordiform; elongated; thicker in the middle than at the extremities. Its tendon, below the hock, is flattened, and upon the anterior surface excavated.

Attachment. Superiorly, to the upper part of the roughened hollow upon the back of the os femoris, above its external condyle. Inferiorly, it is continued over the hock, down the rior part of the leg, to be fixed to the os coronæ.

Relations. Posteriorly, with the gastrocnemius externu skin: anteriorly, with the stifle joint, the muscles of the p rior deep crural region, tendons of the gastrocnemius exte and flexor perforans. The first crural nerve runs also along front side.

Peculiarities. Remarkable for the little difference in volu there exists between the fleshy belly and its tendon; and being entirely tendinous until it has descended to the stifle.

Structure. The belly of this muscle is of considerably le volume than that of the gastrocnemius externus, but it has mor tendon in its composition. About half way down the thigh it becomes entirely tendinous; and its tendon, which is flattened, turns round that of the gastrocnemius externus in approaching the hock: so that the relative position of the two muscles becomes reversed in their tendons. In passing over the point of the hock the tendon expands into a sort of cap or *theca,* which is so fixed and closed in around its border, by cellular substance, to the bone, that a complete ball-and-socket joint is formed between them, circumscribed within the space of about an inch from its centre all the way round, and lined by a thin delicate membrane secreting synovia into the interspace. It constitutes, in fact, altogether, what is denominated a *bursa mucosa;* but is one that, from its size and disposition to take on disease, peculiarly merits the attention of the anatomist. From this bursal formation it proceeds down the posterior part of the leg; and from the place at which it leaves the hock takes the name of *tendo perforatus.* Its subsequent course and attachment, together with its relations to the *tendo perforans,* answer to the descriptions given of the tendons of the same name in the fore extremity.

Action. To extend the hock; but to flex the fetlock and pastern.

PLANTARIS.—*Peroneo-calcaneus.*

Situation. Postero-external part of the thigh.

Form. Elongated; thin; slender.

Attachment. Superiorly, to the head of the fibula; inferiorly, (in union with the tendon of the gastrocnemius externus) to the os calcis.

Relations. Externally, with the skin; internally and posteriorly, with the gastrocnemius externus; anteriorly, with the deep posterior crural muscles. The third popliteal nerve crosses its superior extremity.

Structure. This is the most slender muscle, in proportion to its length, in the body. Its delicate belly, composed of pale shy fibres, and constituting two thirds of its length, sends off ually delicate cordiform tendon, which unites inseparably, bove the hock, with the external gastrocnemius tendon.

.—DEEP POSTERIOR FEMORO-CRURAL REGION.

he muscles contained in this region lie deep-seated, in the terspace between the tibia and the gastrocnemii. They are overed and closely bound down by a dense firm tendinous faschia.

POPLITEUS.—*Femoro-tibialis Obliquus.*

Situation. At the back of the stifle-joint.

Form. Short; thick; triangular.

Attachment. Superiorly, to the postero-external side of the outer condyle of the femur, and to the capsular ligament of the stifle-joint. Inferiorly to the upper half of the inner side of the body of the tibia.

Relations. Posteriorly, with the gastrocnemii internus et externus, the semilunar cartilages, the postero-internal side of the head and the superior part of the body of the tibia: also, with the popliteal artery and vein. Externally, with the internal lateral ligament; internally, with the gastrocnemius externus. Superiorly, with the condyles of the femur; inferiorly, with the flexor pedis accessorius.

Direction. Of the *superior* fibres, nearly transverse; of the *inferior*, obliquely inward and downward.

Structure. Its supero-external attachment consists of a flattened and partially cleft tendon, which plays over the back of the outer semilunar cartilage. This tendon is enclosed within a duplicature of the capsular ligament; but (notwithstanding that) is shut out by the internal fold of that duplicature from the cavity of the stifle joint. This tendon finally sinks into the fleshy part of the muscle, whose substance still in places discovers some scanty tendinous intersections.

Action. To bend the stifle; and at the same time to turn the tibia inwards. It will also extricate the capsular ligament from being pinched between the bones.

FLEXOR PEDIS.—*Tibio-phalangeus.*

Situation. Postero-external side of the limb.

Figure. Fusiform; elongated: fleshy part, thick.

Attachment. Superiorly, to the postero-external side of the head of the tibia; to the supero-posterior half of the body of the bone, and to the posterior side of the fibula. Inferiorly, the tendon assumes the name of *tendo perforans,* and is disposed of in a manner so similar to the tendon of the same name in the *fore* extremity as to render any description of its lower attachments here quite unnecessary.

Relations. Posteriorly, with the plantaris and the gastrocnemii, and also with the posterior tibial blood-vessels; anteriorly, with the tibia and fibula. Superiorly and internally, with the flexor accessorius; externally, with the plantaris and the flexor metatarsi.

Structure. Superior attachment, both tendinous and fleshy, from which at the back of the hock proceeds a strong cordiform tendon, which passes within a groove upon the inner side of the os calcis and runs down the posterior part of the leg, where it becomes connected with the tendons of the flexor accessorius and gastrocnemius internus. With the former of these it unites, and the two together form a single tendon; but with the latter, the union is only one formed by cellular membrane. The tendon is denominated the *tendo perforans,* in contra-distinction to that derived from the gastrocnemius internus, which (as was before observed) is styled the *tendo perforatus.* Both tendons are inclosed within the same sheath; and are, in fact, disposed of down the leg and foot in a similar manner to what the corresponding tendons are in the fore extremity: on which account any further detail would prove but recapitulatory.

Action. That of the gastrocnemius internus corresponds to that of the externus: it extends the hock. But, as it continues down the leg through the medium of the tendo perforatus, it will also flex the fetlock and pastern joints. The flexor pedis will prove of some effect in the extension of the hock: although its principal operation is upon the foot, which it alone flexes; and at the same time it flexes the pastern and the fetlock.

FLEXOR PEDIS ACCESSORIUS.—*Peroneo-phalangeus.*

Situation. Deep seated: postero-internal part of the leg.

Figure. Elongated; fleshy portion pyramidal.

Attachment. Superiorly, to the postero-external part of the head of the tibia: inferiorly, it becomes inseparably united with the tendon of the flexor pedis, about one third of the length of the cannon downwards.

Relations. Posteriorly, with the gastrocnemii; anteriorly, with the body of the tibia, and the posterior tibial artery and vein. Superiorly and internally, with the popliteus; inferiorly and externally, with the flexor pedis.

Structure. Superior attachment, fleshy and tendinous; afterwards entirely fleshy, and so it continues until it ends in a tendon which has its origin in its very centre. Its fleshy belly crosses obliquely over to the inner part of the leg, where it terminates, midway between the stifle and hock, in its cordiform tendon, which passes through a theca at the inner side of the hock. Opposite to the head of the great metatarsal bone it runs in the same sheath with the tendon of the flexor pedis, with which it ultimately forms one common tendon.

Action. It operates as a coadjutor to the flexor pedis.

SECTION III.

CIRCULATORY SYSTEM.

THE CIRCULATORY SYSTEM COMPRISES THE BLOOD, THE BLOOD-VESSELS, AND THE HEART.

OF THE BLOOD.

BLOOD is the red fluid we see issuing from a fresh wound, and of which there is a considerable quantity continually circulating through the body of a living animal. So uniform is it, while circulating, in its appearance, that it looks like a simple, uncompounded, or homogeneous fluid; a character it does not lose until some time after it has been drawn out of the body, and then it gradually assumes a change from a fluid into a solid mass, resembling jelly. In the fluid state it possesses a faint odour, a saline flavour, has an adhesive unctuous feel, and is some little (specifically) heavier than water: the latter being equal to 1000, blood may be estimated at 1090. Also, so long as it continues tepid, it is perceived to emit from its surface a *halitus*, or vapour; which is nothing more than ordinary steam, excepting that the evaporation may carry up with it minute particles of animal matter: a circumstance which will account for the peculiar odour it is known to convey.

It has been observed that blood, soon after its removal from the body, concretes into a solid gelatinous mass. This spontaneous change, called the coagulation, proceeds very gradually to completion, until we discover the formation of two very different component parts: one solid, denominated the *clot*, or *crassamentum;* the other fluid, named the *serum*. Simple concretion takes place in the blood of the horse in about twenty-five minutes: in that of a man it requires only seven. The relative proportions of the crassamentum and serum when the coagulation is finally completed) will be found to vary in the blood of different animals, and that even of the same animal at different periods, depending on the state of health and condition of the subject from which it is drawn. In man, the crassamentum may be said to amount to about one third of the weight of the serum; in the horse, the solid will bear nearly an equal ratio with the fluid portion.

In the more perfect, or, as they have been denominated in contradistinction to the others, the warm-blooded animals, the blood is everywhere found, while circulating in the living body, to be of a certain degree of heat; and this it steadily preserves in its circulation through the inward parts of the body, uninfluenced by the surrounding temperature. In all the interior or unexposed parts, the heat will exceed 100° of Fahrenheit's thermometer; it has been found, however, by experiment, that this degree is not equally maintained in the more superficial situations of the body: what these variations are we have but little to do with, though they may be ascertained by the aid of the thermometer, at any time, with precision. But in the lower orders of animals, or such as are called cold-blooded, the heat of the blood corresponds with that of the medium in which they live. We are not, however, to suppose that the temperature of this fluid is never subject to variation, even in perfect animals, for it is found to be much influenced in them by disease: *e. g.* in the human subject, in whom the heat of the body is, in health, 98°, it has been known to rise to 110° during fever; and, in all superficial parts, increased heat is one of the essential symptoms of inflammation.

The heat of the horse's blood, while flowing into a basin, is 100°. If the bulb of the thermometer be introduced into the wound, the quicksilver will rise to about 101°. The temperature of the more superficial parts of the body will, in course, vary with that of the surrounding atmosphere. Mr. Hunter found that the thermometer, introduced into a wound two inches deep, made into the gluteal muscles of an ass, indicated 100°; and that the heat of the vagina was the same. The interior of the chest of the dog he ascertained to be 101°.

The *colour* of the blood is red. Not in all animals, however; for in such as are called cold-blooded—in most fish, their gills excepted, and in insects—it is colourless and transparent. So, likewise, it is in *parts* even of such animals as are warm-blooded; as, for example, in the common domestic fowl, in which the breast and wings are delicately white, while the legs and body partake of a dusky red hue. I believe the blood of the horse is not so high-coloured as that of a man, and that the latter yields in brightness to that of a dog. All this seems to argue that colour is not an indispensable property.

The *quantity* of blood contained in an animal body may be made matter of speculation, but cannot, for many reasons, be ascertained with any degree of precision. If we attempt to draw all the blood out of the body, the animal sinks and dies long before its vessels are evacuated; and as we possess no means of measuring what remains behind, any calculations we may make from the quantity that has flowed must necessarily turn out vague, if not altogether incorrect. The following experiment will serve to illustrate this; at the same time that its result will serve as a *datum* to guide us in any future computation.

The weight being ascertained to be 79 lb., a puncture was made with a lancet into the jugular vein, from which the blood, which flowed in a very free stream, was collected. The vein having ceased to bleed, the carotid artery of the same side was divided but no blood came from it: in a few seconds afterwards the animal was dead. The weight of the carcass was now found to be 73½ lb.; consequently, it had sustained a loss of 5½ lb., precisely the measure of the blood drawn. It appears from this experiment that an animal will loose about 1-15th part of its weight of blood before it dies; though a less quantity may so far debilitate the vital powers as to be, though less suddenly, equally fatal. In the human subject the quantity of blood has been computed at about 1-8th part of the weight of the body; and as such an opinion has been broached from the results of experiments on quadrupeds, we may fairly take that to be about the proportion of it in the horse: so that, if we estimate the weight of a common sized horse at about 12 cwt., the whole quantity of blood will amount to 84qrts., or 168lb., of which about 45qrts., or 90lb., will commonly flow from the jugular vein prior to death; though the loss of a much less quantity will sometimes deprive the animal of life.* It is well known that young animals possess more blood than old, and that they will, perhaps, on this account, sustain greater bodily injuries, and bear larger hæmorrhages; indeed, they are wisely provided with such an excess, if we may so term it, in order that their growth may be promoted, and their several organs maintained in a state of vigour: but in old, in which the body is gradually decaying, and the powers of life declining, the quantity of this fluid becomes reduced. Mr. Wilson, in his 'Lectures on the Blood,' &c., says, that "fat animals are found to possess less blood than leaner animals; and tame animals, which are confined, less blood than wild ones."

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* Supposing a man to weigh 12 st., or 168 lb., the quantity of blood contained in his body may be rated at 21 lb. or 2 gall. 2 qrts. and 1 pint. Again, granting that a dog weighs 40 lb., the amount of his blood will be 5 pints. These calculations are useful and worth our attention, inasmuch as they serve to guide us in practice, as to the probable extent to which we may, with safety, carry venesection in different animals. For instance, we may reckon the loss of a pint from a man to be equivalent to that of a gallon from a horse, or to four ounces from a dog, and *vice versâ*; selecting individuals from each class about the respective weights we have here set down.

If we take the crassamentum (the solid clot formed by coagulation) and wash it, we shall, by repeated ablution, deprive it of its red colour, and find that we have still remaining a tough gelatinous substance; which, when broken, exhibits a *fibrous* appearance, and on that account has received the appropiate name of

FIBRIN.

Some, however, call it by a name of much older date; viz. *coagulable lymph.* Only let us understand that both mean the same thing. It may be made, artificially, to assume a more perfect fibrous aspect, by stirring the blood as it flows from the body during coagulation, or by receiving it into a bottle, and shaking it therein while it is congealing. In either case it will be made to assume a very similar texture to muscular fibre, which it also resembles in its chemical composition: and the resemblance may become so perfect, that it may seem well to merit the appellation given it by the old physiologists of "liquid flesh." The similar toughness of consistence which it acquires will not become manifest for some days after its coagulation; for I have found that the crassamentum will continue to contract, and very gradually become smaller (at the same time squeezing out serum), even for more than a week from the time of the detraction of the blood.

So singular a phenomenon as the spontaneous coagulation and decomposition of the blood presents, could not fail to attract the attention and consideration of those engaged in physiological pursuits; accordingly we find various reasons assigned for it by the old writers, and yet no one, even up to the present hour, has been able to solve the vital problem. The two most obvious changes of condition to which it is subjected are rest, and exposure to air or cold. But, as we have just seen, it will congeal though it be kept stirred or shaken in a bottle; at the same time, let it be observed, that a very brisk agitation will maintain its fluidity: an effect arising, probably, from the natural attractiveness of the particles for each other being artificially counteracted until it ceases altogether. Neither is exposure to air or a diminished temperature the cause, for blood will coagulate *in vacuo;* and is, likewise, often found in clots in vessels and cavities of the body, with sufficient evidence of its having been so during life. So that neither of these causes will account for the coagulation, though experiments constrain us to admit that they both seem somewhat influential.

Other circumstances and agents also affect the coagulation. It will congeal sooner when drawn from a small orifice, or allowed to trickle down the side of the vessel or the animal's neck, than under opposite circumstances. Various chemical agents thrown into the vessel will effect its coagulation at once: such are certain of the neutral salts, acids, alcohol, and alum.

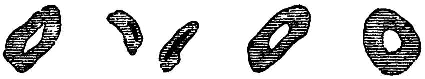
Of the various conjectures and opinions that have been framed to account for this miraculous change in the blood, none seems so well worthy our attention as that left us by the famed John Hunter. He ascribed the coagulation to the presence of a *vital* principle in the fluid. To use his own words: "To conceive that blood is endowed with life while it is circulating, is, perhaps, carrying the imagination as far as it can go; but the difficulty arises merely from its being a fluid, the mind not being accustomed to the idea of a living *fluid*." He next proceeds to show, "that organization and life do not depend in the least on each other; that organization may arise out of living parts and produce action, but that life can never rise out of, or depend on, organization." And, in the third place, he evinces, by many ingenious facts and experiments, a striking analogy between the coagulation of the blood and the contraction of muscular fibre. Animals killed by lightning or electricity have not their blood coagulated, nor their muscles contracted. Those that are hunted to death, or, in fact, in any way suddenly extinguished, exhibit the same coincident phenomena; also their bodies are more disposed to run into putrefaction. From all which evidence, Mr. Hunter concluded that blood in a living body, was possessed of what he termed a *materia vitæ diffusæ*.

Dr. Bostock objects to the Hunterian doctrine on the score that, even were "the life of the blood fully established, it would not offer any explanation of the cause of its coagulation; for the same difficulty (adds he) still remains, in what manner the presence of life operates, so as to produce either the coagulation of the blood or the contraction of the muscles." But this remark is one that would equally apply to all vital phenomena. The Doctor gives it as his opinion that, "perhaps, the most obvious and consistent view of the subject is, that *the fibrin has a natural disposition to assume the solid form*, when no circumstance (either chemical or mechanical) prevents it from exercising this inherent tendency."

RED PARTICLES.

It has been observed that, by repeated ablution, the crassamentum may be deprived of its red colour, and thereby converted into fibrin alone: the water that has been employed for this purpose will be found to be rendered *red*—bloody, as it is termed an effect arising from the commixture with it of the part of the crassamentum now under our consideration, viz., the red particles. The colour of the blood is owing to the presence of innumerable *particles* or *globules*, which are uniformly diffused through it in the fluid state; and in the coagulated, become entan within the substance of the fibrin. I have already remar however, that blood is not red in all animals, nor even in every part of the same animal; still (according to Hewson) this white or colourless blood possesses globules similar in form and structure to the coloured ones. The same author likewise informs us, that the globules are of different magnitude in different animals, but that their volume bears no sort of proportion to the size of the animal; they being as large in the mouse and cat as in the ass and ox; larger than either in birds; and largest of all in the skate.

In making these observations, however, I should remark that no part of the body has afforded a wider field for speculation than these red globules. Being so very minute as only to be discoverable at all through a powerful microscope, their shape and magnitude have become variously reported on according to the varying circumstances under which these microscopic examinations have been conducted: to one they have appeared in the form of perfect spheres; to another, as rings; to a third, as flattened vesicles. Dr. Young (whose account is recent, and pretty nearly coincides with that of Hewson) found the globules in the skate to resemble an almond in form, only to be less pointed and somewhat flattened, and consisting of an external envelope containing a central nucleus; as represented here below:—



We are further informed by experimenters, that the colouring matter of the globule resides principally or entirely in its external covering, the central nucleus itself being without colour; and, also, that it is only the coloured envelope which is soluble in water; the nucleus still retaining its form while floating, and being obtainable in an entire and separate state.

Their magnitude has given rise to as much latitude of opinion as their shape. Dr. Young estimates a globule of human blood at $\frac{1}{3000}$ of an inch in diameter; and we may as well sit down contented with this, as spend our time in searching after other evidence, perhaps, after all, less conclusive.

The colour of the globules is materially affected by atmospheric

Notwithstanding the fluctuating and contradictory accounts of chemical inquirers into the composition of the blood, there appears little reason to doubt the existence of iron in it, and in the red globules in particular the presence of the metal has been proved: through whose metallic agency, we may add, it is, that oxygen produces the remarkable change above alluded to. For the present, let this much suffice. I shall have occasion to amplify much on this part of my subject when I come to speak of respiration.

SERUM.

Is the yellow or straw-coloured fluid which gradually exudes after coagulation from the crassamentum. It has a saline taste, and is adhesive in its nature, on which account it is found somewhat specifically heavier than water.

Superficial observation and analogical inference have given rise to serious error in regard to the proportionate quantities of serum and crassamentum in the blood of the horse. For some hours after a horse's blood is coagulated, it exhibits one uniform gelatinous mass, whose surface is scarcely moistened by serous exudation; whereas that of a man in the same interval of time would discover the clot actually swimming in serum. The truth of the matter, however, is, that so far from there being a comparatively less quantity of serum in horses' blood, there is actually a *larger* proportion; the difference being that it requires *a much longer time* for its evolution in the graminivorous than in the carnivorous animal.

Take a pint of blood from a man, and place it in a temperature of 50°, and in the course of three days it will not only have perfectly resolved itself into its component parts, but will be growing putrid. But draw a pint from a horse, and place it in a medium of the same temperature, and serum will continue to ooze from it even for a week afterwards.

In fact, the two most essential differences between human and horses' blood, are,—1st. That the latter much more slowly resolves itself into its component parts; and, secondly, that it possesses greater preservative powers against putrescency.

Serum itself exposed to the temperature of 160° is converted into a solid, white, opaque mass; also the effect of coagulation. Mineral acids and alcohol will likewise produce this change. It now resembles boiled white of egg; and is found, in fact, to be the same in nature, viz., *albumen.* If this coagulum be cut or squeezed, a limpid fluid issues from it, that has been termed the *serosity.*

"The most important chemical properties of albumen," observes Dr. Bostock, "while in its liquid form, are its solubility in water, and the precipitates which it forms with the mineral acids, tan, and a variety of metallic salts. Of the acids, the muriatic is supposed to combine with it the most readily, and is therefore employed as one of the most delicate tests of its presence in a substance where we expect it to exist. Tan forms with albumen a dense precipitate of tough consistence, and insoluble in water. A variety of the metallic salts precipitate albumen, and, like the acids, serve as very delicate tests of its presence; of these probably the corrosive sublimate, or the bichloride of mercury is the most delicate, and at the same time the most discriminate, as it appears to have no action upon any other of the animal substances which enter into the composition of the albuminous fluids." When coagulated, albumen becomes completely insoluble in water.

The serosity exists in a comparatively very small quantity, and can only be obtained by slicing the albuminous coagulum and allowing it to drain, or else by expression, or by washing in water. It has been particularly examined by Dr. Bostock, and found to contain an animal matter which is not albumen; and whose nature it is difficult to make out, in consequence of its being always found united with soda, and a variety of other salts, from which it cannot be separated, without being, at the same time, decomposed. To this substance Dr. Marcet has applied the name of muco-extractive matter; while Dr. Bostock prefers styling it the uncoagulable matter of the blood.

BUFFY COAT—CUPPED BLOOD.

I make the consideration of these points a distinct one, because I feel desirous to correct what I conceive to be an important error practitioners have fallen into.

Let the crassamentum be examined at the side, and the upper layer of it will be found to be yellow or buff-coloured; below this, it will appear of a light red hue; lower still, darker and darker until it becomes a black or dark purple. This is the natural or healthy aspect of horses' blood: but human blood is said never to put on such an appearance but as symptomatic of inflammatory, or, at all events, of increased vascular action. Whether it does or not, the simple explanation of this phenomenon is, that, in consequence of the blood taking an unusually long time to coagulate, the red particles, being specifically heavier than the fluid containing them, gradually subside to the bottom until they are arrested by the process of coagulation. *And consequently, as the horse's blood takes so much longer to coagulate than the human, it cannot afford any matter for surprise that his blood should be always buffy.* Still, obvious and easily accountable for as this fact is, buffy blood has been attributed to the horse as a *mark of disease.*

And so, in like manner, has *cupped blood;*—by which is meant, crassamentum, whose upper surface, instead of being flat or perfectly plane, is concave or *cupped,* having its surrounding margin elevated and more or less inverted, in the form of a tea-saucer. But this is an appearance often to be met with in perfect health: one that no more certainly indicates any morbid condition with which I am acquainted than does buffy blood. I had a remarkable instance of this while engaged in some experiments connected with this subject. A horse, to every appearance in perfect health, was bled to one pound; after which he was galloped (for the space of about twenty minutes) until he sweated profusely: while under extreme agitation from the exertions he had been put to, another pint of blood was drawn by unpinning the same orifice. The coagulum of the first parcel of blood was sizy, tough, contracted, and deeply cupped: that of the last exhibited no signs whatever of buff, was extremely loose and flabby in its texture; so that, on being handled, it readily mingled with the serum, and in a much shorter time than the first went into the putrefactive state.

This latter fact is intimately connected with what I have already advanced regarding the non-coagulation of the blood after an animal has been coursed to death; since, had exertion been continued until the horse sank under it, the blood would probably have remained wholly fluid; whereas in this case, the animal being only in progress towards that state—being only urged to a point from which he could recover—the coagulating powers of the blood were merely diminished.

I shall conclude this subject with a statement of the results of bleeding twelve horses in perfect health, under circumstances as nearly as possible similar and natural. From each horse the quantity drawn was one pint. The time it took in flowing in no case exceeded a minute. A film of coagulum was generally perceptible on the surface at the expiration of ten minutes. Each parcel was firmly coagulated in twenty-five minutes. All the coagula shewed buff about half an inch in depth; seven of them were very firm, of which five exhibited the surrounding edge elevated and turned in, the other two being still more decidedly cupped. In two out of the five not so firmly congealed, the coagula were soft and flabby. The serum amounted in every parcel to about *one half* of the whole quantity.

OF THE HEART AND PERICARDIUM.

Situation. The heart is inclosed within the pericardium: and both together occupy the middle space of the cavity of the thorax.

PERICARDIUM.

The pericardium is a membrane formed into a conoid sac for the purpose of containing the heart. It has, exteriorly, an opaque white aspect; is dense in its consistence, and firm and tenacious in its texture. It is composed of two layers, intimately united by cellular tissue. The external one is dense and fibrous, is possessed of the chief strength of the membrane, and is attached below by several ligamentary cords to the sternum and tendinous part of the diaphragm, and above to the roots of the large blood-vessels at the base of the heart, upon which we lose sight of it altogether: the sides of it are clothed and additionally strengthened by the adhesions of the pleuræ. The internal layer is fine and cellular, exhibits inwardly a smooth, polished surface, and appears to be similar to other serous membranes in its intimate texture and organization. It not only lines the external layer, and gives a covering to the roots of the large blood-vessels, but is reflected from them upon the heart itself, to which it forms a close and complete tunic: so that the heart is absolutely out of (above) the cavity of the pericardium; in fact, it is situated precisely the same in regard to this membrane as the human head is within a double nightcap.

The liquor pericardii is the pale yellow serous fluid found within the cavity of the pericardium, secreted therein by the exhalents of the membrane. It serves to lubricate the contiguous surfaces of the sac, and to preserve them against any ill consequences from friction.

The use of the pericardium is to confine the heart in its situation, to sustain it in its reciprocal action with the lungs, preventing any undue collision, and to serve as a protecting fence to the organ.

HEART.

Form, Situation, and Attachment. It is of a conoid form. Its base, turned uppermost, is opposed to the bodies of the 4th, 5th, and 6th dorsal vertebræ, from which it is suspended in its situation in the middle of the cavity of the thorax, by the attachments of the venous and arterial trunks immediately connected with it. Its apex hangs loose and unattached within the pericardiac cavity, pointing downwards and backwards, and is inclined to the left side.

The weight of the heart is about six or seven pounds.

Division, external and internal. For the convenience of description, we distinguish in the heart a *base*, a *body*, and an *apex*.

It is also said to have two *sides*, each of which contains two cavities: the two superior cavities (from having been likened to the ears of a dog) have been denominated *auricles;* the two inferior have been named *ventricles.* Their boundaries are marked externally by deep excavations, which are filled with fat; the limits of the ventricles are likewise pointed out by furrows upon the body of the heart, containing fat, continuous in substance with that which is deposited above. This fat is more abundant in old than in young horses.

The heart owes its smooth glossy aspect externally to its thin duplicature of pericardium, which is everywhere in such intimate adhesion with its surface, and so transparent, that its parietes are too plainly demonstrable through it to require that this membrane be stripped off.

The sides of this organ, commonly distinguished by the epithets *right* and *left,* would more properly be described, in allusion to the relative situation of their cavities, as *anterior* and *posterior;* for the right auricle forms the upper and *fore* part, turning its apex to the left side; and the greatest part of the left auricle is apparent *behind,* though its apex is also turned to the left side, and is inclined downward. The ventricles, being situated under their respective auricles, face consequently, like them, forwards and backwards. Though the auricles are essentially the same in structure as the ventricles, they differ from those parts in exterior appearance, in bulk, and in the substance of their parietes; they are of a pale pink colour, are very uneven, when distended, upon their surfaces, and are indented along their inferior borders; whereas the ventricles are of a dull red or deep flesh colour, are smooth and even upon their surfaces, and of themselves compose three fourths of the organ.

THE RIGHT AURICLE, generally found full of blood after death, is lined by a fine, vascular membrane, and presents internally a polished surface, the regularity of which is interrupted in places by many fleshy prominences, named the *musculi pectinati*; between which are numerous little sinuses, or *cul-de-sacs*, that, as well as the fleshy pillars themselves, vary much in size, and are most numerous and remarkable within the *appendix*, or ear-like portion of the auricle, where they form together a reticulated structure. Three venous trunks terminate in this cavity: the vena cava anterior opens into the superior and posterior part of it; the vena cava posterior opens into the inferior and posterior part; and the coronary vein just below it. The vena azygos forms a junction with the anterior cava just as the latter pierces the auricular parietes. Between the openings made by the two venæ cavæ, there is a prominence that is usually called the *tuberculum Loweri*. There is a deep *sac* or *sinus* at the entrance of the posterior cava; and between this and the mouth of the coronary vein, a crescentic *valvular flap*, which projects half way over the mouth of the latter vessel. The right auricle has a free communication with the right ventricle by an aperture of large size, called the *auriculo-ventricular opening*.

One auricle is divided from the other by a muscular partition, denominated the *septum auricularum*; in which may be seen, when the part is held to the light, an elliptical inlet of semi-transparent membrance, crossed in places by fleshy fasciculi, which takes the name of *fossa ovalis*: in some subjects there is a small aperture through it, and this is all that remains of the *foramen ovale*.

The right ventricle is redder and considerably thicker in substance than the right auricle: like it, it commonly contains, after death, a large coagulum of blood. It is likewise lined by a smooth, polished membrane, and has within it numerous *fleshy pillars*, which, instead of being reticulated as those are in the auricle, are disposed longitudinally. In addition to these, there are three conspicuous fleshy prominences, from their size named the *carneæ columnæ*, from which several little tendinous cords, *chordæ tendineæ*, proceed to the edges of three membranous and fibrous productions (sometimes distinguished by the name of *cortina tendinea*) that close the auriculo-ventricular opening: the apparatus altogether forms the *valvula tricuspis*. Other cords, similar to the cordæ tendineæ, but stronger than them, pass between the outer wall and the septum. The pulmonary artery emerges from the upper and back part of this cavity; and its mouth is guarded by three *semilunar valves*, which present little pouches within the cavity of the vessel: these valves consist of doublings of the lining membrane of these parts, infolding, about the middle of their loose edges, three small granular substances, described as the *corpuscula Arantii.* Opposite to the valves, three depressions are apparent in the coats of the vessel, named the *sinus Valsalvæ.*

THE LEFT AURICLE is smaller than the right, and has thicker parietes. It contains, in general, but little blood, and in some subjects none. It presents nearly the same aspect internally as the right. It has not so much of the reticulated structure however—fewer *musculi pectinati;* what there are, are more strongly marked, and are principally confined to the appendix. The *pulmonary veins* terminate by four openings in the superior and posterior part of this cavity. The *auriculo-ventricular opening* is somewhat larger than that of the right side, and is rather square than round. Now that the auricles are both laid open, the *septum auricularum, fossa ovalis,* and *foramen ovale,* may be distinctly viewed.

THE LEFT VENTRICLE, though smaller within, is longer, and moreprominent and extensive without, than the right: it forms, of itself, the *apex cordis.* Its outer wall far exceeds in thickness that of any other cavity of the heart, being thrice that of the right ventricle. Its *musculi pectinati* appear mostly upon the septum, within the apex, and under the valves. It has but *two carneæ columnæ,* but they are very bulky, and project much into the cavity. Its auriculo-ventricular opening is only furnished with *two* valvular productions; in other respects the *cortina tendinea* and *chordæ tendineæ* resemble those on the right side: this valve is called the *valvula bicuspis* vel *mitralis.* The *aorta* takes its rise from the upper and fore part of this ventricle, and, concealed at its origin by the pulmonary artery on one side and venæ cavæ on the other, makes its exit close to the spine. The mouth of the aorta is shut by three *semilunar valves,* similar in formation and disposition to those at the origin of the pulmonary artery: but the *sinus Valsalvæ* are much larger and deeper. Just above two of them are seen the mouths of the *coronary arteries.* The ventricles are divided by a thick, fleshy partition, called the *septum ventriculorum.*

Organization. Though the heart is composed mostly of fleshy fibres, a tendinous structure is demonstrable in its middle, which tendinous intertexture appears to be the common medium of attachment between its auricles, ventricles, vessels, and valves, one to another. The fleshy fibres composing the parietes of the auricles, stronger in the left than in the right, are disposed in every direction; those that form the walls of the ventricles, for the most part, appear to run longitudinally and obliquely, and many of them in a spiral manner. These fibres are more slender than those of other muscles, and are more intimately and firmly compacted; the cellular tissue also, uniting them, is finer, denser, and less in quantity.

The heart is supplied with blood by the two coronary arteries; the first branches given off from the aorta. Its veins pour their blood into the coronary vein, by which it is returned into the right auricle. Its nerves are derived from the cardiac plexus.

OF THE BLOOD-VESSELS.

THERE are two orders of blood-vessels—*arteries* and *veins*: the former conduct the blood from the heart to all parts of the body; the latter return it therefrom back to the heart.

ARTERIES.

These vessels, in all their manifold ramifications, spring originally from two main trunks—the *pulmonary artery* and the *aorta*: the former sends its branches to the lungs; the latter to all the other parts of the body.

PULMONARY ARTERY.

A vessel of larger calibre than the aorta. It takes its origin from the postero-superior part of the right ventricle of the heart, winds upwards to the root of the left lung, and there divides into *right* and *left* pulmonary arteries; which divisions immediately enter the substance of their correspondent lungs, and therein ramify to capillary minuteness, the branches regulating their course and division by the ramifications of the bronchial tubes.

AORTA.

This trunk, together with its manifold branches, may be compared (viewing them altogether) to a short, but straggling and very branchy shrub or dwarf tree of luxuriant but extremely irregular growth; and their number and ramification may be pictured to the mind, by remembering that no organized part of the body is without few or many of them.

TABLE OF THE ARTERIES.

AORTA
- Anterior Aorta
- Posterior Aorta

Anterior Aorta
- Right Arteria Innominata
- Left ditto

LEFT ARTERIA INNOMINATA
- Dorsal
- Posterior Cervical
- Vertebral, *forming* the Basilar
  - Post. Cerebellal
  - Ant. Cerebellal
  - Post. Cerebral
  - Circular Arteriosus
- Internal Pectoral
- External Pectoral
- Inferior Cervical
- Axillary

Axillary
- External Thoracic
- Internal Thoracic
- Dorsalis Scapulæ
- Subscapular
- Humeral

Humeral
- Ulnar
- Spiral
- Radial
  - Small Metacarpal
  - Large ditto

Large Metacarpal
- External Plantar
- Internal ditto

Plantar
- Perpendicular
- Transverse
- Artery of the Frog
- Lateral Laminal
- Circular Arteriosus
  - Ant. Laminal
  - Inf. Communicating
  - Circumflex . . . . Solar.

The Right Arteria Innominata sends off branches correspondent to those on the left side; and, in addition, the

Common Carotid
- Right Carotid
- Left ditto
  - External Carotid
  - Ramus Anastomoticus
  - Internal Carotid

External Carotid
- Submaxillary . . .
  - Ascending Pharyngeal
  - Pterygoid
  - Lingual . . . . .
    - Ranine
    - Sublingual
  - Inferior Labial .
    - Buccinator
    - Angular Oral
  - Facial . . . . . .
    - Masseter
    - Buccal
    - Sup. Labial
    - False Nasal
- Parotideal
- Int. Pterygoid
- Post. Masseter
- Post. Auricular
- Temporal
- Ant. Auricular
- Int. Maxillary . .
  - Deep Temporal
  - Palatine
  - Inferior Maxillary
  - Supra-Orbitar
  - Ocular
  - Infra-Orbitar
  - Palato Maxillary

- Ramus Anastomoticus
  - Occipital
    - Dura Matral
    - Temporal
    - Nuchal
- Internal Carotid
  - Arteria Communicans
  - Anterior Dura Matral
  - Anterior Cerebral . . .
    - Ophthalmic
  - Middle Cerebral
  - Lateral Cerebral.

- POSTERIOR AORTA
  - Thoracic Division
  - Abdominal ditto
- Thoracic Division
  - Bronchial
    - Right Bronchial
    - Left ditto
  - Œsophageal
    - Superior Œsophageal
    - Inferior ditto
  - Intercostals
  - Phrenic
- Abdominal Division
  - Cæliac
    - Splenic
      - Pancreatic Branches
      - Splenic ditto
      - Left Gastric
    - Gastric
      - Superior Gastric
      - Inferior ditto
    - Hepatic
      - Pancreatic Branches
      - Duodenal
      - Right Gastric
      - Right and Left Hepatic
  - Ant. Mesenteric . . .
    - Duodenal Branches
    - Small Mesenteric
    - Cœcal Branches
    - Ant. Colic ditto
  - Renal . . . .
    - Right Renal
    - Left ditto
      - External Branches
      - Capsular Renal
  - Spermatic
    - Right and Left
  - Post. Mesenteric
    - Post. Colic
    - Rectal
  - Lumbars—Five or Six Pairs

Bifurcation of the Posterior Aorta into External and Internal Iliac Arteries.

- Internal Iliac
  - Artery of the Bulb
    - Umbilical
    - Vesical Branches
    - Prostatic
    - Anal and Perineal Branches
  - Obturator
    - Arteria Innominata
    - Foraminal Branches
    - Ischiatic
    - Pubic
    - Int. Pudic
      - Branches to the Crus Penis
      - Ditto Corpus Cavernosum
      - Ditto Dorsum Penis
      - Ditto Glans Penis
      - Cutaneous Branches.

The Middle Sacral issues at the Bifurcation of the Trunk.

- External Iliac
  - Circumflex *of the Ileum*
  - Artery of the Chord
  - Arteria Profunda < Epigastric
    - Branch to the Groin
    - Branch to the Ring
    - Ext. Pudic
  - Femoral
- Femoral
  - Inguinal
  - Muscular Branches
  - Stifle ditto
  - Muscular ditto
  - Popliteal < Recurrent
  - Anterior Tibial . .
    - Recurrent Articular
    - Muscular Branches
    - Cutaneous ditto
    - Metatarsal Branches
    - Metatarsal Artery
      - Recurrent
      - Ext. Plantar
      - Int. ditto
  - Posterior Tibia . .
    - Muscular Branches
    - Medullary
    - Tarsal
    - Int. Metatarsal < Recurrent.

THE AORTA, the main trunk of the *general* arterial system, takes its origin out of the base of the left ventricle of the heart, and mounts upward between the left auricle and the pulmonary artery; the latter vessel by inclining forward leaving visible, on a side view, a small angular portion of the aorta. The length of the single trunk measures about two inches. It is situated directly underneath the fourth dorsal vertebra, where its bifurcation takes place into *anterior* and *posterior aortæ;* vessels that are both of them curved in their course, but of unequal dimensions.

THE CORONARY ARTERIES are the only branches given off from the single trunk: they arise close to its root, immediately above the semilunar valves. *The right coronary artery* emerges from the interspace between the pulmonary artery and the right auricle, winds round the fissure separating that cavity from the right ventricle, and turns down under the termination of the vena cava, within the furrow dividing the ventricles, upon the side of the heart, distributing lateral ramifications in its course, which penetrate the substance of the parietes, and ending in small spiral branches near the apex cordis. *The left coronary artery,* in passing out between the pulmonary artery and left auricle, sends off a large branch which encircles the other auriculo-ventricular fissure; it then takes its course downward within the ventricular furrow upon the left surface of the heart, distributing lateral branches which supply the parietes forming this side, and ending in spiral ramifications which extend quite around the apex cordis, and anastomose with those upon the opposite side.

Anterior Aorta.

The anterior, smaller, and shorter division of the main trunk, whose length falls somewhat short of an inch, in ascending, bends forward, and divides below the body of the third dorsal vertebra into the right and left arteriæ innominatæ vel communes. The course of this vessel is below the windpipe and rather to the left of it, within the space of the mediastinum. The trunk itself furnishes no branches; but its bifurcations give origin to those large arteries which are distributed over the breast, neck, head, brain, and anterior extremities.

Arteriæ Innominatæ vel *Communes.*

The right artery is considerably longer than the left, and measures nearly as much again in circumference, in consequence of its having to form the *common carotid artery* (the trunk from which the two carotids spring) after it has detached branches to the right side correspondent in size, number, and distribution to those into which the left division resolves itself. These vessels form a very acute angle as they leave the anterior aorta, and pursue their course horizontally forward, diverging very gradually as they advance: the *right* is placed lower than the left, and lies more immediately under the windpipe, having the vena cava anterior upon the other side of it; the left describes a curve upward in passing forward, inclines outward, and gets under the œsophagus: both branch out about the middle of the space between the first two ribs, where the right ends in the two carotid arteries, the left in the vessels now to be described, which, as was observed before, are nearly the same on one side as on the other.

1. THE DORSAL ARTERY generally comes off in one common root with the next vessel. From its origin, it curves upward and backward to arrive at the second intercostal space, which it perforates very obliquely close to the posterior edge of the first rib, a little below its head. Out of the chest, it still pursues the same oblique course, crossing over the transverse process of the second dorsal vertebra, and then ascending upon the spines of the withers, among the muscles attached to which its ramifications are expended. Its branches worthy of names are—*a. Superior Mediastinal,* a twig detached near its origin to the mediastinum. *b. Anterior intercostal,* a branch sometimes nearly equal in size to the dorsal itself, given off just before the vessel penetrates the intercostal muscle, by which the second, third, fourth, and fifth intercostal arteries are furnished; the reason for which is, that the posterior aorta (the vessel furnishing the majo-

rity of the intercostals) is too far removed from these anterior ribs to send vessels to them; their deficiency therefore becomes conveniently supplied by the anterior intercostal. These intercostal branches follow the posterior margins of their correspondent ribs, each running within a shallow groove; midway, however, between the vertebræ and sternum, they leave the ribs for the middle of the intercostal spaces, and end in several slender ramifications, some of which may be traced as low as the sternum, there anastomosing with similar ones coming from the internal pectoral artery. The intercostals in their course detach twigs to the pleura, but more especially supply the intercostal muscles.

2. THE POSTERIOR CERVICAL ARTERY, arising in common with the dorsal on the right side, but by a separate root on the left, takes an opposite direction to that vessel, inclining forward and upward. It traverses the upper part of the first intercostal space, piercing the muscle filling it with considerable obliquity, and then ascends in a winding course between the transverse processes of the first dorsal and last cervical vertebræ, upon the body of the latter, where it turns forward, and runs as high as the vertebra dentata, close alongside of the roots of the ligamentum nuchæ, concealed by the complexus major, to which its ramifications are principally distributed. Besides some small and unimportant branches within the chest, it gives off *the first intercostal artery*, which descends behind the first rib, and anastomoses with twigs from the internal pectoral.

3. THE VERTEBRAL ARTERY is a vessel of considerable size, and is vastly important, from being one of the principal conduits of blood to the brain. It arises with a sort of bend from the upper part of the arteria innominata, directly opposite to the first rib, in such manner, that, if a knife were thrust into the chest behind the rib, the artery would just escape puncture. The right vertebral is at its origin placed lower than the left, and deviates somewhat less from a straight line in proceeding, which it does, close under the transverse process of the seventh cervical vertebra to enter the foramen through that of the sixth. They then both of them continue their passage to the head, passing directly through the foramina of the fourth, third, and second vertebræ, wherein they run securely barred from external injury; arriving at the atlas, they make a curve upward upon its transverse processes, proceed through the posterior pair of foramina, and enter the foramen magnum. In its course along the neck, the vertebral artery on either side detaches several short branches of considerable size, which turn round the transverse processes, and ramify among the deep-seated muscles. It also sends some smaller ones inward, which enter the intervertebral holes for the supply of the medulla

spinatis and its membranes. Under the atlas, the vertebral trunk receives a large vessel of communication from the internal carotid: its further description, however, must be suspended until we come to trace the vessels of the brain.

4. THE INTERNAL PECTORAL ARTERY, less in volume than the vertebral, leaves the trunk below, opposite to the origin of that vessel above, protected by the first rib, along the posterior and inner margin of which it descends in a perpendicular direction towards the sternum. Leaving the lower extremity of the rib, it makes a broad sweep downward and backward, and descends upon the internal surface of the second bone of the sternum: it afterwards diverges gradually from its fellow, traverses the ends of the cartilages of the posterior true ribs, and, having crossed that of the last, splits into two divisions. One of these ascends upon the internal part of the chest, along the border of the seventh true cartilage; thence it crosses the false cartilages, detaching slender ramifications to them which anastomose with some of the posterior intercostals, and makes its way towards the flank, and disperses its ultimate branches among the muscles there, some of which reach far enough to communicate with the ramifications of the circumflex artery of the ileum. The other division (generally considered as the continuation of the trunk, being rather the larger one) pierces the sheath of the rectus, and makes its appearance upon the upper surface of that muscle, over which it ramifies extensively, sending branches out again to anastomose with the epigastric. Exclusively of these divisions, the trunk detaches *muscular branches* along the first rib, inwardly *anterior mediastinal vessels, larger branches* to the muscles of the sternum, and *inferior mediastinal;* and also *thymic twigs.*

5. THE EXTERNAL PECTORAL ARTERY, comparatively small and unimportant, comes off also from the under part of the trunk, makes a turn downward in front of the sternum, and distributes its ramifications among the pectoral muscles. This artery in some subjects is derived from the internal pectoral.

6. THE INFERIOR CERVICAL ARTERY, longer and larger than the afore-described vessel, arises from the common trunk opposite to or in company with it, and makes its exit from the chest below the vertebral artery, and then bends outward. At the bottom of the neck it divides into several branches: these run principally to the contiguous muscles, though some few ramify with the adipose substance in the neighbourhood, and others are destined to the absorbent glands hereabouts.

7. The seventh and last branch, and largest (if we except the carotids on the right side, and the continuation of the main trunk on the left), is the—

Axillary Artery,

The source from which is derived all THE ARTERIES SUPPLYING THE FORE EXTREMITY. This vessel is so buried between the scapula and the trunk, that not only is it out of the way of all injury, but is excluded from all possibility of being got at for the purpose of demonstration without detaching the limb from the side. It arises within the chest from the arteria innominata, and gains exit by making a sudden turn around the first rib, rather below its middle, crossing the lower border of the scalenus in the turn: it is first directed outward in this flexure, and then backward, and at length reaches the inner part of the head of the humerus, where it makes another turn backward, and subsequently takes the name of *humeral artery.* Its branches are—1. *The external thoracic* extends backwards across the arches of the ribs, taking the same course as the vessel called the "spur vein," and supplying the muscles thereabouts. 2. *The humeral thoracic* runs to the point of the shoulder, and gives its branches to the levator humeri and shoulder-joint. 3. *The dorsalis scapulæ* ascends in a flexuous manner obliquely upon the shoulder-joint, crossing the insertion of the subscapularis; it next runs for a short way along the anterior costa, around which it subsequently continues to reach the antea-spinatus. 4. *The subscapularis,* a large artery arising from the upper part of the trunk, but near to its termination, creeps upward along the posterior costa, screened from view by the edges of the subscapularis and teres major, to both of which muscles it detaches laterally several small branches, and ends near the posterior angle of the bone. It gives off a considerable branch at a short distance from its origin, which proceeds in a waving line across the inner surface of the triceps, and ends in the panniculus carnosus; and another, a deep-seated one, about the middle of the costa, which is principally expended in the head of the triceps.

THE HUMERAL ARTERY descends from the inner and back part of the head of the os humeri in an oblique direction to the inferior and anterior part of the body of the bone, where it splits into the *ulnar, spiral,* and *radial arteries.* To its inner side run the spiral and ulnar nerves; in front, the radial nerve; and behind, the humeral veins: and it is covered internally by the pectoralis magnus, to which it sends some small branches. But its principal branches are—1. One near its origin, which crosses the bone to get to the flexor brachii, and sends twigs to the shoulder-joint. 2. A posterior branch, arising a little lower down, which bifurcates and then enters the triceps. 3. Near its termination, another anterior branch passes to the flexor brachii. In the place where the artery divides, it is covered by the humeral plexus of veins, and by the absorbent glands of the arm.

THE ULNAR ARTERY consists of a common root from [illegible]ual [illegible]ed spring three or four vessels of considerable size running in wav[illegible] lines upon the inner surface of the lower end of the humerus. The upper one, commonly the largest, is directed to the ulna; splitting, however, before it reaches the bone, and sending one branch upward upon the olecranon, and another downward to the heads of the flexors, to which muscles the other branches of this vessel are exclusively distributed.

THE SPIRAL ARTERY, the outermost division, turns round the os humeri, and passes under the flexor brachii, sending a recurrent branch to it, to arrive at the front of the head of the radius, where it splits into several branches, of which—1. Some run into the elbow-joint. 2. Others, larger and more in number, penetrate the heads of the extensors. 3. Two long slender ones descend upon the radius, under the extensor muscles, to which they give branches in their course, as low as the front of the knee, and there end in ramifications about and into the joint, anastomosing with others coming from the radial.

THE RADIAL ARTERY, the principal division of the humeral, continues its descent along the radius, inclining as it descends from the inner to the back part of that bone; so that if it were purposed to cut down upon it about the middle of the arm, the incision should correspond in a line with the inner edge of the radius, from which, to expose the vessel, the faschia must be first detached, and afterwards the flexor metacarpi internus. The radial nerve, which in this place accompanies it, runs upon its outer side, but subsequently gets behind it. A short way above the knee, it splits into the *metacarpal arteries*. It gives off—1. Small vessels to the elbow-joint. 2. Various branches to the flexor muscles during its course. 3. The medullary artery of the radius, at about one fourth of the length of the bone downward.

THE SMALL METACARPAL ARTERY descends, within a cellular sheath, along the inner and back part of the knee, more outwardly situated than the large one, from which it is separated by the posterior annular ligament. It continues its descent along with the metacarpal vein (which runs to its inner side) until it arrives below the knee, where it bifurcates and transmits its divisions down upon the front of the suspensory ligament—between it and the cannon-bone. It sends off—1. Cutaneous branches over the front of the knee, which anastomose with the spiral. 2. Ramifications to the front of the cannon. 3. To the suspensory ligament.

THE LARGE METACARPAL ARTERY, which may be regarded as the continuation of the radial trunk, continues its course down the leg by the side of the tendo perforatus, passing along with it the knee under the posterior annular ligament, but inclosed within a cellular sheath of its own. As it proceeds, it inclines to the side of the tendo perforans, and, in approaching the fetlock, gets in advance of that tendon. Immediately above the joint, where it is situated between the tendo perforans and the suspensory ligament, it splits into three vessels. The middle division slides into the interval between the bifurcated terminations of the ligament, and between them and the bone forms a transverse arch, from which three recurrent arteries retrace in a flexuous line the suspensory ligament, and form communications with the small metacarpal artery: the lateral divisions become *the plantar arteries.* From the arch, below, come off two lateral branches which descend into the joint.

THE PLANTAR ARTERIES, one *external,* one *internal,* in the fore extremity result from the bifurcation of the metacarpal, in the hind from that of the metatarsal artery: I prefer this appellation for them, because it denotes their destination at once, and because it saves us the useless division of a trunk only six inches in length into *three* nominal arteries; and because our descriptions and memories are not clogged by it as they are by the "large pastern," and the "small pastern," and the "coffin arteries." Their general distribution is the same both in the fore and hind feet.

The plantar arteries, in emerging from their common origin behind the flexor tendons, describe two sides of the figure of a triangle, the base of which, turned downward, is represented by a line drawn across the backs of the sesamoid bones, the apex being the point of bifurcation. They descend the fetlock upon the outer sides of the sesamoids, in company with their correspondent veins which run in front of them, and with the plantar nerves which proceed behind them; in this part of their course, they describe correlative curves outward, to conform to the prominences of the fetlock, and henceforward continue to pursue precisely the same uniformity both in course and distribution, so that we need only in the progress of our description make mention of one. In its passage over the sesamoid, the outer edge of that bone is found to rise between the vessel and the flexor tendon; but in quitting the fetlock, the artery again approaches the tendo perforatus, and subsequently runs alongside of it to its implantation in the head of the os coronæ, at which place the artery sinks down behind the cartilage into the substance of what is called the "fatty frog." Inclining forward in its subsequent descent, the artery next passes the inner and upper extremity of the ala of the os pedis, where it enters a groove scooped in that bone, and is conducted obliquely forward and inward, into the foramen in the posterior concavity of the bone. Here we lose sight of it altogether—the knife and forceps no longer avail us to discover its progress and destination: either the bone must be chiselled away, or (the vessels being previously injected) be eroded by maceration in an acid. We shall then detect the artery in the interior of the coffin-bone, making a turn outward again, and subsequently another inward, in the course of which, meeting with its fellow, the two trunks coalesce, and in so doing form an arterial semicircle corresponding to the circumferent line of the edge of the os pedis, which has been very properly named by the Professor, *the circulus arteriosus.** The plantar vessels and nerves are invested in the course of their descent to the foot by cellular substance, which binds them *loosely* to the parts contiguous, whereto they pass. This accounts for their canals being flexuous when distended with injection, or when the foot is flexed upon the fetlock; a circumstance that seems to have escaped the notice of writers on the foot. The branches of the plantar artery are many and important. After detaching some small ramifications inwardly to the fetlock, posteriorly to the flexor tendons, which anastomose with their fellows, and anteriorly to the extensor tendon, which are also anastomotic, it sends off—

1. THE PERPENDICULAR ARTERY, a little above the middle of the os suffraginis: a slender branch that descends upon the side of the bone, inclining forward, and ends in the space above the coronary ligament in anastomosis with its fellow, forming an arch, presenting its convexity downward, called *the superficial coronary,* from which emanate about eighteen small *descending arteries* that run down over the coronary plexus of veins, whose principal function, it is said, is "to secrete the crust." I would beg to remark here, however, that, although I believe what I give to be the *ordinary* arrangement of these arteries, there is so much variation to be found in different subjects, that I cannot vouch for the unexceptionable correctness of this description, however I may stand amenable for its general accuracy. The plantar trunk having detached various small unimportant branches backward, the great design of which appears to have been to preserve free and uninterrupted intercourse with the opposite trunk, it next sends off, below the pastern-joint,

2. THE TRANSVERSE ARTERY, which proceeds directly across the front of the os coronæ, underneath the extensor tendon, to join its fellow branch from the other side, the two together forming the *superior coronary circle:* this pours most of its blood through two short lateral conduits, *the communicating arteries,*

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* Professor Coleman, 'On the Foot of the Horse,' vol. ii.

into the inferior coronary artery; though other short twigs are sent both upward and downward from it.

The above two, just described, may be considered as *the anterior branches* of importance: we now proceed to those arising *posteriorly*: the first we need notice particularly is—

3. The artery of the frog. It comes off opposite to the pastern-joint, and descends obliquely inward through the substance of the fatty frog, wherein it bifurcates: both divisions take nearly the same direction, one passing down upon the side of the cleft along which it continues, distributing branches in its course to the toe of the frog, and forming communications with the vessels of the sole; the other ramifies over the heel of the frog, and sends branches outward to the cartilages.

4. The lateral laminal artery leaves the trunk just as the latter reaches the os pedis, passes through the foramen in the ala, and proceeds within a superficial groove to the front of the foot, distributing branches upward and downward to the laminæ, and disappearing through a small foramen in the anterior and lateral part of the coffin, whose substance it enters in order to form a communication with the circulus arteriosus. From this vessel a branch descends upon the side of the bone to join the circumflex artery.

5. The circulus arteriosus, resulting from the coalition of the main trunks, preserves, to a certain extent around the toe of the coffin, the same curve *interiorly* that is made by the *exterior* edge of the bone itself, at the distance of about an inch above it. From the circulus arise two principal sets of vessels.

1. The anterior laminal arteries, numerous, small, short branches springing from the front of the circulus, and making their exit through the various foramina in the front and sides of the coffin, to ramify among the laminæ, and anastomose with the descending and lateral coffin arteries.

2. The inferior communicating arteries, "thirteen, and sometimes fourteen," in number, according to the Professor, arise from the convexity of the circulus arteriosus, and descend through the foramina in front of the coffin, a little above its boundary edge: having made their exit, they continue the same direction to gain the extreme edge, around which they are all received by the

3. Circumflex artery, which is commonly described as encircling "the toe" of the coffin-bone. Then again, from this vessel spring

The solar arteries (which may be so named, as well from their radiated arrangement, as from their destination), thirteen or fourteen in number, though they run from the same channel, do not "take their origin *immediately opposite* the termination of the vessels into the circulus arteriosus." They are destined for the supply of the sole, upon which they run in radii, at pretty equal distances, whose common centre is the toe of the frog, where they end in communications with the arteries belonging to that body.

The Carotid Arteries.

The right arteria innominata (having detached seven branches which differ but unimportantly in their mode of origin, and not at all in their general course and distribution, from the seven arteries into which the left division resolves itself) becomes the *common carotid:* a vessel of large caliber, about an inch in length, emerging through the upper part of the anterior opening of the chest, having the trachea between it and the spine, above; the vena cava anterior, below it; and dividing, as it quits the cavity, into the *right* and *left carotids.* These arteries bend upward from their origin, diverging as they ascend along the neck so as to leave a space between them for the windpipe, which they closely embrace and cling to for the first part of their course: towards the middle of the neck, however, we find them gradually inclining, as they ascend, to the posterior and lateral borders of that tube, a line of direction they preserve during the remainder of their course.* Having reached the top of the larynx, the carotid of either side splits into three divisions—the *external* and *internal carotids,* and the *ramus anastomoticus:* at which place, though the trunk itself is found deeply lodged in soft parts, yet its situation is well indicated by the larynx (with which it is in contact) below; the transverse process of the atlas, above; the angle of the jaw a little in advance of it; and the coronoid process farther removed above and before it. A deep incision corresponding to the posterior border of the stylo-maxillaris, would sever the vessel at or very close to its division. The carotid detaches—1. Several unimportant *muscular branches* in its progress up the neck. 2. *The thyroideal artery,* coming off opposite to the top ring of the trachea: a branch of no mean size, which turns round the windpipe and enters the substance of the thyroid gland. In its way, the thyroideal furnishes the *laryngeal,* a small artery that perforates the ligament uniting the cricoid and thyroid cartilages, and is dispersed upon the membrane lining the larynx: in some instances, however, this forms a branch of the main trunk. The common division of the carotid is into the three vessels just named; but not infrequently we meet with a fourth coming from the point of ramification, the additional one being the facial artery; and, occasionally, we only find a simple bifurcation of the vessel into the external and internal carotids.

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* The carotids lie more deeply the higher they proceed up the neck: each is covered by the sterno-maxillaris; and the readiest way to find the vessel is to make a cut along the upper border of this muscle, and depress it with the finger or handle of the knife. The artery is separated; except at the bottom of the neck, from the jugular vein by a thin partition of muscular fibres; the par vagum accompanies it outwardly, and the sympathetic nerve runs between the two.

The External Carotid Artery

Is the large division, the one that looks like the continuation of the trunk of the common carotid itself. It takes a flexuous course: first it curves downward behind the angle of the jaw, where it crosses the insertion of the stylo-maxillaris, by which it seems defended from injury; next it makes a curve upward and forward, crosses the membranous sac of the fauces, and passes between the stylo-maxillaris and cornu of the os hyoides, deeply buried under the parotid gland; lastly, it makes a third curve, directing it forward along the posterior border of the branch of the jaw, and to that it subsequently corresponds in its course until it bifurcates, which it does immediately behind the neck of the condyle. This vessel is so bedded in glandular substance, surrounded by venous and nervous trunks, and protected by neighbouring bony prominences and muscles, that but a small, and that the upper, portion of it is safely accessible to the knife: rather more than an inch below and behind the condyle, it is comparatively superficially lodged, being there only covered by the anterior thin border of the parotid and a thick aponeurosis, in addition to the common integuments. We reckon eight branches from it.

1. SUBMAXILLARY ARTERY: it comes off behind the cornu of the os hyoides, just as the vessel is going to make its second curve, and ranks next in size to the carotid itself. It takes an oblique course downward and forward within the submaxillary space, preserving at first the line of the cornu; afterwards it crosses the lower portion of the pterygoideus, and reaches the posterior border of the branch of the jaw (about one third of its length downward), round which it turns to mount upon the face: in making this turn it becomes subcutaneous, distinctly perceptible to the feel, and (from being in contact with the bone) very conveniently compressible, on which account, it is the vessel ordinarily selected to convey a knowledge of the state of the pulse. In ascending upon the face, it corresponds to the anterior border of the masseter; but before it reaches the alveolar processes it ends, by a pretty equal division, in the *facial* and *inferior labial*

arteries. Its branches are—*a. The ascending pharyngeal,* which mounts obliquely over the cornu of the os hyoides, and ramifies upon the side of the pharynx, giving off commonly a laryngeal twig or two in its way, and another to the velum, which in some instances is derived from the submaxillary itself. *b.* Various inconsiderable branches to the pterygoid muscle and parotid gland. *c. The lingual,* nearly or quite equal in magnitude to the submaxillary itself. It first bends its course obliquely inward, detaching a few twigs into the submaxillary space; it then splits into two arteries, the *ranine* and the *sublingual.* The ranine, the larger one, the apparent continuation of the lingual, turns downward and proceeds in a flexuous manner along the under part of the tongue, serpentining between the muscles, and transmitting many branches into the interior: it continues of large size even to the tip of the organ, wherein its extreme ramifications are expended. Its ramifications, I believe, have no anastomosis in ordinary cases with those of its fellow on the other side; though I have a head now before me in which I find the two ranine arteries communicating by a large cross branch at the root of the tongue. *The sublingual branch* winds along the under and outer border of the tongue, preserving a more superficial course than the former. It supplies the sublingual gland, and distributes its longer ramifications over the membrane and papillæ of the tongue. *d. The submental artery* leaves the submaxillary contiguously to the internal side of the jaw, a little before the latter vessel begins to make its turn. It follows the course of the branch of the jaw, nearly preserving the line of its middle, detaching twigs principally to the pterygoideus and mylo-hyoideus, and transmitting its furthest ramifications into the substance of the gums internally. *e. Anterior masseter branches,* one large, or two or three small vessels, coming off in the course of the ascent of the trunk upon the face.

f. THE INFERIOR LABIAL ARTERY courses the side of the jaw, occupying nearly the same site externally to what the submental does internally, invested in the cellular and fleshy substance belonging to the retractor labii. It is principally destined for the supply of the glandular substance of the under lip, wherein it anastomoses with its fellow vessel. It gives off—*a. Slender ramifications* to the investing cellular substance. *b. Buccinator arteries. c.* A large branch to the angle of the mouth, which distributes *buccal twigs* in its course, and then bifurcates, sending its divisions respectively to the upper and under lips, along their lateral borders: these form the *superior* and *inferior coronary arteries of the lips.*

FACIAL ARTERY ascends upon the side of the face, with an inclination forward and downward, crossing the buccinator muscle a little in advance of the anterior border of the masseter. Having run as high as the level of the bony ridge from which the masseter arises, it detaches a large branch, and then winds upward and spreads into an arborescent expansion upon the upper and fore part of the face. *a.* It mostly sends one or two *masseter branches* backward. *b. Buccal twigs* from both sides. *c. The superior labial,* the branch whose origin has just been shown, takes its course below the false nostril, to which it sends ramifications, to the upper lip, wherein it anastomoses with the terminating branches of the palatine arteries and also with its fellow. *d.* Long slender branches, commonly two, to the false nostrils. *e.* Terminating ramifications to the cellular substance and skin covering the fore part of the face, which anastomose with others making their exit from the infraorbitar foramen, and also with some straggling twigs escaping from the cavity of the orbit.

2. THE PAROTIDEAL BRANCHES are those we may consider next to the submaxillary branch of the external carotid. They are too variable in number, size, and mode of origin to admit of special description: they come off as the vessel continues its course under the gland.

3. A large branch, internally, to the pterygoideus.

4. One much longer, externally, *the posterior masseter artery.*

5. THE POSTERIOR AURICULAR commonly comes off from the external carotid immediately opposite to the last-mentioned branch. It emerges from underneath the parotid gland, and ascends in a direct line to the back of the concha of the ear, where it splits into three divisions, which thence proceed along its dorsum to its tip, distributing branches right and left; and these anastomose freely with one another, and likewise with the other auricular arteries, and thereby form a beautiful vascular net-work. It also gives branches to the parotid gland, to the muscles of the concha, the meatus auditorius externus, and membrana tympani.

6. THE TEMPORAL ARTERY, *the anterior auricular,* and *the internal maxillary,* may be considered as the terminating branches of the external carotid. The temporal leaves the trunk just as it is issuing from the depth of the parotid gland, and then curves upward and forward around the neck of the jaw, a little below the condyle, which serves as a guide to cut down upon it; from this, it runs in a straight line towards the outer circumference of the orbit, opposite to which margin it dips into the substance of the masseter, and so eludes further trace without the aid of dissection. We find it henceforward corresponding in course to the line of the maxillary ridge, sending branches down into the

muscle, and freely anastomosing with the anterior and internal masseter arteries.

7. THE ANTERIOR AURICULAR ARTERY, arising in common with the former, inclines in an opposite direction, upward and backward, and is deeply seated at first under the parotid gland. It ascends to the fore part of the root of the ear, and ends in short ramifications to the anterior muscles of the concha, and in other superficial ones which anastomose with the anterior auricular arteries. It sends off—*a.* Branches to the temporal muscle. *b. An internal auricular branch,* which enters the concha. *c. A subcutaneous branch,* which descends upon the forehead and anastomoses with the supra-orbitar arteries.

8. THE INTERNAL MAXILLARY ARTERY originates deeply buried on the inner side of the articulation of the jaw, a little below the condyle, between the neck of the inferior maxilla and the upper portion of the cornu of the os hyoides. It pursues a winding course, first bending inward then downward, to the bottom of the orbit, where it splits into four arteries. In its way to the orbit, it gives off—*a. Deep temporal branches:* several small arteries, variable in number, some of which run into the pterygoid muscle, while others, longer ones, ascend in the space behind the orbit, ramifying within the adipose matter there, and penetrating the lower portion of the temporal muscle.

b. Long slender twigs to the soft palate, to the ear, and to the articulation of the jaw.

c. The inferior maxillary, a small artery of considerable length, which creeps down the branch of the jaw, crossing the pterygoid muscle, to enter the foramen maxillare superius in company with the nerve of the same name; within which canal it distributes branches to the roots of the molar teeth and to the diploe, and afterwards makes its exit, greatly diminished in size, through the foramen maxillare inferius, upon the side of the mouth, where it becomes lost in anastomosis with the inferior labial artery: in some instances, the latter artery sends a twig into this hole in place of one coming out. The vessels in which the internal maxillary terminates are—

d. The supra-orbitar artery, which traverses the upper and inner part of the roof of the orbit, and leaves the cavity through the foramen supra-orbitarium, and is lost in slender ramifications in the cellular membrane upon the forehead, anastomosing with the temporal branches of the anterior auricular and the ascending deep temporal arteries.

e. The ocular, under which name are included a bunch of arteries arising from the bottom of the orbit, distributed to the fatty matter thereabouts, to the muscles of the globe, and to the lachrymal gland, eyelids, and ductus ad nasum. One in particular, larger than the others, named the *lateral nasal branch*, enters the cavity of the cranium through the foramen orbitale internum, and after forming a communication there with the anterior cerebral artery, turns round and enters the nose through the ethmoidal cells to be dispersed upon the Schneiderian membrane.

f. The infra-orbitar, a considerable branch entering the infra-orbitar canal, in order to supply the anterior molar teeth and medullary substance of the bone with blood: having served this purpose, it sends its remaining twigs out upon the cheek, through the maxillary hole there, whereupon they anastomose with the ramifications of the facial artery.

g. The palato-maxillary, the largest of the terminating divisions of the inferior maxillary artery, enters the foramen palatinum superius, descends through the palatine canal, reappears upon the roof of the palate, and follows the tract of the palatine groove, some short distance removed from the sides of the molar teeth, out of which, inferiorly, it makes a curve inward, just above the roots of the front teeth, to take its passage through the foramen incisivum, to reach the front of the jaw, there to join its fellow. From this remarkable arterial union issue several branches, some of which run down to supply the glandular structure of the upper lip, while others are directed upwards upon the external nares: the deeper-seated ones penetrate the dilatator narium and depressor labii superioris; and many of them anastomose with the terminating ramifications of the superior labial artery. This vessel gives off some few branches to parts at the back of the orbit, before it enters the foramen; and other short twigs, as it courses the palate.—Sportsmen and farriers have a practice of cutting through the bars and severing the palato-maxillary, in order to detract blood on any occasion of emergency: the artery, however, seldom bleeds much—it soon retracts into its cellular case, and forms a coagulum; and this renders the operation, in a general way, both ineffectual and harmless.

The second and smallest *division of the* CAROTID, is the

Ramus Anastomoticus.

It leaves the trunk of the carotid, commonly at the angle formed by the external and internal carotids, crossing the latter in proceeding to the spine. Deeply seated beneath the parotid gland, in its course it describes an arc backward, which, in the ordinary position of the head, nearly corresponds to the under border of the stylo-maxillaris. From below the coronoid process, it turns under the transverse process of the atlas, where it joins the vertebral artery, as soon as the latter has emerged from the foramen in that bone. From about the middle of the arch comes off.

The occipital artery, a vessel nearly equal in magnitude to the trunk itself, which pursues a flexuous course to the occiput, first ascending upon the coronoid process, and then climbing the occipital ridge to reach the vertex. Its branches are—*a.* A long, slender, deep-seated one, that mounts upward and enters the cranium through the foramen lacerum to be dispersed upon the dura mater, though this is sometimes a branch from the anastomotic trunk itself. *b.* Twigs forwarded to the temporal muscle. *c.* Terminating ramifications to the straight and oblique muscles of the occiput.

The third division of the carotid is the

Internal Carotid Artery.

This vessel, whose caliber is not more than half that of the external carotid, is originally deeply lodged within the submaxillary space, whence it ascends to the base of the skull, crossing the upper extremity of the cornu of the os hyoides, inwardly, in its course, which is rendered remarkable by several tortuous turns: it first curves backward, next inward, then upward, and lastly forward, to reach the anterior part of the foramen lacerum, through which it enters the cavity of the cranium. It is accompanied in its way by one of the principal branches of the jugular vein, by the eighth pair of nerves, and by the sympathetic nerve. At its entrance into the skull, we find the artery lodged within the cavernous sinus, wherein it makes two more turns, one forward, the other inward, from which last flexure comes off a vessel named the

1. **Arteria communicans.**—This runs in a direction upward and backward, passing under the crura cerebri, to join the basilar, with which it makes one continued vessel, thus forming one side of the *circulus arteriosus*—to be presently described. After having given off this branch, the internal carotid pierces the dura mater, and continues its course upward, alongside of the optic nerve, and immediately over the optic decussation splits into four principal divisions. At the point of division, however, or prior to it, are sent off—2. Two or three long branches of small size, which run forward and spread their ramifications upon the anterior and inferior portions of the dura mater.

Its four divisions or remaining branches are—

3. **The anterior cerebral**; which advances by the side of the optic nerve, and in front of its decussation transmits a considerable branch across, which unites with a similar one coming

from the opposite division, thereby forming a vessel nearly equal in size to the internal carotid itself, named the *arteria corporis callosi:* this is reflected upward and forward around the corpus callosum, and pursues through its entire length the tract of the raphe, detaching as it proceeds numerous lateral twigs for the supply of the corpus. The anterior cerebral artery now subdivides into several branches, which, with the exception of one, are distributed over the anterior lobes of the brain. This one,

The ophthalmic artery, leaves the cranium through the foramen lacerum orbitale, in company with the nerve of the same name, and at the bottom of the orbit, after forming some anastomoses with the *orbital artery,* furnishes *a twig* to the lachrymal gland, *long ciliary arteries* to the choroid coat and iris, and *the central artery* to the retina.

3 and 4. THE MIDDLE ARTERIES OF THE CEREBRUM.—These vessels come off directly opposite to each other at right angles from the trunk, take a flexuous passage between the anterior and middle lobes, and ramify extensively within their substance.

5. THE INTERNAL ARTERY OF THE CEREBRUM; which arises a little higher than the former, pursues the course of the tactus opticus, and winds round to the tubercula quadrigemina.

The remaining vessels of the brain are derived from the

Vertebral Artery.

This artery enters the cranial cavity through the foramen magnum, and mounts upon the cuneiform process of the occipital bone, where, about opposite to the middle of the medulla oblongata, it unites with its fellow, the two forming a single trunk denominated the *basilar artery.* The vertebral itself gives off—1. *Posterior arteries* to the dura mater. 2. Ramifications to the medulla oblongata.

The BASILAR ARTERY sends off—

1. THE POSTERIOR ARTERIES OF THE CEREBELLUM; which leave it as it passes under the medulla oblongata, wind upward around that body, and cross over to the cerebellum, to the posterior portions of which they are distributed.—The basilar artery then continues its course under the tuber annulare, detaching lateral branches as it advances, and from that passes between the crura cerebri, where it bifurcates. Its bifurcations proceed but a short way before each of them subdivide into two vessels: one (2.) runs forward to meet the communicating artery; the other is the

3. ANTERIOR ARTERY OF THE CEREBELLUM; which winds outward, around the crura cerebri, thence crosses to the cerebel-

lum, and is principally expended within its lateral lobes.—Below the origin of this vessel, from the sides of the *arterial circle* come off three or four considerable branches, the principal of which is the

POSTERIOR ARTERY OF THE CEREBRUM.—This runs obliquely backward, across the crus cerebri and tractus opticus, and afterwards mounts upon the posterior lobe of the cerebrum to distribute its ramifications.

THE CIRCULUS ARTERIOSUS, then (as we have seen), is formed, anteriorly, by the *transverse branch* of the anterior cerebral divisions; laterally, by the *communicating arteries;* and, posteriorly, by the *bifurcations of the basilar artery.*

The Posterior Aorta,

Considerably longer and of greater volume than the anterior aorta, is the main trunk from which are derived the arteries of the abdomen, pelvis, and posterior extremities, the posterior intercostals, and some few of the thoracic arteries. It commences opposite to the fourth dorsal vertebra, and is there some little distance removed from the spine. From its origin, it makes a curve, first upward and then backward—having the pulmonary artery on its left, the termination of the windpipe on its right: having reached the bodies of the dorsal vertebræ, it enters the superior mediastinum, and afterwards directs its course straight along the spine, inclined to the left side—having now the œsophagus and vena azygos to its right, the thoracic duct to its left. The portion of the vessel within the cavity of the thorax, distinguished as the THORACIC AORTA, gives rise to many branches, but they are but small.

1. THE BRONCHIAL springs from the under part of the curvature of the trunk, bends its course downward and forward towards the root of the left bronchial tube, at which place it divides into two—the *right* and *left bronchial arteries.* These vessels penetrate their respective lungs in company with the right and left bronchial tubes, to the branches of which they continue to cling in the course of their ramification within the substance of the parenchyma.

2. THE ŒSOPHAGEAL likewise springs from the concavity of the arch, near to the former, in some instances before it; and proceeds backward and to the right, to reach the œsophagus. Here it splits into a *superior* and an *inferior* division; which both course the entire length of the œsophageal tube, distributing branches right and left over its surface, and terminating at the cardiac orifice in anastomosis with the gastric artery.

3. THE INTERCOSTALS, the remaining branches, come off in

pairs from the sides of the vessel, and are destined for the supply of those intercostal spaces posteriorly to the last which received a branch from the anterior intercostal artery. These arteries preserve the lines of the ribs, running close to their posterior borders, and expend themselves about the inferior parts of the thorax and abdomen in anastomosis with the internal pectoral and epigastric arteries. They furnish, near their origin, small branches which enter the vertebral canal through the spinal holes; and also numerous muscular twigs during their course.

Having detached these several small vessels, the posterior aorta continues its passage between the crura of the diaphragm into the cavity of the abdomen: in making its exit from the thorax, however, it gives rise to two other small arteries (or else to a single branch which afterwards forms two) named the

PHRENIC OR DIAPHRAGMATIC ARTERIES, *right* and *left*. These vessels penetrate their respective crura, in whose substance they ramify, and ultimately expend themselves upon the chordiform tendon. Within the abdomen, the aorta continues to be firmly attached to the spine through the medium of its several vessels and cellular covering, and thus proceeds, still inclined to the left side, as far as the last lumbar vertebra, underneath the body of which it splits into four large arterial trunks. Prior to this division, the ABDOMINAL AORTA gives off—

1. THE CŒLIAC ARTERY; which is nothing more than an indemonstrable stump, or rather common root, from which spring the *splenic*, *gastric*, and *hepatic*—arteries that in some instances have separate roots—whose origin is from the under part of the trunk, a little posteriorly to the issue of the phrenic.

a. The splenic artery, the middlemost of the divisions of the cœliac, takes a winding course to the left side of the cavity, turns forward along the greater curvature of the stomach, running between that and the concave part of the spleen, and at length ends in *the left gastric artery*. Soon after its origin, it gives two or three twigs to the *pancreas* as it passes that gland; many considerable branches to the *spleen* from the convexity of its flexure; whilst from the concavity of it are passing smaller but longer branches upon the greater curvature of the stomach. It is prolonged beyond the tapering termination of the spleen, distributing shorter branches to the stomach as it proceeds, and continuing to encircle the organ towards its right extremity, from which is coming to inosculate with it the right gastric artery.

b. The gastric artery, the smallest of the cœliac divisions, runs forward to the small curvature of the stomach, between the layers of the omentum, splitting before it reaches the organ into two branches that take the names of *superior* and *inferior gastric*:

these spread their ramifications, in an arborescent form, upon the upper and under surfaces of the stomach, and anastomose with those of the right and left gastric.

c. The hepatic artery, the largest of the cœliac divisions, proceeds in front of the pancreas to the right side of the cavity, and winds forward over the pyloric end of the stomach. It gives off—*α*. Divers small branches to the *pancreas,* as it passes by the gland. *β*. Near the pylorus, it sends a considerable branch to the beginning of the *duodenum,* which, as soon as it reaches the intestine, bifurcates: one division, the *duodenal,* retrogrades along the gut, and ends in anastomosis with branches coming from the anterior mesenteric; the other, *the right gastric,* crossing the gut, proceeds to the great curvature of the stomach, where it inosculates with the left gastric. The hepatic trunk itself is continued forward to the porta of the liver, where it divides into the *right* and *left hepatic:* the right, the larger and shorter one, after giving off a considerable branch to the portio media, turns back to reach the right lobe; the left also gives off a branch or two to the middle portion, but they are but small, and then runs to the left, along the left fissure, to penetrate the other lobe.

2. THE ANTERIOR OR GREAT MESENTERIC is the next vessel to the cœliac, a little behind which it is issuing from the under part of the posterior aorta. The trunk of this artery is extremely short; but it is of large size—*aneurismal* indeed in the ass species—and is the parent stock of a numerous collection of extensive ramifications. From its origin it passes directly downward within the layers of the mesentery, detaching from behind some slender twigs to the *pancreas* in its descent, and soon suddenly resolves itself into a set of branches, of very large size compared with the trunk (commonly from eight to twelve in number), varying in length and caliber, from which are derived—*a*. A branch that runs to the *duodenum,* within the concavity of which it divides into two small ones, which turn in opposite directions and form arches; one by union with the duodenal artery, the other with the next mesenteric, from the convexities of which arise other small transverse branches, which encircle the intestine and ramify to great minuteness under its peritoneal covering, forming altogether a beautiful vascular net-work. *b*. A collection of branches of considerable length, more uniform than the rest, run backward for the supply of the other small guts; these in like manner run in arches and inosculate, and furnish an abundant supply of nutrient and secerning vessels. *c*. Two branches shorter than the other proceed to the *cæcum caput coli,* whence they run along the sides of the *cæcum,* sending off numerous transverse branches which encircle the gut and anastomose freely with each

other. *d.* Several long and short branches to the *colon,* which furnish with lateral ramifications, distributed after the same manner, the cœcal portion of the gut, and its two great flexures or arches: the last of these branches, which is directed towards the sigmoid flexure, is met in anastomosis by the first of the posterior mesenteric.

3. The renal or emulgent arteries leave the aorta at right angles, one on each side, directly opposite each other, either about the same place as or somewhat posteriorly to the origin of the preceding vessel. They pass directly outward in straight lines, and each enters the notch of its appropriate kidney, and therein splits into three or four large divisions which penetrate the glandular substance. The right is the longer one, in consequence of the inclination of the aorta to the left side, and its having to cross the vena cava posterior in its course. Both furnish in their way—*a.* Twigs to the enveloping adipose membrane. *b.* A small artery destined for the supply of the capsula renalis: in some instances this last vessel comes from the aorta; rarely, from the anterior mesenteric.

4. The spermatic arteries, *right* and *left,* in comparison to their diameter, are the longest vessels in the body, springing near to each other from the under part of the aorta, about midway between the origin of the renal arteries and its bifurcation: in some instances these vessels come from the posterior mesenteric. They pursue divergent and flexuous courses backward, pass out of the abdomen at the internal abdominal rings, and enter into the constitution of the chords with which they proceed to the testicles. In the female, these arteries run within the layers of the broad ligaments to the ovaries, to which they are principally distributed; but they also transmit branches to the Fallopian tubes and to the horns of the uterus.

5. The posterior or small mesenteric, the last of the abdominal arteries, a much longer vessel than the anterior mesenteric, likewise comes from the under part of the aorta, and commonly very near to the roots of the spermatic arteries. It descends within the folds of the mesocolon, and distributes its principal branches to the left—to the sigmoid flexure of the colon; the others run backward and ramify upon the anterior portion of the rectum: their arrangement and distribution are similar to the colic ramifications of the anterior mesenteric. The anterior division anastomoses with the posterior of the great mesenteric; and the posterior forms communications with the other arteries supplying the rectum.

6. Five or six pairs of lumbar arteries (according with the number of vertebræ) are also furnished by the posterior

The Internal Iliac Arteries

Are the product of a kind of second bifurcation; for there is still a continuation of the trunk of the aorta after it has given off the external iliacs: and this forms a remarkable difference between it and the division of the corresponding vessel in the human subject, the horse having no *common iliac arteries.* The internal iliacs are larger than the external, but extremely short. They diverge from the parent trunk, backward and outward, and hardly quit the body of the vertebra before each gives off a large branch, *the artery of the bulb :* the vessel continues a little further, and by the side of the sacral articulation splits into three nearly equal divisions,—the *obturator, gluteal,* and *lateral sacral arteries.*

THE ARTERY OF THE BULB springs from the under and outer part of the internal iliac, and proceeds in its course backward between the trunk of the artery and the external iliac vein, which latter at the same time is a little above it. It next makes a sweep backward, around the sides of the pelvis (to which it is closely bound by peritoneum and cellular adhesions) ; then insinuates itself between the laminæ of the sacro sciatic ligament, and continues along the upper border of the ischium to the ischial arch, the side of which it turns round to reach the bulb of the penis, wherein it terminates. In the female, this artery sends its terminating branches to the bulb of the vagina and lining membrane of that canal. Its branches are—1. *The umbilical artery,* or rather the remains of that vessel which in the fœtus nearly equalled in size the iliac arteries themselves, and was surpassed by none in regard of importance. In the young subject these vessels commonly remain pervious as far as the bladder ; but in process of time they degenerate into the *round ligaments of the bladder ;* in the description of which organ further notice will be taken of them. 2. Sundry small *vesical branches,* in passing, to the bladder. 3. In leaving the pelvis, *the prostatic artery,* which detaches twigs to the vesiculæ seminales, but distributes its ultimate ramifications to the prostates. 4. Divers branches, *anal* and *perineal,* to the posterior portion of the rectum, anus, and parts composing the perineum.

THE OBTURATOR ARTERY, the lowermost of the divisions of the internal iliac, corresponds in the first part of its course to the brim of the pelvis, in which it is accompanied by the crural nerve: it subsequently inclines upward to gain the posterior nook of the foramen obturatorium vel magnum, and there gains exit through the perforation in the obturator ligament. It now turns round the branch of the ischium, and on the front of that bone ends in division into the ischiatic, pubic, and internal pudic arteries. Its branches are—1. *The arteria innominata,* one of very large dimensions, which comes off not far from its origin from the iliac. This proceeds backward and outward, close under the pelvic margin, crossing obliquely the external iliac artery and the psoæ and iliacus muscles, and dips deeply into the substance of the haunch, wherein it sends branches downward to the rectus, upward to the tensor vaginæ. 2. Ramifications to the obturator muscles and ligament, in passing through the foramen. Its divisions or remaining branches are—3. *The ischiatic,* which turns down upon the back of the haunch, passing opposite to the hip-joint, and distributes its branches to the triceps. 4. *The pubic* runs backward along the branch of the ischium, and expends itself in the large head of that muscle. 5. *The internal pudic artery* turns inward and backward, around the ischial arch to the root of the penis, where it splits into two sets of branches. *a.* One set penetrate and end in the crus penis. *b.* Two or three branches belonging to the other set run further forward, and pierce the fibrous case of the corpus cavernosum. *c.* One or two slender branches of the same run along the dorsum penis. *d.* Another accompanies the pudic nerve to the extremity of the organ. *e.* Besides which there are sundry cutaneous twigs.

THE GLUTEAL ARTERY, the middlemost of the iliac divisions, shortly after its origin leaves the pelvis through the hole in the sacro-sciatic ligament, at the anterior nook of the notch, in company with the sciatic nerve, which runs behind it: immediately that it has made its exit, it splits into two or three branches of large size, whose ramifications are destined principally for the gluteal muscles, though some descend to aid in the supply of the posterior femoral muscles.

THE LATERAL SACRAL ARTERY proceeds directly backward, along the side of the sacrum, to which being closely bound by cellular adhesion it necessarily takes the slight curve of that bone: having reached the coccyx, it splits into two long, slender, terminating branches. It furnishes—1. *Sacro-spinal branches*, five or six in number, which enter the spinal canal through the internal sacral foramina. 2. *The perineal artery*, a branch as large as, or even larger than, the trunk itself, of which it might be more correctly, perhaps, considered as the continuation; and which soon divides into several ramifications, of which—*a.* many run to the gluteal muscles; *b.* while others descend upon the back of the thigh; *c.* and a third set are distributed to the anal muscles, and to the skin and cellular substance of the perineum. 3. *The lateral coccygeal artery*, one of the terminating branches of the lateral sacral, runs close to the side of the os coccygis, even to its extreme point, preserving the line of direction of the spine, diminishing in diameter as it recedes, and distributing numerous branches laterally to the coccygeal muscles. 4. *The inferior coccygeal artery*, rather larger than the lateral, takes the same correlative course along the inferior and lateral part of the bone, and may also be traced to the tip. It sends down a long slender twig or two to the anus: the remainder of its branches are distributed to the coccygeal muscles.

THE MIDDLE SACRAL ARTERY is a very inconsiderable branch coming off, generally, from the trunk of the posterior aorta at its angle of bifurcation into the internal iliacs. It is traceable for a little way only, along the middle of the sacrum.

The External Iliac Arteries,

Right and *left*, result from (what may be significantly described as) the *first bifurcation* of the posterior aorta; which takes place underneath the body of the last of the lumbar vertebræ. They take the same oblique direction (outward and backward) as the internal iliac; but they are less in diameter, and bear no comparison in respect to length. The best guide to their situation is the brim of the pelvis; considering the bowels to be removed, they are found running along this brink of the cavity, uncovered by anything but peritoneum, following the bony curvature outward to their termination; which takes place upon the same brim, about midway between the symphysis pubis and anterior spinous process of the pelvis. Each vessel gives off—

1. THE CIRCUMFLEX ARTERY OF THE ILEUM: a large branch that departs from the outward side of the trunk, near its origin. It winds directly across the loins to the flank, covered only by peritoneum, crossing in its way the two psoæ and the iliacus; arriving in front of the anterior spinous process of the os innominatum, it splits into two vessels, which take opposite courses: one inclines backward, penetrating the transversalis, to which and to the originating portion of the internal oblique muscle

its ramifications are distributed; the anterior and longer division curves forward between the transverse and internal oblique muscles, and sends its ramifications to them, but principally to the latter, with the exception of its ulterior twigs, and they run on and form communications with the last intercostals. These vessels also anastomose, among the muscles, with the lumbar arteries.

2. THE ARTERY OF THE CHORD (which in other cases comes from the last-described branch, or from the aorta itself) arises from the under part of the vessel, a little further backward than the circumflex. This is a very slender vessel, but of sufficient length to reach, obliquely backward, the spermatic chord, and proceed with it through the inguinal canal, for the general supply of its component parts.

3. THE ARTERIA PROFUNDA FEMORIS is a very large branch, and one that may be said by its origin to mark the limit of the iliac artery, posteriorly, and the femoral, anteriorly, and one also that may be considered to be given off by either of these trunks at the place where they individually change their names. The profunda plunges at once into the thick of the haunch, and there makes an oblique curve round the neck of the os femoris, passing under the short and long heads of the triceps. Having reached the posterior quarters, it sends its ramifications principally into the biceps. Prior to its dipping into the substance of the thigh, it gives rise to a large branch,

The epigastric artery; which at first makes a curve backward, downward, and outward, and in so doing turns round the inward margin of the internal ring, running at this time between the peritoneum and the tendon of the transversalis; next, it makes a sweep outward and subsequently upward, in the course of which it gradually insinuates itself between the disgregated tendinous fasciculi of this muscle until it at length is found pursuing its way between the transverse tendon and internal oblique muscle. It afterwards continues its passage forward, within the sheath of the rectus, along the upper and inner border of the muscle, furnishing as it proceeds ramifications from its sides, and at length ending in anastomosis with ramifications coming in a contrary direction from the internal pectoral. In passing the ring, it gives origin to a considerable branch which turns round the crescentic borders of the tendons forming that aperture, and then splits into several small arteries. Of these—*a.* A twig runs to the groin, and ramifies among the adipose membrane and absorbent glands there. *b.* A long slender branch makes its way to the ring, and descends upon the cremaster: this is furnished, however, in some instances by the external iliac. *c.* A subcutaneous twig to the thigh. *d. The external pudic,* the largest and longest of these divisions (at least when this is their arrangement, for the origin of these vessels is attended with much variety), runs forward, invested in the subcutaneous cellular substance of the scrotum, sending ramifications to the tunica vaginalis and the skin, and continuing forward upon the penis, where it inosculates with the superficial ramifications of the internal pudic.

The Femoral Artery.

Regarding the profunda femoris as a limb of the external iliac, we descend from the latter to the femoral artery, the direct continuation of the same trunk. This artery proceeds in an oblique direction down the haunch, preserving nearly. the line of its middle; and so speedily afterwards disappears from our view, and from no part of it being made visible by the removal of the femoral faschia, that it would seem as if it directly plunged deep among the muscles of the thigh; this, however, is by no means the case, for the upper half of the vessel may be considered, in an anatomical sense, as superficial: an incision carried along the anterior prominent border of the gracilis, detaching it from the sartorius, will (the latter being pushed forward) at any point in the upper half of the thigh, immediately expose the vessel.* The beginning of the femoral trunk, which is curved outward, is covered by lymphatic glands of the groin; it is next overlapped by the thin posterior edge of the sartorius, and subsequently by the anterior border of the gracilis, running, rather below the middle of the thigh, within a triangular space formed by the approximation of the two; here the vessel dips deeply into the muscular substance, having the long head of the triceps on its inner side, the bone on its outer, after which it takes its course between the heads of the gastrocnemius externus into the hollow at the back of the stifle, wherein we find it close to the joint, but nearer to the outer than the inner side: opposite to the head of the tibia it bifurcates into the *anterior* and *posterior tibial arteries.* The femoral trunk is accompanied by its vein, which courses at first behind, and afterwards gets to the outer side of it; and by the principal branch of the crural curve, which runs for nearly one third of the way likewise along its outer side: they are all three invested in some loose cellular substance. Its anterior branches are—1. *The inguinal;* one of large size arising in the groin, covered at its origin by the lymphatic glands, to which it sends twigs; it then crosses under the sartorius, to which it also sends ramifications, and gets between the vastus internus and rectus, where it splits into two divisions which penetrate those muscles. 2. Three or four small branches to the sartorius. 3. A long slender one to the side and front of the stifle. Its posterior branches are—1. A considerable one to the gracilis, which detaches twigs to the long and short heads of the triceps. 2. A small one that turns inwardly to the vastus internus. 3. A branch supplying both the long and large heads of the triceps. 4. One that turns round the back of the bone, about the middle of the thigh, for the supply of the biceps. 5. One large or two smaller branches sent along the posterior border of the gastrocnemius externus, from which recurrent ramifications ascend to the triceps. At the back of the stifle come off the *popliteal branches,* four or five in number, taking opposite directions, which are destined for the supply of the stifle-joint: one runs down upon the posterior tibial muscles; another, *the recurrent branch,* climbs the back of the os femoris, and anastomoses with the descending ramifications of the profunda femoris.

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* The vena saphena major will prove a safe guide for the knife; and the artery will be found most accessible at the place where that vessel ceases to be visible under the skin, or, in other words, ceases to be subcutaneous.

The Tibial Arteries,

Anterior and *posterior,* are to be regarded in no other light than the bifurcated continuation of the femoral trunk: this division takes place at the back of the head of the tibia.

The posterior tibial artery, the smaller of the two, is curved outward at its origin; it then descends through the posterior deep region of the thigh, inclining all the way, from the outer to the inner side, at first running between the flexor pedis and the popliteus (which is behind it); subsequently between the former muscle and the flexor pedis accessorius; and at length between the tendon of the last-named muscle and the inner, posterior, and inferior part of the body of the tibia. Just above the hock, it inclines inward again, and gets deep-seated between the lower end of the flexor pedis and the bone, where it ends in bifurcation. Its branches are—1. One, which comes off a short distance from its origin, and runs into the flexor pedis. 2. *The medullary,* which enters the medullary foramen, in the upper and back part of the tibia. 3. Unimportant twigs to both the flexors. Of its terminating branches—*the external one* proceeds round the outside of the hock, ramifying there subcutaneously, and anastomosing with some articular twigs of the anterior tibial; *the internal* continues down the leg over the tendon of the flexor pedis, within a cellular sheath formed between that tendon and the root of the os calcis, in company with the internal metatarsal nerve, and creeps along the inner edge of the metatarsal bone, between the flexor tendons and suspensory ligament, ending at the lower part of the cannon in divers small ramifications. At the hock, this artery sends off one or two recurrent branches, which ascend upon the back of the os calcis, and anastomose with others coming down from the posterior tibial.

THE ANTERIOR TIBIAL ARTERY no sooner leaves the common trunk, than it suddenly turns forward, and passes between the tibia and fibula towards the fore part of the thigh. Next we find it between two veins, crossing with very gradual obliquity the outer part of the bone to gain the front, which it does about midway between the stifle and hock; it then continues to descend between the outer border of the flexor metatarsi and the bone until it reaches the front of the hock, where it makes another sweep outward, and ultimately arrives in the channel between the external and large metatarsal bones, in which situation it becomes *the metatarsal artery*. Its branches are—1. Some small recurrent articular, ascending to the stifle and communicating with the popliteal branches. 2. Various *muscular branches*, in its course down the thigh. 3. Divers, small, articular and cutaneous branches, as it obliquely winds from the front of the hock to its outer and anterior part. 4. A slender *metatarsal artery* which descends upon the front of the cannon, in close connection with the bone, along the inner border of the extensor tendon, whose ramifications, mostly cutaneous, are distributed over the inner and fore part of the leg, the terminating ones reaching as low as the fetlock.

THE METATARSAL ARTERY pursues its course, unaccompanied by any vein, along its (above-noticed) channel, for two thirds or thereabouts of the length of the leg; it then passes between the internal and large metatarsal bones, and gains the posterior part of the latter, between which and the suspensory ligament, a little above the fetlock, it divides into three vessels: one forms an arch (as in the fore extremity) sending off the recurrents, which anastomose with the posterior tibial artery; the other two—the lateral divisions—become *the plantar arteries*.

Henceforward, the arteries in the hind leg are similar in all respects to those in the fore extremity: the description already given of the latter, therefore, will be found equally applicable here.

OF THE VEINS.

There are ten radical veins, though no more than two of them possess a volume correspondent with the main arterial trunk: these two, denominated the *venæ cavæ,* may be looked upon as the fellow-vessels of the anterior and posterior aortæ: the other eight are the

PULMONARY VEINS;

Which vessels originate within the air-cells of the lungs, from the extreme ramifications of the pulmonary artery, and, by repeated and reiterated union and coalescence, at length form themselves into eight venous trunks, which proceed directly from the roots of the lungs to the left auricle of the heart, and into that cavity empty themselves by four openings.*

VENÆ CAVÆ,

Anterior and *Posterior,* form the two main or general trunks of the venous system; the former receiving the blood returned from the fore parts of the body; the other, that flowing from the hinder parts. Their ramifications in most parts exceed, in number and size, those of the correspondent arteries; in addition to which, veins are found in many parts (and those mostly superficial) where arterial trunks do not exist; which excess of number and duplicity of course has caused a division of the veins into those that are *superficial,* and those that are *deep-seated.*

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* The English veterinary professors reckon *eight* pulmonary veins; the French, but *four.* The disagreement arises from the former reckoning being made at the issue of the veins out of the substance of the lungs, and the latter being taken from their termination in the cavity of the left auricle.

TABLE OF THE VEINS.

- ERIOR A CAVA
  - Jugular . . .
    - Auricular
    - Temporal
    - Int. Maxillary . . .
      - Palato-maxillary
      - Infra-orbitar
      - Supra-orbitar
      - Ocular
      - Inf. Maxillary
      - Deep Temporal
    - Parotideal
    - Masseter
    - Pterygoid
    - Occipital
    - Submaxillary
      - Facial
      - Labial
      - Varicose
      - Submental
      - Sublingual
      - Lingual
      - Pharyngeal
      - Inf. Laryngeal
    - Thyroideal
    - Tracheal
    - Muscular
    - Cutaneous
    - Superficial Brachial
      - Muscular
      - Cutaneous
      - Anastomotic
  - Pectoral . .
  - Vertebral
  - Axillary . . .
    - Ext. Thoracic
    - Humeral Thoracic
    - Dorsalis Scapulæ
    - Subscapular
    - Humeral . . . . .
      - Muscular
      - Articular
      - Ulnar
      - Radial
        - Anastomotic
        - Metacarpal
          - Cutaneous
          - Articular
          - Anastomotic
          - Plantar
          - *Ext.* and *Int.* . .
            - Articular
            - Perpendicular
            - Veins from the Laminæ
            - Veins from the Frog
            - Veins from the Sole.
  - Dorso-Cervical
  - Inf. Cervical
  - Vena Azygos
    - Muscular
    - Post. Intercos

)STERIOR
:NA CAVA
- Phrenic
- Hepatic
- Renal
- Spermatic
- Lumbar
- Iliac . . . .
  - Muscular
  - Circumflex
  - Middle Sacral
  - Int. Iliac . .
    - Ischiatic
      - Vesical
      - Anal
      - Perineal
      - Pudic
    - Lateral Sacral
      - Perineal
      - Sacro-Spinal
      - Coccygeal
  - Ext. Iliac .
    - Inguinal
    - Cutaneous Abdominal
    - Femoral . . .
      - Vena Saphena Major
      - Vena Saphena Minor
      - Muscular
      - Medullary
      - Post Tibial . . .
        - Muscular
        - Medullary
        - Small Metatarsal
      - Ant. Tibial . . .
        - Anastomotic
        - Large Metatarsal. . .
          - Ext. Plantar
          - Int. Plantar.

Vena Portæ . . .
- Splenic. .
  - Gastric
  - Omental
  - Pancreatic
- Ant. Mesenteric
  - Cæcal
  - Colic
  - Gastric
  - Pancreatic
- Post Mesenteric . . .
  - Colic
  - Rectal.

The Anterior Vena Cava

Forms the main trunk of (or common reservoir for) the veins returning the blood from the head, neck, parietes of the chest, and fore extremities. It is a short vessel, but one of considerable volume, becoming remarkably bulky at its termination in the summit of the right auricle. In relative position, the trachea lies above it, the anterior aorta to its right, and it is with both included in the interspace of the superior mediastinum. The anterior cava is principally formed by the concurrent union of the *jugular* and *axillary veins*, and is situated at its formation within the interval between the two first ribs, about midway between the sternum and vertebræ: it also receives the *pectoral, vertebral, dorso-cervical,* and *inferior cervical veins,* and the *vena azygos;* which again augment its volume in its course to the heart.

Jugular Vein.

This forms the principal venous conduit from the head, along the neck, corresponding in course and ramification to the carotid; consequently there exists a *right* and a *left* jugular vein, and it is quite unimportant which is taken by way of description. The jugular vein has its formation at the foramen lacerum basis cranii, from the termination there of the lateral sinus of the dura mater, from which it receives the blood returned, principally from the cerebrum, partly from the cerebellum. Concealed at its origin by the condyle of the jaw, it descends to the inner side and behind the neck of the condyle, deeply buried under the parotid gland: lower down, it makes its appearance behind the branch of the jaw, and there joins the external carotid artery, along with which it continues its passage into the neck. In this part of its course it receives the following branches of importance—1. THE AURICULAR VEINS, *anterior* and *posterior,* and also *internal,* varying in their number and mode of termination, which are seen descending over the root of the ear. 2. THE TEMPORAL, a vein of considerable size, running along the upper side of the temporal artery. 3. THE INTERNAL MAXILLARY, a large vein keeping company with its artery; and in its course receiving many small veins—*the palato-maxillary, infra* and *supra orbitar, ocular, inferior maxillary,* and *deep temporal.* 4. THE PAROTIDEAL, numerous veins from the parotid, and some also from the submaxillary gland. 5. Branches from the masseter and pterygoid muscles.

6. THE OCCIPITAL VEIN, a long flexuous branch descending from the head along with the occipital artery, that brings blood from the occipital sinuses, receives veins from the posterior lobes

of the cerebrum, and from the cerebellum, as well as veins from the dura mater; and also several muscular branches in the course of its descent.

7. THE SUBMAXILLARY VEIN, the most considerable branch of the jugular, so large, indeed, compared to the continued trunk, that some regard the two together as a bifurcation of the common jugular. It is formed upon the side of the face by the coalition of the *facial, labial,* and *varicose veins;* whence it turns round the branch of the jaw, between the artery of the same name and the parotid duct, and joins the trunk by the side of the trachea, just below the parotid gland. In its course it receives other veins which likewise contribute to its volume, of which the principal are—*the submental, sublingual, lingual, pharyngeal,* and *superior laryngeal veins. The facial vein* results from a ramous expansion of small veins upon the side of the face, and in its course receives one or two branches, one of which is commonly varicose, from the masseter. *The labial vein* is formed by the union of a plexus of venous branches coming principally from the angle of the mouth, in conjunction with others from the upper and lower lips. *The varicose vein* is a vessel deeply buried under the substance of the masseter, descending obliquely along the furrow made by the aproximation of the jaws (when the mouth is shut), and is very remarkable from having naturally a large varix or reservoir for blood at its origin: not, however, that this is the only varicose vein, for the temporal commonly bulges more or less, as well as a vein from this muscle already noticed; but this is the largest specimen of so extraordinary a formation. I believe that these varices serve to guard against stagnation or congestion in the brain and its membranes, and from consequent rupture of their sinuses and delicate veins, by continuing to admit of the influx of blood at a time that the circulation is interrupted or impeded by the motions of the jaw.

The jugular trunk having received the submaxillary vein, which it does in the space between the larynx and vertebra dentata, proceeds down the side of the neck, covered by the cervical portion of the panniculus carnosus, along a channel formed for it by the lower border of the levator humeri and the upper one of the mylo-hyoideus: by a layer of oblique fibres coming from the former of which muscles it is separated from the carotid artery and trachea, they being situated to its inner side, and rather below it: in its course down the lower half of the neck, however, the vein gets deeper-seated, approaches the windpipe, and afterwards runs in company with the carotid artery. It terminates in the anterior vena cava within the space between the two first ribs. At or near the junction of the submaxillary, the jugular vein receives some small veins, principally *thyroideal:* during its course it also receives many small branches—*cutaneous, muscular,* and *tracheal veins.* Near its termination it receives a considerable branch, *the superficial brachial vein,* which originates in front of the radius, about two thirds of the length of the bone upward, from the main brachial vein, ascends along the anterior border of the biceps, and continues upward in the hollow between the breast and arm, winding as it proceeds a little outward, to reach the jugular: this by farriers is called *the plat-vein*—it is the one we are in the practice of opening for lameness in the shoulder. It receives some unimportant muscular and cutaneous branches in the course of its ascent.

The Vertebral Vein

Is the fellow vessel to the vertebral artery: the two pursuing their course together, on either side of the neck, from the head to the chest, passing through the foramina in the transverse processes of all the cervical vertebræ with the exception of the last. This vein has communications with the occipital sinus and posterior cerebral veins; but it owes its formation principally to the veins coming from the medulla oblongata, and the spinal marrow and its membranes: it also receives vessels from the deep-seated muscles in the vicinity. In its course it runs above the artery, and at the entrance of the chest quits its companion to terminate in the anterior vena cava, just behind the first rib.

The Axillary Vein

Forms the main channel for the return of the blood distributed by the divisions and ramifications of the axillary artery (to which it corresponds) to the various parts of the fore extremity. Its forming branches may be arranged into sets—a superficial and a deep-seated set: the former run for the most part immediately underneath the skin; the latter, exceeding them both in number and size, accompany the arteries, among the muscles. Besides, there exist divers vessels of communication between the two sets. It will facilitate the description of these vessels, at the same time that it is the most natural mode of proceeding, for us to descend at once to the foot, and trace them from their origin: this will direct our commencement from the

Plantar veins. There is not, perhaps, a piece of vascular structure in any part of any animal that can be exhibited as a specimen of greater beauty of venous arrangement than the foot of the horse; the sole displays a curious and intricate network of small veins, and the laminæ in every part show a similar reticular venous ramification, altogether giving the foot quite a covering of venous netting. We have seen that the arteries of the foot elude pressure, and consequent impeded or interrupted circulation, by piercing the substance of the os pedis; we now perceive that the veins, running all outside (for, to have admitted them also through it, the bone must have been perforated in so many places that it would have become physically inadequate to the superincumbent burden), guard against the impediments constantly occasioned to the circulation in some one or other of them by the numbers of communicating canals crossing in every direction: in addition to which, in order to give every facility to the flow of blood through them, they are unprovided with valves.

The veins of the sole pour their blood into the veins of the laminæ, with the exception of some few of the posteriormost, and they end in the veins of the frog.

The veins of the laminæ increase in size as they approach the coronet, and gradually unravel themselves so as to form a great many plexuses or bunches, which run directly upward, crowd through the substance of the coronary ligament, and afterwards collect into *the superficial coronary vein.* From them also, larger branches proceed laterally, to be united in transverse communication by *the deep coronary,* a vein commonly double. From this the larger veins upon the sides diminish in number, and all conjoin into two or three branches, which, opposite to the pastern-joint, unite into a single vein.

The veins of the frog, after ramifying in the form of network over that body, ascend along the inner sides of the cartilages into the heel, converging and uniting into larger vessels as they leave the foot, and finally forming a single vein upon the pastern-joint, which runs up and unites, a little above the head of the os suffraginis, with that coming from the laminæ, thereby forming the plantar vein.

The plantar vein ascends in front of the plantar artery, keeping company with that vessel until both unite with their fellow venous and arterial trunks of the opposite side, and become metacarpal. In its course, it is joined by the perpendicular vein, besides other small unimportant branches: at its termination, it receives one or two veins of considerable size which emerge from the fetlock-joint.

THE METACARPAL VEINS, two in number, result from the union of the plantar; and this takes place in the form of an arch immediately over the sesamoids, in the interval between the flexor tendons and the suspensory ligament. These veins pursue their course up the leg, one on either side, along the same correspondent channels, between the tendons and the ligament, to the back of the knee, where they end in a remarkable anastomosis, formed by a transverse branch equal in diameter to either of the trunks. *The internal metacarpal vein* accompanies the artery, having that vessel situated behind and the inner small metacarpal bone in front; *the external vein,* the smaller and deeper-seated one, also preserves the line of the splint bone on the other side, but it is more inwardly placed. These veins receive in their course cutaneous veins from the front of the cannon, and at their origin one or two descending veins from the back of the leg. There is some variety commonly found in regard to the number and disposition of the anastomosing and other branches at the back of the knee; but there are ordinarily two principal venous trunks, one of which ascends over the inner and back part of the joint, having the artery situated behind it, the other mounts close along the inner border of the trapezium. As they pass the joint, these vessels receive the blood from the anterior and posterior articular veins. A little above this, they communicate by a short and free anastomosis, and afterwards run on to form the superficial and deep-seated veins of the arm.

THE SUPERFICIAL BRACHIAL VEIN (*the cephalic* of the human subject, *the plat-vein* of our farriers) continues to ascend along the inner side of the radius, inclining very gradually forward, until it has arrived at the elbow-joint; here it crosses obliquely over to the front of the biceps, and pursues its ascent upon that muscle, in a direction to the point of the shoulder, to the inner part of which it creeps round, and afterwards plunges inward to reach the jugular vein, in which it terminates. This is one of the superficial veins of the arm, it being covered only by the skin from its origin to its passage over the shoulder-joint; and is, as was observed before, the vein we commonly let blood from. In its course, it receives divers cutaneous and muscular branches, which contribute to augment its volume a little; and, besides, contracts anastomoses with the other veins of the arm, among which should not be overlooked a large and remarkable communication it has with the humeral vein, just before it leaves the radius, through the medium of a branch that runs directly upward.

THE RADIAL VEINS, springing from the coalition of the metacarpal veins above the knee, are two in number, and take the same course as the radial artery, and a little above the shoulder-joint concur with the anastomotic branch coming from the superficial brachial to form the humeral vein. They receive many muscular branches as they ascend, and also some anastomosing vessels from the ulnar and superficial veins.

THE ULNAR VEINS are divers small vessels taking the course of their respective arteries. One of them, apart from the others, is connected with the humeral by a separate canal, and makes a curve upon the inner part of the elbow-joint in the direction of the olecranon, and afterwards descends upon the side of that projection along the backs of the flexors, where it becomes superficial, and continues so to its termination at the knee. The others all end by one common trunk in the humeral vein, about its middle.

THE HUMERAL VEIN, the issue of the union of the anastomotic branch from the superficial brachial with the radial veins, is a large vessel extending along the inner side of the humerus, in contact with the bone. The humeral artery, which accompanies this vessel, is at first concealed between the bone and the vein, but higher up the artery gets in front of the vein. It receives small veins from the joint, and divers others from the muscles around, whose number is indeterminable, and whose course is best learnt by a reference to that of the arteries. It also receives a considerable branch from the triceps.

THE AXILLARY VEIN is the continuation of the humeral, augmented by the accession of the triceps vein. The axillary artery enters the limb directly opposite to the shoulder-joint, and the vein runs immediately below and in company with it. It follows the future course of the artery, turning along with it around the first rib, to join the vena cava anterior, which it does at the same place that vessel receives the jugular. Its branches are—1. *The subscapular vein,* one of considerable size accompanying the subscapular artery, receives as it runs along branches from the triceps and subscapularis, corresponding to the arteries, and joins either the root of the axillary or the termination of the humeral. 2. *The dorsalis scapulæ* pursues the course of the artery of that name, bringing blood from the antea and postea spinati, and terminating about midway between the thorax and shoulder. The remaining branches of the axillary come from the parietes of the thorax. They are—*a. The humeral thoracic,* comprising two or three veins, corresponding to the arteries so called, the original ramifications of which issue from the muscles about the point of the shoulder. *b. The external thoracic,* a long vein traversing the lower part of the chest, in a horizontal direction, behind the arm. A great portion of it runs subcutaneously, and is distinctly traceable in the living animal through the skin; from which circumstance it has been noticed by horsemen, and named, from its situation, the *spur vein.* It is originally derived from the abdominal parietes, from the union of two convergent branches which issue from the integuments of the sheath, or, in the female, the mammæ: it receives also, as it crosses over the ribs, other small veins, and these likewise contribute to its volume.

The Pectoral Vein

Answers in course and distribution to the pectoral artery. It originates in branches from the abdominal parietes, continues to receive laterally accessory vessels in its passage, and ascends along the inner and posterior border of the first rib, in front of the artery, to arrive at the under part of the vena cava anterior.

The Dorso-Cervical Vein

Consists of two divisions ramifying along with the dorsal and posterior cervical arteries, and returning blood from the muscles they supply. It also receives the anterior intercostal vein, the companion of the artery so named, which is the common trunk of the veins corresponding to the second, third, fourth, and fifth intercostal arteries.

The Inferior Cervical Vein

Is the vessel or vessels descending along the inferior part of the neck in company with the inferior cervical artery. Its principal branches are muscular; though some come from the skin and absorbent glands in the vicinity.

The Vena Azygos,

The last and only *single* branch of the vena cava anterior, in whose supero-posterior part it ends, just as the trunk opens into the auricle. It arises, as far backward as the loins, by some small straggling veins; and takes its course across the bodies of the dorsal vertebræ, on the right side of the posterior aorta, growing somewhat larger as it advances towards its termination, where it forms a remarkable curvature downward, to reach the trunk of the cava. It receives at its origin many veins from the neighbouring muscles, those of the loins more particularly; but its destined office is to conduct the blood from the posterior intercostal veins—from twelve to thirteen of them on the right side, from eight to nine only on the left, in consequence of its being placed inconveniently for the reception of more of the latter: had the vena cava posterior been raised alongside of the posterior aorta, a vena azygos would not have been required; it may be said, therefore, to supply the place of that vessel along the spine.

Posterior Vena Cava.

This is the correspondent venous trunk to the posterior aorta—

the conduit returning the blood from the parietes of the abdomen and pelvis, the urinary and genital organs, and the posterior extremities. The internal and external iliac veins, unlike their accompanying arteries, coalesce and form two common iliac trunks, from the subsequent union of which, upon the last vertebra of the loins, results the main trunk now under consideration. Thus formed, it takes its course underneath the bodies of the lumbar vertebræ, runs within the great fissure of the liver, perforates the chordiform tendon, and pursues its way directly across the middle space of the cavity of the chest to the posterior and inferior part of the right auricle. In its passage it is joined by the *lumbar, spermatic, renal, hepatic,* and *diaphragmatic veins.*

THE LUMBAR VEINS, correspondent in number and course to the lumbar arteries, result from the union of small veins issuing from the muscles clothing the loins; receiving in their subsequent passage, each of them, a branch emerging from the vertebral canal; and ultimately joining the main trunk at right angles.

THE SPERMATIC VEIN ascends alongside of its artery, pursues its course forward within the abdomen, and terminates in the under side of the posterior vena cava; in some instances, uniting first with its fellow into one common vessel.

THE RENAL OF EMULGENT VEIN, formed by a combination of branches emerging from the pelvis of the kidney, which commonly exceed in number the divisions of the artery, accompanies the renal artery to the spine, and ends in the under and outer part of the main trunk. The left vein is longer than the right, in consequence of having to cross the aorta. They also receive the veins belonging to the capsulæ renales.

THE HEPATIC VEINS, manifold in number, spring from the terminations of the vena portæ and hepatic artery, issue from the parenchyma of the liver, and end in the vena cava, as it runs along the great fissure, by numerous orifices resembling pinholes.

THE PHRENIC OF DIAPHRAGMATIC VEINS.—From the arborescent venous display upon the surface of the diaphragm result six ascending branches of considerable size; these, however, conjoin afterwards, and make but two on each side, which enter the trunk as it perforates the tendinous substance.

The Common Iliac Veins

Take their rise under the sacro-iliac symphysis from the union of the external with the internal iliacs. Their course, which is very short, is obliquely forward under the last vertebra of the loins, where they coalesce and form the main trunk. They receive, however,—1. A considerable vein resulting from the conjunction of small branches coming from the psoæ and iliacus course; but these are too variable in their number and distribution to come very usefully into any general description.

THE VENA SAPHENA MINOR springs from the small metatarsal vein. It runs directly up the back of the hock, over the root of the os calcis, and pursues its course upward along the front of the gastrocnemii, and ultimately joins the femoral vein. It anastomoses with the greater saphena, and receives in its course both cutaneous and muscular branches.

The Vena Portæ.

The veins of the chylopoietic organs have a peculiar and distinct arrangement from those of the body in general, and on this account a separate description is commonly given of them. They receive blood, as has been already seen, in a similar manner to other parts; but they return their blood into a channel which conveys it all through the liver, instead of conducting it immediately into the vena cava posterior: this channel is the vena portæ, a vessel principally formed by the union of the splenic and mesenteric veins, though it is likewise contributed to by veins coming both from the stomach and pancreas.

THE SPLENIC VEIN, in company with its artery, occupies the fissure of the spleen, makes a circuit in a flexuous manner towards the right side, receiving in its way branches from the stomach, omentum, and pancreas, besides all the veins of the spleen, and at length ends in the vena portæ.

THE MESENTERIC VEINS, *anterior* and *posterior*, bear much correspondence to their arteries. *The anterior* one is of large size, being constituted of those numerous ramifications which diverge over the small intestines, together with the arteries: it also receives branches from the cæcum and cæcum caput coli, some few from the stomach, and some from the pancreas. *The posterior mesenteric* runs obliquely forward, after having received branches correspondent to those of its fellow artery.

The vena portæ is concealed at its origin by the pancreas; immediately above which its formation takes place. From this it runs under the beginning of the duodenum, on the right of the hepatic duct and artery, and makes its way to the concave part of the liver. About opposite to the centre of the right lobe, the vein splits into two divisions: the right immediately enters the substance of that lobe; the left is continued forward along with the hepatic artery, and, the same as that vessel does, bifurcates to supply the left and middle lobes.

SECTION IV.

RESPIRATORY SYSTEM.

THE RESPIRATORY SYSTEM COMPRISES THE LARYNX, THE TRACHEA, AND THE LUNGS.

OF THE LARYNX.

The larynx is the organ producing the voice of the animal.

Situation. It is joined to the top of the trachea (or windpipe), and is placed in the throat, between the posterior and broadest parts of the branches of the lower jaw; having the pharynx and uppermost part of the œsophagus situated above it; the superior portions of the sterno-hyoidei and thyroidei below it; the tongue with its muscles, and the os hyoides, in front of it; and the trachea issuing from below and behind it.

Attachment. The larynx is retained in its place by its connection with the os hyoides and pharynx; by its muscles; and by its coalition with the trachea.

Conformation. The larynx has so complete a fleshy covering, that it is not until it is divested of its muscles (which have been heretofore described) that it is discovered to be composed of five pieces of cartilage, so joined together as to be moveable on one another, and open both superiorly and inferiorly to admit of the passage of air into and out of the trachea. These cartilages have received the names of *thyroid, cricoid,* (two) *arytenoid,* and *epiglottis.*

THE THYROID or *shield-like* cartilage, by much the largest of the five, forms the superior, anterior, and lateral parts of the larynx. It consists of two broad lateral portions, continuous and prominent at the upper and anterior part of the neck, the prominence corresponding to which in human anatomy has received the name of *pomum Adami.* Below this point of union the divisions recede from each other, leaving a triangular space between them, which is occupied by a ligament denominated the *ligamentum crico-thyroideum.* The four projecting corners from the posterior parts of the thyroid cartilage are named its *cornua:* the two superior are joined by capsular articulations to the body of the os hyoides; the two inferior are connected by very short capsular ligaments to the cricoid cartilages; the union of all which parts receives additional strength from expansions of membrane. At the roots of the superior cornua are two foramina that give passage to nerves, of considerable importance, to the interior of the

This cartilage not only constitutes by far the most extensive part of the larynx, but, as its name indicates, incloses and shields from external injury all the others.

THE CRICOID or *ring-like* cartilage is placed below the thyroid. In front it appears like part of the trachea; but it broadens so much behind, that it overlaps the first ring of the windpipe, somewhat after the form of a helmet. Upon its broad or posterior part are four surfaces of articulation: the two upper receive the hinder extremities of the arytenoid cartilages, the two lower are adapted to the inferior cornua of the thyroid cartilage: they are all furnished with capsular ligaments and synovial membranes. Furthermore, it is attached by ligamentous expansions to those parts, and likewise to the first ring of the trachea.

THE TWO ARYTENOID, or *ewer-shaped* cartilages, triangular in their figure, lie over the upper and back part of the trachea, leaving an aperture between them leading into that canal, denominated, from its proximity to the tongue, the *glottis*. Their inward parts are everted, and form a triangular prominent border, over which is spread *the membrane of the glottis*: their outward surfaces are marked by concavities in which are lodged the arytenoid muscles. Posteriorly, they repose upon the cricoid cartilage, and are connected with them by capsular articulations: in front, they have a membranous connection with the cartilage next to be noticed.

THE EPIGLOTTIS, so named from being raised over the *glottis*, and occasionally covering it like the lid of a pot, is well adapted, from its heart-like shape, to the *rima glottidis;* whose margin is completed by two narrow slips of cartilage proceeding from the base of the lid to the arytenoid. By some, these slips of cartilage have been separately considered: but in my opinion improperly so; for they are, in reality, nothing more than prolongations or appendices of the epiglottis. The surface of this cartilage presented to the interior of the larynx is smooth and concave, and covered by an extensiou of membrane from the glottis; that part opposed to the tongue is unevenly convex, and is tied to that organ, as well as to the os hyoides, by a doubling of membrane infolding some muscular fibres: to this musculo-membranous ligature, which assists in retaining the cartilage in its elevated position, the name of *frænum epiglottidis* is properly given. The frænum receives co-operation in this function from strong elastic ligaments connecting the base of the epiglottis to the thyroid and arytenoid cartilages.

If we detach the epiglottis, or raise it forcibly, in order to obtain a more complete view of the rima glottidis, the latter will be found to be stretched into an oblong quadrilateral figure, whose width gradually diminishes from the middle towards either extremity, and bears a ratio of about one to six when compared to its length. The sides turned forwards, are formed by the arytenoid cartilages; those directed backwards, by two prominent folds of membrane (which envelope the thyro-arytenoid muscles), commonly described as the *vocal ligaments*, from their being concerned in the formation and intonation of the voice. Immediately over them are slit-like apertures, opening into membranous sacs, each large enough to contain a walnut; these are the *ventricles of the larynx*, whose use is also connected with the production and modulation of the voice.

The membrane lining the cavity of the larynx is one of great susceptibility; on which account it is kept continually moist by a mucus, oozing from numerous *lacunæ*—the excretory orifices of small subjacent follicles whose situation is denoted by the little round eminences upon its surface. This is the common seat of that species of catarrh which is accompanied by cough.

OF THE TRACHEA.

The *trachea*, or windpipe, is a cartilaginous tube extending along the neck, from the larynx to the lungs, for the passage of air. In horses of ordinary size, it is from twenty-five to thirty inches in length.

Course. The trachea commences from the inferior border of the cricoid cartilage, opposite to the body and transverse processes of the atlas; takes its course along the anterior and inferior part of the neck, inclining to the near side, between the sterno-myloidei muscles (which by their approximation conceal the lower portion of it), and enters the chest between the two first ribs; wherein, under the curvature of the posterior aorta, it divides into two parts, the *bronchial tubes*.

Structure. From fifty to sixty annular pieces of cartilage enter into the composition of the windpipe; altogether constituting a structure so remarkable for the inequality or asperity of its exterior, that the ancients, in order to at once distinguish it from all other vessels, called it the *aspera arteria*. No entire or undivided tubular substance could have partaken of the various motions of the head and neck, without having suffered more or less distortion, and consequent deformity and diminution of caliber, of some part of its canal, which would have been attended with frequent interruptions to the free passage of the air, dangerous, and even fatal, to the respiratory functions; whereas, constructed as it is, with the aid of its muscular power, no attitude into which the animal may naturally put himself will impede the freedom of passage through it. The cartilages, or, as they are commonly described, the *rings* of the windpipe, have all a close resemblance to one another: if there be any disparity between them worthy of notice, it consists in those that form the superior part of the pipe being somewhat larger and broader than those nearest to the bronchial tubes.* A ring is not uniform in its breadth, in consequence of having waving or scolloped borders; the advantage of which is, that a sort of dove-tailed connection is effected which materially contributes to the compactness and strength of the entire structure. Its front and sides measure, in the broadest places, half an inch in breadth, and nearly a quarter of an inch in thickness—evidently made so substantial to resist external injury; whereas its posterior or unexposed parts grow suddenly thin and yielding, and taper to the extremities; which instead of meeting and uniting, pass one over the other, and thus form a shield of defence behind, while they admit of a certain dilatation and contraction of the internal dimensions of the tube. These attenuated ends are joined together by a ligamentous expansion, mingled with a quantity of cellular membrane. The rings are likewise attached to one another by narrow ligamentary bands, strong and elastic; which after they have been drawn apart in certain positions of the head and neck, have the power to approximate them: when the pipe is removed from the body, and suspended by the uppermost ring, these ligaments counteract the tendency its weight has to separate the rings, and still maintain them in apposition. The lowermost ten or twelve pieces of cartilage appear on examination but ill to deserve the name of rings; indeed they are little more than semi-annular, the deficiencies in them behind being made good by intermediate moveable pieces of cartilage. These pieces, whose breadth increases as we descend, are let into the vacuities in such manner as to overlap the terminations of the segments, and they are confined and concealed by the same sort of ligamentary and cellular investment as was before noticed.

Muscle. Where the outward extremity of the ring suddenly turns inward and degenerates into a thin flexible flap on either side, a band of muscular fibres is fixed and stretched across the canal, dividing it into two unequal semi-elliptical passages:—the anterior one is the proper air channel; the posterior or smaller one is filled with a fine reticular membrane connecting the band to the posterior part of the ring, and preventing it, in action, from encroaching upon the main conduit. This self-acting band appears to me to have been added to the tube to enable it to *enlarge* its caliber—not to diminish it, as a superficial view of these parts might lead one to imagine; for, in consequence of the passage being naturally elliptical, and the muscle being extended across its long diameter, the contraction of its sides will give the tube a circular figure, by increasing the curvature of the ring anteriorly, and thereby, in effect, will expand and not contract the caliber of the canal. I would say, then, that the trachea was made muscular in order that it might have the power of increasing its capacity for the passage of air, whenever the lungs were called into extraordinary action: in addition to which, I think, that this band may, in some degree, counteract any tendency certain positions of the head and neck have to alter its shape and diminish its circumference. This opinion is corroborated by the circumstance, that the muscle grows slender and pale as we approach the lower end of the pipe, where the canal itself is nearly circular, and where it is placed in the least moveable part of the neck.*

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* Now and then we find, at the upper part of the tube, two or three or more of these rings accreted together; it gives rise to some prominence thereabouts generally, and may often be detected by taction in the living animal.

Membrane. The trachea is lined by a soft, pale red membrane, which, anteriorly, has a close adhesion to the rings themselves, and presents a smooth polished internal surface; but which, posteriorly, is loosely attached to the muscular band, and puckered into fourteen or fifteen longitudinal *plicæ* or folds, that extend with regularity from one end of the tube to the other. These folds were evidently made to allow of the contraction and elongation of this muscular band; for I cannot myself assign any reason why they should exist in its relaxed state unless this fulness of membrane be given to admit of enlargement of the caliber of the tube during the contractions of that muscle: if this be plausible, I may adduce the corrugation of the membrane as another proof that the caliber of the trachea is susceptible of augmentation. This membrane is continuous with that which clothes the rima glottidis; but it is paler than it, and not near so sensitive. Its arterial ramifications, also less abundant than upon the glottis, exhale a vapour from its surface; independently of which, it is kept continually lubricated by mucus, furnished from its numerous *lacunæ*, to defend it from anything acrimonious that may be contained in the breath.

BRONCHIAL TUBES.—The trachea having entered the thorax, bifurcates into the two *bronchial tubes:*—of them, the right is the more capacious canal, on account of having communication with the larger division of the lungs; the left the longer one, in consequence of having to cross under the pos-

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* In this opinion I find I am at variance with Girard. The French professor ascribes to it the power of *contracting the caliber* of the trachea. "Cette couche, bien evidemment musculeuse, peut *retrecir le calibre* de la trachée en rapportant les extremités des segmens." '*Anat. Vet.*,' p. 146 et 147, tom.ii.

terior aorta, in its course to the left division of the lungs. The last cartilage of the main pipe has a spear-like or angular projection extending down between the bronchial tubes, filling up that space which would otherwise be left open from the divergent manner in which they branch off: it is quite loosely attached, in order that the branches may accommodate themselves to the motions of the neighbouring parts. The bronchial tubes vary in structure from the trunk that gives origin to them: instead of their rings being formed of entire pieces of cartilage, they are constituted of several separate pieces, making up so many segments of the circle, overlapping one another, and united together and invested by an elastic cellular substance: they also differ in having no muscular band, another fact connected with the physiology of that part. The bronchial tubes, in penetrating the substance of the lungs, subdivide—the right into three principal branches, the left into two.; from which spring innumerable others that grow smaller and smaller, until the ramifications become so reduced that they are no longer traceable by the naked eye. In the larger branches we may dissect out five and even six segments of cartilage, held together by a thin, but dense and elastic cellular substance: in the smaller divisions, only two are found, and they are diminished in size; and in the smallest visible ramifications of all, cartilage is altogether wanting, though, in many places, marks of the rings may be traced upon the continuation of the lining membrane, which in these intimate parts composes the entire parietes of the tube. In the larger branches this membrane (which is continuous throughout the bronchial system) assumes a plicated disposition—apparently to admit the more readily of expansion.

Thyroid Glands.

Two egg-shaped, apparently glandular bodies, attached just below the larynx to the sides of the trachea, and united in front of that tube by an intervening portion of the same substance, which, by way of distinction, is by some called the *isthmus*. They are enveloped and attached in their situation by cellular membrane; are larger and more vascular in the young than in the old subject; and exhibit a spongy texture when cut into, which I am at present ignorant of the precise nature of. They are well supplied with blood-vessels, and have many small nerves going to them. Their physiology still remains obscure.

OF THE LUNGS AND PLEURA.

The lungs are the essential organs of respiration: *the pleura* is but the membrane by which they are invested.

Pleura.

The pleura is a fine semi-transparent membrane, lining the cavity of the chest, and giving a covering to the lungs. By that portion of it which is called the *mediastinum,* the cavity is divided into the right and left *sides* of the thorax.

General Conformation. If the lungs be exposed, by breaking off one or two of the ribs, we shall perceive that their surface, as well as that of the cavity itself, is everywhere smooth, polished, and humid: this is owing to the extensive investment of the pleura, the surface of which is now presented; so that, in reality, without breaking the surface, nothing but pleura can be touched; although, from its extreme tenuity and pellucidity, the viscera appear, on a superficial view, to present their own bare exterior. Its other side, on the contrary, is rough, having numerous cellular flocculent appendages, by which it is united to the parts it invests: and so close and firm are these adhesions, that to cleanly detach it, in the recent subject, is a very difficult and tedious dissection.

The pleura is a *reflected* membrane; by which is meant one that not only lines the cavity in which the viscera lie enclosed, but, by duplicature, or what in anatomical language is called *reflection,* gives a partial or complete covering to the contained organs themselves. It is evident, therefore, that such a membrane admits of division into two portions:—a *lining* or *parietal* and a *reflected* portion; and these, with regard to the pleura, have, for the sake of more definite description, received the names of *pleura costalis* and *pleura pulmonalis:* they are both, however, continuous at all points, are precisely similar in structure and function, and, in fact, are still but one and the same pleura.

Mediastinum. There is yet a third portion of this membrane to which a distinct appellation has been given, and that is *the mediastinum,* the membranous partition between the cavities or sides of the thorax; it differs from both the others in being composed of *two* layers, which are derived from the two pleuræ of the opposite sides. If we conceive the pleuræ of the two sides of the thorax to be perfect sacs or bags, with flattened sides turned inwardly, and closely applied and united together, in such a manner that the double membrane formed by their union extends through the middle of the chest, from the dorsal vertebræ to the sternum, we shall at once have a tolerably correct idea of the formation as well as situation of the mediastinum.

Structure. The pleura, from the nature of its secretion, is one of those included in the list of *serous* membranes, to which it has been demonstrated also to be similar in its intimate organization.

Like them, it presents a shining secreting surface, of a whitish aspect, and considerable transparency, and is composed of little else than condensed cellular substance, whose texture is penetrated by blood-vessels, absorbents, and nerves: by long maceration in water, indeed, it may be entirely resolved into cellular substance. In most parts it is extremely thin, and by no means tough: but it is not so in all; for that portion which faces the diaphragm is much denser and stronger than the pulmonary or costal division of it.

Organization. The arteries of the pleura, which come from the adjacent parts, are in the natural state exceeding small, admitting only the colourless parts of the blood—a circumstance that accounts for its pellucidity; under inflammation, however, they contain red blood, and such is the explanation of that arborescent vascularity upon the sides of the thorax in horses that die of pneumonia; than which state nothing can better demonstrate the comparative number and distribution of these blood-vessels. The majority of them terminate in exhalent orifices, from which is continually poured, upon the contiguous surfaces of the smooth interior of the membrane, a serous fluid, in the form of steam or vapour, which may at any time be rendered visible by opening the chest of an animal recently dead. *The absorbents* of this membrane are very numerous; and though their extreme exility prevents us from demonstrating them in a state of health, yet may they often be seen in considerable numbers in horses that die of dropsy of the chest; we have also abundant proofs of their existence from various phenomena that occur in the diseases of the part: we know, for instance, that these vessels take up the serous fluid effused in hydrothorax, for they have been found full of it after death; and it is a fact that no longer admits of doubt, that blood extravasated into the chest, is absorbed by the mouths of these minute vessels.

The nerves of the pleura are too small to be traced by dissection; but, though it is not possessed of much sensibility in a healthy state, we know, at least we presume from analogy, that it is highly sensitive in the diseased; for few diseases are more acutely painful in the human subject than pleurisy, and we have every reason to believe that horses suffer much from the same malady.

Secretion. It has been observed that the exhalents of the pleura secrete a serous fluid, which is emitted, in the form of an exhalation, or vapour, into the cavity of the thorax; and that it may be rendered visible at any time, if an animal, recently dead, be opened while yet warm; or, if an opening be made into the chest of a live animal: in either case, a whitish steam will be perceived to issue from the interior of the cavity. This vapour, shortly after death, becomes condensed and converted into a liquid; which accounts for the contiguous surfaces of the pleura being moist, and for a collection of more or less fluid, resembling water, existing in the most depending parts of the cavity. In consequence of every part of the membrane being bedewed in this manner, the lung itself may be said to be in an insulated state; for the pleura costalis does not, philosophically speaking, touch the pleura pulmonalis, nor is the latter in actual contact with the mediastinum: all friction, therefore, in the motions of these parts, is by this interfluent secretion effectually prevented. In this, then, consists the chief use of the pleura, viz., to furnish a secretion for the purposes of lubrication and facility of motion, which it further promotes by its extreme glibness of surface. It is said also to answer the purpose of *ligaments* to the contained organs, thereby confining and strengthening them. The use of the mediastinum is to divide the chest into two compartments.

Lungs.

The lungs (by butchers called the *lights*) are two spongy bodies formed for the purpose of respiration.

Situation and Relation. They are contained in the lateral regions or sides of the thoracic cavity; separated from each other by the mediastinum and heart, which occupy the middle region. Prior to any opening being made into the thorax, the lungs continue to fill up every vacuity: no sooner, however, is a perforation made into the thoracic cavity than they shrink in volume, and become in appearance too small for the spaces they occupy. This arises from their being during life—or rather during the unopened state of the thorax—in a constant state of inflation with atmospheric air, which preserves them expanded; and they suffer collapse of substance the instant air is admitted, in consequence of the pressure of the atmosphere upon them, from which they were protected before by the parietes of the thorax.

Division. The lungs are two in number: the *right* and the *left lung;* partitioned from each other by the mediastinum. A further division of these organs has been made into *lobes:*—that on the right side, the larger of the two, consists of three lobes; the left, only of two: these lobes, which are nothing more than partial divisions of the lung by fissures of variable extent through its substance, serve to adapt them more accurately to the thoracic cavities, and, at the same time, render them fitter for the purposes of expansion and contraction.

Volume. The lungs of the horse, when inflated, are of great bulk*; and the right is the larger of the two: in consequence of the heart being inclined to the left side, less space is given for the left lung.

Attachment. The lungs are attached, superiorly, to the spine (which attachment is sometimes called their *roots*) by blood-vessels, the divisions of the trachea, and the mediastinal portions of the pleura: everywhere else, in a healthy subject, they are free and unconnected.

Figure. In form, the lungs of the horse are very like those of the human subject; and the latter have been compared to the foot of an ox, to which the injected lung of the fœtus bears indeed much resemblance: for, though the two lungs are not symmetrical, yet, both together, they put on this shape, which is the counterpart of that of the cavity they occupy. With regard to their general figure, however, the lungs may be said to be conical: being broad and concave posteriorly, where they are opposed to the convex surface of the diaphragm; narrow and somewhat pointed anteriorly, where they are received into the blind pouches of the pleura, in the space between the two first ribs.

Colour. In colour, these organs vary somewhat, depending upon the age of the animal, and upon the quantity and distribution of the blood they contain. In the young subject, they are of a lighter and more uniform shade than in the adult. In perfect health they assume a pink hue; which, as age advances, becomes mottled with purple and grayish patches. Sometimes, in the dead subject, they are found of the colour of the darkest venous blood, which arises from an inordinate congestion of that fluid within the pulmonary veins.

Structure. The lungs are composed of the branches of arteries and veins, and of the ramifications of the trachea; all which vessels are connected together by an abundant, intervening cellular substance, known by the name of *parenchyma*. Beneath the curve made within the chest by the posterior aorta, the trachea divides into the two bronchial tubes, of which the right is the larger, but the shorter: the left the longer, in consequence of having to pass under the aorta in order to reach the left lung. Having entered the substance of the lung, the right tube divides into four others; the left only into three; which difference arises from the right lung possessing an additional lobe: these branches may be traced for a considerable extent within the parenchyma, giving off in their passage numerous other smaller tubes of similar structure; but, as we prosecute our dissection of them, we shall find that, in growing smaller, they partake less and less of the nature of cartilage, and that the extreme ramifications are not only entirely membranous in their composition, but of so fine a texture as to be perfectly transparent. It will be remembered here, that, in speaking of the trachea, a membranous lining to it was described of the mucous kind, which, it was observed, thence passed into the bronchial vessels: now, it is of the continuation of this membrane in an attenuated state that the minute air-tubes appear entirely to consist; at the extremity of every one of which the membrane is prolonged into a kind of blind bag or cul-de-sac, to which the name of *air-cell* has been given.

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* I consider, in comparison with the body, that they exceed in magnitude

From the arborescent ramification and peculiar mode of termination of the bronchial tubes, some anatomists have compared them, and the cells at their extremities, to a bunch of grapes—supposing the stalks to represent the ramifications of the former, and the grapes connected with them the air-cells; others have described them as having a resemblance to a honeycomb: and so far as the knife, with the aid of glasses, can develope their intimate structure, the first is an apt comparison, insomuch as it relates to the disposition of their cells; the last, insomuch as it conveys an idea of their ready inter-communication. For, though they do not communicate but through the ramifications of the bronchial tubes, this is a medium of intercourse at once so general and free, that numbers of them are inflated at the same time by impelling air into any one of the larger branches: with the parenchymatous substance, however, they have no communication whatever.*

The blood-vessels that enter into the composition of the lungs are denominated the *pulmonary*. The pulmonary artery, having taken its origin from the right ventricle of the heart, winds upward to the root of the left lung, and there divides into the *right* and *left* pulmonary arteries, which divisions enter their correspondent lungs. The ramifications of these vessels (which differ from other arteries in having no anastomotic communications one with another) accompany those of the bronchial tubes, and, like them, divide and subdivide, grow smaller and augment in number as they approach the air-cells; upon the internal* surfaces of which they become capillary, and assume the texture of correspondent thinness and pellucidity with the cells themselves. Through these minute vessels every particle of blood is impelled every time it is circulated over the system, as was stated when on the blood: a remarkable change of colour is thereby effected in it, and we have now an opportunity of seeing in what manner this fluid is exposed to the influence of atmospheric air for the purpose. It is evident that no immediate contact can happen between the air and the blood, for the thin, transparent side of the vessel, if not that of the air-cell likewise, must ever be interposed; so that whatever this influence be, it must take effect through one or other or both of these membranes. We might conceive, indeed, that such minute vessels could not transmit through them such a body of fluid as the blood; but when we took at the volume of the lungs, and consider the incalculable number of air-cells they must contain, the globular surface of every one of which is furnished with an expansion of pulmonary vessels, we shall feel more surprise and admiration at the extreme division and diffusion of this fluid in order to receive the necessary change, than that such a prodigious number of capillaries should be equal, in their united caliber, to the pulmonary artery itself.

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* If the substance of the lungs be lacerated or rent asunder, the surface will be found to present a *lobulated* aspect. Introduce a blow-pipe into one of these *lobuli*, and all the other lobules—the entire lung—may be inflated from this one; showing the free communication existing between them. The same may be effected by injecting quicksilver. You may do the same with the interstitial substance: but in this case you do not fill the lobules. In fine, the lungs with their cells resemble a sponge; only that the connecting tissue has no communication with the sponge.

From the extremities of the arteries, upon the surface of the air-cell, arise the pulmonary veins. These, by repeated union with one another, form themselves, first, into visible branches, which subsequently become branches of larger size, until at length they end in eight pulmonary venous trunks, which proceed to, and by four openings terminate in, the left auricle of the heart. The ramifications of these veins, unlike the generality of others, are not more numerous than those of their correspondent arteries: and the reason for this is obvious; for, here, one set of vessels are not more subject to compression than the other, nor does the heart (which is so proximate to them) require any such aid as an additional number of veins affords to carry on the circulation. The pulmonary veins have only to convey the blood back to the heart, after it has received its due change within the capillaries upon the air-cells.

Organization. Besides the pulmonary blood-vessels, there are two others, named the *bronchial* arteries. They come off, by one trunk, from the posterior aorta, and each of them enters a division of the lungs, in the substance of which it branches forth, and

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* Some say, "upon the *external* surfaces."

The absorbents of the lungs are large and numerous, particularly the deep-seated: and of the superficial, we may often succeed in injecting considerable numbers, by introducing a quicksilver-pipe under the pleura pulmonalis. They all pass through the absorbent glands situated around the roots of the bronchial tubes.

Parenchyma. The connecting medium of the various constituent parts of these organs, or, as it is termed, their *parenchyma,* appears to consist of little else than cellular tissue, without any intermixture of adipose matter: it admits of the free diffusion of any fluid that may be extravasated into it—of air that may have escaped from the air-cells, or of serous fluid poured out when the lungs become anasarcous; but, as was observed before, there is no intercommunication between it and the cells or vessels, as long as the organs preserve their integrity of structure.

Specific Gravity. The lungs, when healthy, are exceeding light in comparison to their volume; so that if they be immersed in water, unlike most other parts, they will float upon the surface,—a fact familiar to every one who has seen the liver and lights of an animal thrown into a pail of water to be washed: indeed, the name of *lights* itself seems to have been given to them from this very property. If the fœtal lungs, however, be so treated they will instantly sink to the bottom of the vessel: and this experimental result at once shows why those of an animal that has once breathed should swim; for, in the one instance they contain air, in the other they are wholly free from it. They are not to be regarded as respiratory organs in the fœtus. It is evident, therefore, that the lungs owe their property of lightness to the air they contain; and, as a further proof of it, if that fluid be by any means absorbed or pressed from them, and their bulk diminished by collapse of the air-cells, like other viscera, they will prove heavier than an equal volume of water: hence it is that the lungs of a horse that has died of hydrothorax, even though they be sound, are of a greater specific gravity than those of one in health. It occasionally happens, however, that these viscera evince, in this particular, the properties of airless lung, while their natural volume and general appearance remain the same: there must be present interstitial deposition.

Bronchial Glands.

Small, oval-shaped, glandular-looking bodies, situated about the roots of the lungs, adhering more particularly to the bottom of the trachea and the bronchial tubes. They exhibit a dirty French gray hue, interspersed with dark blueish spots, and are about the volume (though this varies much) of a tick-bean. For a long time the nature of these bodies remained obscure: of late, skilful injections have clearly shown them to be absorbent glands. They possess their capsules, and, when cut open, exhibit a cellular structure. They contain a dark fluid, which will soil anything it touches; whose principal ingredient chemists have found to be carbon.

SECTION V.

DIGESTIVE SYSTEM.

IN THIS SYSTEM ARE COMPRISED THE MOUTH, TONGUE, SALIVARY GLANDS, PHARYNX, ŒSOPHAGUS, STOMACH, INTESTINES, LIVER, SPLEEN, PANCREAS.

OF THE MOUTH.

It may be observed here (as prefatory to the description of this part), that in quadrupeds in general, the facial angle* is one of very considerable obliquity, in consequence of the prolongation of that part of the head which corresponds to the face in the human subject: and this development of feature is in none more striking than in the horse and dog. Consequently, in these animals, the nose and mouth are cavities of large dimensions. And in the horse, the mouth appears to have been thus prolonged, not only to enable him to collect his food with more facility, but also that he might subject greater parcels of it at a time to the action of the grinding teeth, whereby the processes of mastication and deglutition are greatly accelerated.

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* The *facial angle* is the point at which one line drawn parallel with the exterior of the frontal bone is intersected by another extended parallel with the lower border of the inferior maxilla.

Conformation. The mouth is constructed, in part, of bone, and in part of soft materials. The superior and anterior maxillary and the palate bones form the roof; the inferior maxilla, the lower part; the incisive teeth, the front; and the molar teeth, the sides. The lips, cheeks, soft palate, gums, and buccal membrane, constitute its soft parts. The tongue occupies its cavity, and the salivary glands are appendages to it.

Lips.

General Conformation. The lips, two in number, *superior* and *inferior,* are attached to the alveolar projections of the superior and inferior maxillæ, by the muscles that move them; by the cellular tissue entering into their composition; and by the membrane that lines them. Their borders surround and bound the orifice of the mouth, and are united together on either side; which points of union are denominated their *commissures,* or the *angles* or *corners of the mouth.* Exteriorly, the lips are creased down the middle by perpendicular lines of division; exhibit little papillary eminences upon their surface; and present a softer and shorter coating of hair than what is found in ordinary places, out of which project several long straggling horse-hairs or *whiskers.* The inferior lip is altogether smaller, and is thinner in substance than the superior: and is distinguished by a remarkable prominence about its centre, from which grows a tuft of long coarse hairs, vulgarly designated as the *beard.*

Structure. The lips are both muscular and glandular in their composition. Several small muscles (which have already come under our observation*), arising from the maxillary bones, are inserted into them, and endow them with great self-mobility: one alone, consisting of circular fibres, is interwoven in their substance without having any other connection; this is denominated the orbicularis oris, or sphincter labiorum, from its use, which is that of closing the mouth. This muscle is an antagonist to all the others; they raise or depress the lips, or draw them to one side; but this contracts them, and occasionally projects them in such a manner, that the horse can exert with them a prehensile power, which is most remarkably evinced at the time that he is picking up grain from a plain surface; indeed, the act of nibbling our hands with his lips demonstrates this faculty, and also the force with which he can employ it. The lips are lined by the same membrane that lines other parts of the cavity of the mouth. Beneath it are seated numerous mucous follicles that elevate it everywhere into little *papillæ*, which are perforated by the mouths of these follicular glands, as may be readily seen with the naked eye by everting either the superior or the inferior lip. The skin covering the lips is extremely thin, and possesses considerable vascularity and sensibility. To the tenuity of it, and to the shortness and scantiness of their pilous covering, is to be ascribed the superior sensitive faculty of these parts.

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* Vide "Anterior Maxillary Region," p. 89.

Cheeks.

The cheeks are constituted substantially of the masseter and buccinator muscles, covered by the skin upon the outside, and the *buccal membrane* upon the inside. Their internal or membranous surface is studded with scattered mucous follicles, whose excretory orifices may be seen by everting the part.

Gums.

The gums consist of dense, compact, prominent, polished masses, of the nature of periosteum, adhering so closely and tenaciously to the teeth and the sides of their sockets, that it renders the one inseparable from the other but by extraordinary mechanical force. Like other parts of the cavity of the mouth, they receive a covering from the buccal membrane.

Palate.

Two distinct parts are included under this head; the *hard* and the *soft* palate. The hard palate is constituted of the palatine processes of the superior and anterior maxillary bones: and of a firm, dense, periosteum-like substance, the vaulted, inward part of which is elevated into several semi-circular ridges, vulgarly called the *bars*. The fibres of this substance, which possess great tenacity, are inserted into the pores of the bone in every part, but are most numerous and dense along the palatine suture; the interstices are filled up by a dense cellular tissue, through the substance of which are dispersed the ramifications of the palatine vessels and nerves.

THE SOFT PALATE, sometimes called the *velum palati*, is attached to the superior or crescentic border of the hard palate, the border formed by the palatine bones; from which the velum extends backward and downward as far as the larynx, and there terminates over the epiglottis, in close apposition with that part, in a loose semi-circular edge. In consequence of the velum palati being long enough to meet the epiglottis, the cavity of the mouth has no communication with that of the nose—these two parts forming a perfect septum between them; hence it is that a horse cannot respire and vomit by the mouth like a human being, in whom the velum is so short that there is an open space left between it and the epiglottis, through which air or aliment can pass either upward or downward. The soft palate is composed of extensions of membrane from the nose and mouth, between which is interposed a pale, thin layer of muscular fibres (described at page 103, under the appellation of *circumflexus palati*).

The velum performs the office of a valve: it prevents the food in the act of swallowing from passing into the nose, and it conducts the air from the windpipe into that cavity, without permitting any to escape into the mouth.

OF THE TONGUE.

The *tongue*, the principal organ concerned in taste and deglutition, is lodged in the mouth; filling the interspace between the branches of the inferior maxilla.

Duplicity. Like the other organs of sense, it is double; being composed of two parts, whose union is marked by a longitudinal crease along its middle, the divisions having no vascular nor nervous connection, nor in fact any intercommunication whatever: so that an animal has to all intents and purposes *two* tongues, and apparently for the same reason that he has two eyes, two ears, und two nostrils. Anatomy, as far as we can carry our researches, demonstrates this: perhaps we have no better proof of it, however, than what happens in hemiplegia, a disease in which only one half of the body is paralytic: under these circumstances, in the human subject, the patient can only see with one eye, use one arm, and taste with but one (and that the correspondent) side of the tongue.

Division. The tongue, in description, is commonly divided into *root*, *body*, and *apex*: by the attachments of the two former it is held in its situation; the latter is loose and unconnected.

Attachment. At its root, it is deeply and firmly inserted by several muscles which arise chiefly from the os hyoides and the inferior maxilla: it is also connected with the pharynx, and with the soft palate. From the sides of the lower jaw, separate layers of the membrane of the mouth are reflected upon its body, forming by their junction a sort of bridle, which is thence extended to the symphysis: to this part, which serves to restrain the organ in its motions, the name of *frænum linguæ* has been given.

Papillæ. The *dorsum* or anterior surface of this organ has a peuliar covering, which, though it appears to be continued from the buccal membrane, is a different structure altogether, and serves quite a different purpose. The surface of it is roughened, possessing a villous texture, everywhere studded with numerous little conical eminences, called *papillæ,* which are supposed to be formed out of the extremities of the nerves, and to be the especial seat of the sense of taste. These papillæ vary in size and figure, and are more abundant and larger upon the base and along the sides of the organ. Interspersed with them are a number of mucous follicles, whose apertures may be seen with the naked eye, through which a mucus is discharged upon the papillary surface keeping it continually moist, and rendering its perception of taste more acute.

Structure. The tongue is said to possess a covering of common integument; and certainly its strong compact tunic has all the appearances of skin, and presents the common tests of it: the external layer is laminated, is bloodless, is insensible; the internal or substantial part is tough, fibrous, vascular, and sensitive, in fact, is like cutis; and the intermediate or connecting material is delicate, soft, and reticular, and forms a bed for the lodgement of the papillæ. The substance of the tongue itself consists of an inter-union, or rather an incorporation of its muscles, the fibres of which intersect one another, and take a variety ef directions; but intermixed with them is a fine adipose tissue to which is owing the flabby softness of the organ, and the peculiar aspect it exhibits when cut into.

Use. Though the tongue is emphatically denominated, from its essential character, *the organ of taste,* it is not the only part that possesses this faculty; for the palate, the pharynx, and the œsophagus, it is believed, participate in it. The tongue, in addition to possessing this faculty, disposes of the food during manducation, and, when sufficiently masticated, collects and thrusts it, portion after portion, into the pharynx: and furthermore, at the time the animal is drinking, it is not only employed as an instrument of suction, but also as a canal along which the fluid ascends into the pharynx.

Organization. Every part of this organ is plentifully supplied with blood. Its arteries are the lingual, branches of large size from the external carotids. The blood-vessels of either side are generally found free from anastomosis with one another: if either of the arterial trunks is filled with injection, it rarely happens that the opposite half of the organ receives any colouring from it. Its nerves are the ninth pair, which run to the muscles, and a considerable branch from the fifth pair, in whose extreme ramifications, which are distributed to the papillæ, the perception of taste is supposed to be inherent.

OF THE SALIVARY GLANDS.

Number and Names. The salivary glands, properly so called, are six in number, three upon each side of the head;—the parotid, the submaxillary, and the sublingual.

THE PAROTID, the largest of these glands, so called from being placed near the ear, lies within a hollow space at the upper and back part of the head, bounded by the branch of the lower jaw before, and the petrous portion of the temporal bone behind: it extends as high up as the root of the ear, and as low down as the angle of the jaw, by which latter a small portion of it is concealed. This gland, like the others of the same class, is enveloped in a case of dense cellular membrane, and is constituted, in structure, of many little lobes or *lobuli*, connected together by processes transmitted into the interior from this cellular covering. Every lobulus is composed of a distinct set of secretory vessels, from which numerous *tubuli* arise, conjoin, and at length form one main branch; these branches, which correspond in number to the lobuli, unite and re-unite until they end in one common excretory duct. The duct emerges from the inferior part of the gland, runs along the inner part of the angle of the jaw, and crosses over the posterior edge of the bone immediately above or behind the submaxillary artery and vein: in the remainder of its course it corresponds to the border of the masseter, and, about opposite to the second anterior molar tooth, pierces obliquely the buccinator, and terminates by a tubercular eminence upon the internal surface of the buccal membrane.*

THE SUBMAXILLARY GLAND, of smaller volume than the parotid, lies in the space between the angles of the jaw, to which, and to the muscles thereabouts, it is loosely attached by cellular membrane: a portion of it is also generally found proceeding backward as far as the trachea. Its structure is similar to that of the parotid gland. The submaxillary duct issues near the centre of the gland, creeps along the under and inner border of the tongue, close to the lower edge of the sublingual gland, and terminates by a little mammiform elongation of membrane, vulgarly called the *barb* (barbillon) or pap, upon the frænum linguæ, about half an inch above its attachment to the symphysis. Among the other ridiculous and mischevious practices of farriers is that of snipping off these processes. They were seemingly designed as valves, to prevent the insinuation of alimentary matters into the ducts. The coats of this vessel are extremely thin and transluscent.

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* To expose this duct, at or near its issue from the gland, an incision should be carried along the posterior border of the branch of the lower jaw: first, dividing the skin; secondly, the panniculus; thirdly, the cellular tissue immediately covering the duct, which is readily distinguished by its glistening pellucid aspect. By extending the incision around the angle of the jaw, directing it towards the inner edge of the bone, the duct will be found making its first turn: here, however, it is lodged in a hollow, deeply buried in cellular tissue.

THE SUBLINGUAL GLAND is still smaller in volume than the submaxillary, though, altogether, one much resembles the other in figure. It lies along the under part of the tongue, covered by the buccal membrane, where, from the lobular unevenness it gives to the surface, its situation is well marked. Its ducts penetrate the membrane by the side of the frænum linguæ.

The use of the salivary glands is to secrete a saline limpid fluid, called, *saliva;* which is conveyed and poured by their ducts into the mouth during manducation: here it is mixed with the food, mollifying it, and rendering it more easy of digestion, and at the same time facilitating the passage of the alimentary bolus into the stomach.

OF THE PHARYNX.

The pharynx is a funnel-shaped sac, lodged in the throat for the reception of the food.

Situation. The pharynx is contiguous to the guttural pouches, superiorly; the larynx, inferiorly; and the anterior portions of the parotid glands and branches of the jaw, laterally. Posteriorly, it is continuous in substance with the œsophagus: anteriorly, it presents an opening to the mouth.

Attachment. In front, to the os hyoides and palate bones; below, to the larynx; behind, it grows narrow and ends in the œsophagus.

Structure. The pharyux is in part muscular and in part membranous. Of the muscles belonging to it (described at page 100) the constrictors are those that more immediately enter into its composition. They are so disposed as to give the membrane forming the sac a complete fleshy covering, which is rendered the more uniform by their proximate fibres being indistinguishably blended: thus the muscles form the most substantial part of the pharynx. The lining membrane, which is of the mucous class, is soft and thick in substance, and palely tinged with red.

in colour, and is papillary and in places rugose upon its surface; being perforated by the ducts of numerous follicles which discharge a mucus that preserves glibness and moisture to its interior. The membrane itself is (where it meets them) continuous both with the buccal membrane and that which lines the esophagus.

Although the pharynx is designed for the reception of the food, it does not open directly into the mouth: the two cavities are separated from each other by the soft palate and epiglottis. Except in the act of swallowing and coughing, they have no communication: in the former case, the velum is pressed upward by the food against the posterior openings of the nose; in the latter, the larynx is depressed by a convulsive action of the muscles in the vicinity. Into the cavity above the velum there are four openings—two of the chambers of the nose, one of the larynx, and one of the esophagus: the eustachian tubes do not open into the pharynx; they end in two large membranous pouches at the upper part of the fauces. The opening leading into the esophagus is constantly closed, except when alimentary matters are passing to or from the stomach; so that air received into the pharynx through the nose can pass nowhere else but into the windpipe; but if food be returned from the stomach, it will be regurgitated into the nose; at least, only that portion of it which enters the pharynx at the moment that the larynx is depressed in the act of vomiting, can be thrown into the mouth: in the same way that air is in the act of coughing.

OF THE ESOPHAGUS.

The esophagus, or gullet, is the tube through which the food is conducted from the pharynx into the stomach.

Course. It has its beginning from the pharynx, and is there placed at the upper and back part of the larynx, taking the first part of its course above and behind the trachea, between that tube and the cervical vertebræ. Having proceeded a short way down, it inclines to the left, and soon after makes its appearance altogether on the left side of the trachea, and continues so placed during the remainder of its passage down the neck: this explains why we look for the bolus during the act of swallowing on the *left*, and not on the right side of the animal. In company with the trachea, the esophagus enters the thorax between the first two ribs, at which place, running above that tube, it quits its companion for the superior mediastinum, which cavity it traverses below and a little to the right of the posterior aorta. Immediately beneath the decussation of the crura, the esophagus pierces the substance of the diaphragm, and enters the stomach, at a right angle, about the centre of its upper and anterior part.

Structure. The œsophagus presents, externally, a strong, red, *muscular* coat; internally, one remarkable for its whiteness, which in its nature is *cuticular.* The muscular coat is composed of two orders of fibres—a longitudinal, forming an outward layer; and a circular, an inward layer: the former will shorten the tube, and perhaps dilate it for the reception of food; the latter, by successive contractions of the canal, will transmit the food into the stomach. The second, or internal coat, is called the cuticular, from its analogy to the cuticle of the skin. Although it is continuous with the membrane of the pharynx, it is of a totally different composition: it is thinner, but it it much more compact and stronger in its texture, and, I believe, is both insensible and inorganic. It adheres to the muscular covering by a fine cellular tissue, the extensibility of which gives full play to the latter; and admits, during the empty or collapsed state of the tube, of the former being thrown into many longitudinal *plicæ* or folds; as is demonstrated by making a transverse section of the tube: such appearances result from the contraction of the one coat, and the want of proportionate elasticity in the other. Between the two tunics, embedded amongst the connecting cellular tissue, are numerous follicular glands, whose office is to pour forth a mucous secretion upon the internal surface of the lining membrane to render the passage of food along it glib and free from any friction.

OF THE ABDOMEN.

In consequence of the organs next to be described being contained in the cavity of the abdomen, it will be necessary to examine this cavity, in order to understand their relative situation and connexion.

THE ABDOMEN, or *belly*, is formed principally of soft parts; which parts consist, in the main, of the four pairs of abdominal muscles (described at page 124): at least, they constitute its broad superficies below and laterally. Its anterior part (where the most important viscera are situated, viz. the stomach and liver) is bounded at the sides by the false ribs, and in front by the diaphragm; its posterior compartment (containing the organs of generation), by the pelvis; its superior, by the dorsal and lumbar vertebræ, and muscles belonging to the loins.

Seeing that the contained organs lie altogether in this cavity, which is one of capacious dimensions and without any natural division in it, anatomists have found it necessary (in order to render their descriptions definitive) to divide the cavity artificially; and they have done this by drawing certain imaginary lines over its superficies, which are supposed, by means of imaginary planes let down perpendicularly from them, to intersect or partition the cavity into so many compartments, to which the name of *regions* has been assigned.

The primary and grand division of the abdomen is into three regions—the anterior, or *epigastric;* the middle, or *umbilical;* and the posterior, or *hypogastric.*

THE EPIGASTRIC REGION is the space comprehended between the ensiform cartilage and an imaginary line drawn across the abdomen, posteriorly to the cartilages of the false ribs: it is subdivided into three others—the *scrobiculus cordis,* the space included between the ribs; and the *right and left hypochondria,* the lateral cavities or boundaries of it.

THE UMBILICAL REGION extends in breadth from the line just mentioned to another drawn across from one anterior spinous process of the ileum to the other: it is equally subdivided into three others by transverse lines, the middle of which retains the name of *umbilical region,* while the lateral are called the *lumbar regions.*

THE HYPOGASTRIC REGION extends over the remainder of the belly. It is also subdivided into three: the part included between the spinous processes of the ilea and the pubes receives the name of *regio pubis;* the latter subdivisions, of *iliac regions.*

The abdominal viscera of the horse differ from those of the human subject chiefly in the shape and comparative size of the stomach and the colon: their general relative situation and connection we shall find to be much the same in both.

Having opened the cavity of the abdomen, by making a crucial incision through its muscular parietes, we perceive that its interior, and the viscera lying within it, present an uniform glistening surface; are smooth, polished, humid, and slippery to the feel; and are bedewed with a limpid exudation: all which arises from their possessing a general investing membrane of the same (serous) class as the pleura, and which appears, in most respects, to perform similar uses. To this part the name of *peritoneum* has been given.

Peritoneum.

The peritoneum is the membrane, then, that lines the cavity of the abdomen, and is reflected upon the contained viscera. When I introduce my hand into the belly, every surface I apply it to being covered by peritoneum, I am not, in truth, able to actually touch any of the viscera within it: this, we know, is precisely the same case in regard to the pleura.

Texture. The texture of this membrane also is like that of the pleura. Strip it off from any part, and it will prove rough and shaggy, exteriorly, from the presence of numerous little flocculent adhesions; and this shows the nature of its attachment to the several parts it invests; viz. by cellular tissue. But its interior surface is everywhere smooth, glib, and humid; and this is assignable to two causes—to the uniformity and compactness of its texture, and to the exhalation of a serous vapour, which after death becomes condensed, and which we always find more or less of, in the liquid state, between the different viscera. The peritoneum appears to be composed of condensed cellular membrane, interwoven with numerous blood-vessels, some nerves, and many absorbents. It is extremely elastic, whereby it accommodates itself, without corrugation, to the perpetually varying capacity of the cavity, as well as the frequent change of volume and relative situation of many of the viscera: indeed, at certain times, it must admit of very considerable extension; *e.g.* in the mare during gestation, and in ascites.

Ligaments. What are called the *ligaments of the peritoneum*, are certain parts which in the fœtus were vessels of importance, but which in the adult degenerate into impervious chords, and for this reason have their name altered. The *anterior ligament* or *ligamentum rotundum* (originally the umbilical vein) runs between the peritoneum and abdominal muscles, from the *umbilicus*, or navel, to the liver. The two *posterior ligaments* (consisting of what once were the umbilical arteries and the urachus) pass in the same manner from the navel to the bladder; the former traversing its sides to join the iliac arteries, the latter entering the substance of the bladder at the very apex of its fundus. In the young animal it generally happens that these vessels are pervious for a considerable distance; but then their caliber is exceedingly reduced in size, their coats being proportionately thickened.

Use. The principal use of the peritoneum is to secrete a serous fluid—a fluid that exists in a vaporous state during life, for the lubrication of every part of the membrane; in consequence of which those viscera that are continually moving within the belly glide over one another not only without friction, but without exciting the least consciousness of their motions on the part of the animal himself. In addition to this, the peritoneum furnishes most of the viscera with a complete external tunic, and thereby adds strength and firmness to their several textures; it attaches, and supports, and confines those viscera (within certain limits) in their respective places; and it strengthens the abdominal cavity altogether by its uninterrupted extension every where through and around it.

Of the Situation of the Viscera of the Abdomen.

When the cavity of the belly is laid open, the large intestines present themselves first to view; consequently they are placed undermost when the animal is standing, and are lying immediately in contact with the abdominal muscles. About the middle of the cavity, the apex of the cæcum is seen protruding from the body of the intestine of that name, which is extended to the right side, encircled by the colon. Generally speaking, the small intestines are not seen on first reflecting the muscular flaps: this, however, will depend on the state of the large; for if they are flaccid some of the small guts will insinuate themselves between the cæcum and colon: should we not see them, however, in the first instance, they may at once be brought into view by turning the cæcum to the right side.

THE STOMACH is principally lodged in the left hypochondriac region, though a part of it extends into the epigastric, and there crosses the spine. Its anterior or convex part lies against the diaphragm and the false ribs of the left side; its posterior or concave part is concealed by the intestines; its lower surface is invested by omentum; its left extremity has the spleen attached to it, which viscus also extends along its great curvature; and its right end is in contact with the left and middle lobes of the liver.

Prior to proceeding to the situation and course of the intestines, it becomes necessary to anticipate a little in our descriptions, by observing here, that anatomists have divided these viscera into *small* and *large;* and that the former, beginning from the stomach, comprehend three subdivisions—the *duodenum, jejunum,* and *ileum;* the latter, commencing from the termination of the small, likewise three—the *cæcum, colon,* and *rectum.*

THE DUODENUM takes its beginning from the right extremity of the stomach, and soon after forms a curvature around the head of the pancreas; having the liver above, and the great arch of the colon below it. Having reached the concave part of the liver, it makes a sudden turn backward and to the right, and becomes attached to the right kidney; lastly, it crosses the spine, between the roots of the mesentery and mesocolon, to the left side, where it takes the name of jejunum. This gut, during its course, is so closely bound down by peritoneum, that its motions must prove exceeding limited; so that it will always bear pretty nearly the same relative situation in regard to those viscera whose motions, like its own, are confined—the stomach, the liver, and the kidney.

THE JEJUNUM AND ILEUM (two intestines that do not essentially differ from each other, except that the latter is one fifth longer than the former) constitute together numerous convolutions, which are lodged principally in the umbilical region, where they are encircled and in part concealed by the colon. They are but loosely connected to the spine by peritoneum; so that (unlike the duodenum whose attachments are so short) they can move in various directions and to a considerable extent: a circumstance, of course, that will materially affect their relative situation.

THE ILEUM, towards the right side of the cavity, terminates in a part of the *large* intestines, which, from its continuity with the colon, to which and to the cæcum it appears to give origin, has been denominated the *cæcum caput coli*, or blind head of the colon. From this part proceeds downward the *body* of the CÆCUM, and this accounts for its apex protruding in the manner already described, amid the convolutions of the colon.

THE COLON, taking its origin from the same part as the cœcum, at first passes downward, and encircles the body of the cœcum, running both before and behind that gut: next, it reflects upon itself, and makes a second turn like the first; so that this part, which may be called its *great arch*, is double. That portion of the second flexure of the intestine which forms the upper and anterior part of the arch, and which fills up the bottom of the space between the cartilages of the false ribs, is of very considerable volume; in its course, however, to the left side of the spine, it becomes again contracted, aud is there attached to the spleen, with which it now runs in contact. Under the left kidney it makes a sudden curve backward, and becomes reflected upon itself somewhat like the letter S: from which peculiarity of figure this part is called the *sigmoid flexure of the colon.* It is worthy of remark here, that although the colon and cæcum are intestines that possess considerable motion, they are so united that they cannot alter their places materially *in regard to each other:* it may be added also, that they will invariably occupy the lowermost parts of the abdominal cavity.

RECTUM.—As soon as the colon has reached the basis of the sacrum, it ends, and the intestine assumes the name of RECTUM: the remaining portion of gut, however, though so called, is not perfectly *straight*, but follows the bend of that bone. It terminates by an enlarged extremity in the anus.

THE OMENTUM (the intestines being drawn to one side) is now brought into view, investing the lower part of the stomach; to the great curvature of which, and to that portion of colon which crosses the spine to form the sigmoid flexure (its last turn), it is attached. In the horse, the omentum is small, and seldom contains much adipose matter. It consists of four layers of peritoneum: two derived from the stomach, and two from the colon; which are disposed in a manner that will be pointed out when the reflection of that membrane is considered.

Mesentery. The small intestines are loosely connected to the spine by a duplicature of peritoneum, called the MESENTERY; the colon is attached in like manner to the bone by a production of the same membrane, named the MESOCOLON; and the rectum is confined in its place by a similar reflection, by some described as the MESORECTUM.

THE LIVER is, in major part, situated in the right hypochondriac region, though some part of it lies in the epigastric, and a small portion extends between the stomach and diaphragm into the left hypochondriac region. This viscus is confined in its situation by means of, what are named, its *ligaments;* which, with the exception of one, are nothing more than productions of peritoneum. The one attaching the right lobe to the diaphragm, is called the *right ligament;* a similar one connecting the left to it, the *left ligament;* between the diaphragm and its middle lobe, we find the *suspensory ligament;* and immediately above that, surrounding the posterior vena cava, the *coronary ligament:* lastly, within the folds of the suspensory ligament are the remains of the umbilical vein, to which the name of *round ligament* has been given. The large lobe of this gland is concealed by the great arch of the colon; its left and middle lobes are in contact with the stomach, and its right with the duodenum and upper margin of the right kidney: to all of which it has peritoneal attachments.

THE SPLEEN is situated in the left hypochondriac region, lying there within the concavities of the false ribs, with the hindermost cartilages of which its margin lineally corresponds; so that if the abdomen were pierced from the left side posteriorly to the last rib, this organ would escape injury. It is attached to the left half of the great curvature of the stomach; but the chief bulk of it lies behind and rather above the stomach. Its anterior end lies in contact with the left lobe of the liver: its posterior is connected to the left kidney, and concealed by the convolutions of the colon.

PANCREAS. — The most ready way to get a view of the pancreas is to tear through the omentum. It lies across the spine, within the epigastric region, underneath the crura of the diaphragm, immediately behind and a little above the small curvature of the stomach. Its head is surrounded by the duodenum, with which, and with the stomach and colon, it is chiefly connected; and its body which is pierced by the vena portæ, has one attachment to the spleen, another to the left kidney.

Of the Reflection of the Peritoneum.

In order that the various connexions and relations of the peritoneum may be perfectly understood, it is usual, at this time, to trace (what the Schools call) its *reflections;* by which is meant, to show the way in which it lines the cavity, and afterwards invests the different viscera contained in it. The peritoneum, though a perfect sac, taken as a whole, is not, as far as regards the cavity of the belly, a circumscribed bag; at least, it is not in the male, subsequent to the descent of the testicles; for those organs in their passage carry down a portion of the membrane into the scrotum, whereby the cavity of the tunicæ vaginalis (in which the testicle is contained) becomes continuous with that of the abdomen; and ever afterwards the two have free communication, so that water or air will readily pass from the one to the other: notwithstanding this, however, the integrity of the peritoneum itself remains still unimpaired. In consequence, therefore, of the membrane being continuous at all points, it possessing, the same as a bag without an opening, neither beginning nor ending, it imports but little from what part of it description is commenced. We may begin at the inferior part, where it gives a lining to the abdominal muscles, passing from them over the pubes upon the fundus of the bladder, from which it is extended on either side to the parietes of the pelvis, which extensions are called the *vesical ligaments.* From the fundus it continues round upon the superior surface of the bladder, as far backward as its *cervix:* at the same time ascending to inclose the rectum and attach it to the sacrum; thus forming the *mesorectum.* From the sacrum it advances upon the lumbar vertebræ, which it soon after quits to invest the colon, and afterwards returns to the spine, in this manner forming the *mesocolon.* It descends from the spine a second time, to invest the whole mass of small intestines (and also the arch of the colon); and having done so, returns again, and thus forms the *mesentery;* at least one layer of it, the other coming up to meet this from off the surface of the pancreas. Having reached the spine, these two layers unite by adhesion, and become reflected together in a direction downward, and afterwards backward, spreading under the bowels for some short way posteriorly, and then doubling over upon themselves and turning back and advancing again, and running to the stomach, giving that a covering: in this manner the loose floating production of peritoneum denominated the *omentum,* is formed: which consequently consists of four layers of peritoneum. From the stomach the membrane spreads right and left: the left invests the spleen; the right passes to the liver, and having given the gland a complete covering, is continued upon the posterior surface of the diaphragm: the several portions of peritoneum connecting the one to the other, forming the *ligaments of the liver.* The part of the membrane which comes off from the posterior parts of the liver extends from it to the duodenum, and from that to the pancreas, to go to form the anterior layer of the mesentery. The kidneys and the pancreas cannot be said to receive peritoneal coverings; inasmuch as the membrane simply passes over their unattached surfaces.

OF THE STOMACH.

The stomach is a pouch or bag, formed for the reception of the food as it passes through the esophagus.

Importance. It is an organ of singular importance in the body; and the strongest proof, probably, we have of its being so, is the universality of its existence in animals, from the highest to the lowest amongst them: this is not the case with the brain, much less with the heart; and it was this circumstance that led Mr. Hunter to regard the presence of a stomach as the chief characteristic between animals and vegetables. The stomach has been emphatically denominated *the organ of digestion;* because within it, the aliment transmitted by the esophagus in a crude state, undergoes its primary and principal change in a process the object of which is to convert it into material for the support of the body.

Situation, Position, and Plenitude.—The stomach is situated principally in the left hypochondrium, which it nearly fills, extending more or less into the epigastrium, according to its state of plenitude. Its anterior part lies in contact with the liver; its left extremity is opposed to the diaphragm and spleen, and it lies in part upon the small, but mainly upon the large intestines. It is evident that the full and empty conditions of the stomach must affect its position in relation to the neighbouring viscera, and that the motions of the diaphragm will alter its situation; for during the recess of that muscle, it must be pushed more or less into the umbilical region. On the other hand, the action of the diaphragm will be impeded by distension of the abdominal viscera, and more particularly by fulness of the stomach: increased pressure must counteract its efforts to recede, and the thorax, under these circumstances, must have recourse to other inspiratory agents—the intercostal muscles, and those passing from the ribs to the fore extremities. This accounts for the inaptitude of horses recently fed to undergo violent exertion, and the increased embarrassment in respiration that hard work then occasions—why they should be sooner *blown*, and why they will, if pressed, absolutely sink from premature exhaustion: hence the practice of keeping hunters *short of water*, and of feeding them unusually early, and on corn only, on the morning of hunting.

Form. The stomach has been not inaptly likened to the air-bag of a set of bag-pipes: I should probably fail in conveying so good an idea of its shape by any other resemblance.

Division. For the convenience of description, it has been divided into several parts: *e. g.* an *upper* and an *under surface*; a *left* or *large extremity*, which is formed into a large blind pouch or *cul-de-sac*, called its *fundus*; and a *right* or *small end*, which opens with a bend into the duodenum or first intestine; a *large curvature*, to which the spleen is attached; and a *small* one, extending between its two openings: the former of these curvatures in the living animal, is turned upwards and backwards; the latter, downwards and forwards.

Orifices. The stomach has two *orifices*. One, in which the esophagus terminates, is situated about the centre of its anterior part, at the right extremity of the small curvature, and takes the name of *cardia*: it is constantly closed but when matters are passing into or out of the organ. The other is placed at the termination of the right or small extremity, and opens into the duodenum: though it has the power of closing, this one is mostly open.

Connexion. The stomach is fastened in its place by its union with the esophagus and duodenum. It has other connexions, but they are of a peritoneal nature: viz. at its great curvature, it is attached to the spleen and colon by the omentum, at the cardia to the diaphragm by a fold of peritoneum, and near its pyrolic end to the liver by an extension of the same membrane. The esophagus, previously to entering the stomach, makes a sudden incurvation downward, by which an angle of such a nature is formed between them at their junction as to have the effect of a valve in preventing any regurgitation of aliment.

Volume. Perhaps no animal, in proportion to its size, has so small a stomach as the horse. Let us only compare it with that of the human subject: the stomach of a middle-sized man (a man weighing twelve stone) will contain more than three quarts of water; whereas that of an ordinary-sized horse, whose body exceeds his in weight and bulk by *eight* times, will not hold more than three gallons, or *four* times the quantity of the man's. We are to bear in mind, however, that the stomach, like other hollow muscles, has the power of accommodating itself to the bulk of its contained matters; so that we are not at liberty to draw conclusions of its comparative volume barely from the state of plenitude in which we may find it. At another time I shall endeavour to show why Nature has given so small a stomach to the horse; an animal whose consumption of food we know to be enormous.

Structure. The stomach is composed of four layers of substance, termed *coats.* The first is that which it derives from the peritoneum, thence called the *peritoneal coat:* at the greater curvature the layers coming from the omentum disunite and separate, and spread uniformly over both surfaces of the organ. In texture, this coat is the same as the parietal portion of the membrane, and, like that, exhales a serous vapour from its surface, to obviate friction between the stomach and those viscera with which it lies in contact. Inwardly, the peritoneal adheres, by a fine dense cellular tissue, to the next tunic.

The second or *muscular coat,* lies immediately underneath the peritoneal. It is composed of two orders of fibres, which may be most plainly seen when the stomach is distended with air, and its peritoneal covering stripped off. The exterior fibres run in a longitudinal direction, and are fewer in number and weaker than the interior, which take a circular course, and are strong and well-marked, particularly about the pyloric extremity, where they appear to be blended with those of the duodenum: from this arrangement of the fibres, the cavity can be diminished in every dimension.* If we slit open the pylorus, we shall find a valvular projection, forming the boundary line, internally, between the stomach and the intestine: this is called *the valve of the pylorus;* it is made up of a circular production of muscular fibres enveloped within a fold of the internal coat. Though this valve certainly tends to prevent the return of alimentary matter from the intestines, yet do physiologists not regard this as its *principal* use. They believe that its operation is rather that of preventing the escape or expulsion from the stomach of any crude or indigested aliment—of solid matters that have not been duly softened and dissolved—into the intestinal canal: I say *solid* matters, for fluids pass freely through it at all times into the intestines, without detention in the stomach. Actual experiment evinces that they do: but we may also satisfy ourselves of this fact by contrasting the quantity of water a horse that is thirsty will take at a single draught with the known capacity of his stomach.

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* In a case of œdema of the coats of the stomach, I found the muscular coat in a state particularly favorable for demonstration. I could not detect any longitudinal fibres *but at the curvatures;* and they were most distinguishable around and in the vicinity of the great curvature. The circular fibres were everywhere very strong and demonstrable—their *fasciculi* were plainly shown, in consequence of being separated and elevated from the internal tunic by the serous fluid with which the connecting cellular substance had become infiltrated. They were, many of them, nearly as large as crow-quills, and put on a very pale ash-coloured hue.

Cuticular. The stomach of the horse-species differs remarkably from that, I believe, of all other quadrupeds, with the exception of the graminivorous *monogastric,* in having a partial *cuticular* lining, that may be reckoned as a *third* coat: by turning the viscus inside out, or by slitting it open along it great curvature, this part, so conspicuous for its white and wrinkled surface, will be broadly exposed to view. And now we can trace its well-defined border, forming the boundary line between it and the other internal coat, the course of which is waving or serpentine, something like the figure of an S. This lining extends over the cul-de-sac or left extremity of the stomach, covering not quite one half of its entire internal surface. We commonly find it thrown into wrinkles, technically termed *rugæ,* which in some are so disposed, as to form a sort of net-work; a condition that is owing to its not being possessed of sufficient elasticity to accommodate itself to the varying capacity of the organ. This cuticular substance is of the same nature as the lining of the esophagus, with which, indeed, at the cardia it is continuous. Numerous small openings are visible upon its innner surface, through which issues a mucous fluid, the product of follicular glands underneath, which serves a use in the digestive process.

The fourth, mucous, villous, or other internal coat, extends over that part of the stomach left unoccupied by the cuticular. Its surface is of a yellowish cast, inclining in places to a red. It is soft, fine, and cellular in its texture, and possesses considerable vascularity. When closely and attentively examined, it is found to present inwardly, numerous little ragged or shaggy processes, which, from their giving it the appearance of velvet, have received the name of *villi:* hence the epithet, *villous.* They appear to be composed principally of the minute ramifications of those blood-vessels which we believe to perform the office of the gastric secretion: by some the villi are supposed to have numerous minute glands in their composition; but, in point of fact, we do not know precisely what is their intimate structure.* This coat, as well as the cuticular, occasionally exhibits numerous rugæ upon its internal surface, which disappear upon extension.

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* Some persons say that the follicles upon the internal coat are for the purpose of secreting *mucus;* others, that they prepare the *gastric fluid.* Every

Organization. For no organ, with the exception of the brain, has Nature made more ample provision to insure a supply of blood than for this. Its arteries are—the *superior gastric,* which is derived from the posterior aorta, and is distributed to its small curvature, and upper and under surfaces; the *right* and *left gastric,* which branch from the hepatic and splenic arteries, and take their course along its great curvature; besides numerous small ramifications from the trunk of the splenic, called the *vasa brevia.* Most of these vessels take a tortuous course, and by so doing accommodate themselves to the varying volume of the organ. Their ultimate distribution is to the villous lining, in which they ramify to great minuteness, and exist in such abundance as to render it uniformly red when injected with size and vermilion. The veins, which are somewhat larger in size than the arteries, and have no valves, terminate in the vena portæ. The stomach possesses numerous absorbents, and is well supplied with nerves from the eighth pair and sympathetic.

OF THE INTESTINES.

The intestines are cylindrical tubes of extremely unequal volumes, forming one continued but convoluted canal from the pyloric orifice of the stomach to the anus; in which, the process of digestion, begun in the stomach, is completed.

Situation. These viscera, taken collectively, cannot be said to be lodged in any particular regions: they are spread over principally the *inferior* parts of the cavity of the abdomen, immediately supported by the abdominal muscles, and are found, one or more of them, in every region of a cavity, of most of which they occupy the greater space.

Length. The intestines of the horse are ninety feet long, or between *eight and nine* times the length of his body: those of the human subject are about thirty-four feet long, or *six* times the length of the body.*

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one knows that the stomach does secrete mucus, and a peculiar liquor; but I do not, for my own part, see the sources of this. We see distinct sources in the intestines, but we do not in the stomach; at least I cannot.—*Abernethy's Lectures, in the Lancet.*

* I was at first undetermined in my mind how I should draw this comparison. I put down the ordinary height of men at 5 feet 8 inches. I then extended a line from the forehead, above the orbital arch, of a middle-sized horse, to the point of the hip, and thence carried it to the ground: this I found to measure 11 feet. These, with the relative lengths of the intestinal

Division. These viscera are divided into the *small* and *large* intestines: the latter, as their name implies, exceed in volume the former. Each of these divisions is subdivided into three parts; and these have each of them a particular name. I shall take into consideration the *general* structure of these tubes, in which they all agree, before I proceed to a detail of their differences.

General Structure. An intestine is composed of three coats; the first or external is called the *peritoneal;* the second or middle, the *muscular;* and the third or internal, the *villous* or *mucous coat.*

The peritoneal coat is simply a covering continued from the peritoneum itself, which includes the mesenteric vessels and nerves in its way to the intestines, and connects them to the spine, to one another, and to other viscera. It intimately adheres by fine cellular membrane to the muscular coat underneath. It serves to strengthen the tubes; to furnish a lubricating serous perspiration; and either to restrain their motions within certain limits, or to confine them altogether to their places.

The muscular coat, like that of the stomach, is composed of two orders of fibres:—a longitudinal, running immediately underneath the peritoneum, and consisting of a few pale scattered *fasciculi;* and a circular, of which the fibres are placed more inwardly, are stronger, more numerous, and more distinct. By a combination of both their actions, the intestine may be contracted in every direction; for while the former will have a tendency to shorten it, the latter order of fibres will operate forcibly in diminishing the caliber of its canal: it is the circular fibres, however, that are principally called on for action; by their operation the aliment is propelled gradually through them.

The villous or mucous coat of the intestines, though in general appearance it resembles the one of the stomach, differs from it in many essential particulars. It is also of infinitely greater extent, presenting a surface for absorption and secretion, exceeding even that of the common integuments. Its *villi* (more especially in the small intestines), instead of consisting principally of minute blood-vessels, are crowded with lacteals, which are supposed to take their origin from them by open mouths. And besides the villi, its interior is studded with numerous glandules, the size and seats of which vary somewhat in the different in-

canals, I have taken as the *data* of my calculation. Whatever objections they may be liable to, we may at least draw this conclusion from them,—*that the intestines of a horse exceed in proportionate length those of a man.*

testines: these secrete a glairy, mucous fluid, which they pour forth upon the surface of the membrane, in order to sheath and defend it from the acrimony or mechanical irritation of the aliment (as well as from any supplementary mechanical or chemical irritant), and also to facilitate its passage through them. In the small intestines of the human subject, this coat is collected into numerous transverse folds, called *valvulæ conniventes,* from their being supposed to have the effect of so many imperfect valves: but in those of the horse no such structure exists, it not being requisite (for reasons I shall hereafter give) either to retard the passage of the aliment here, or to multiply the lacteal apparatus. Having described the appearance and structure of the intestines *in general,* I shall proceed to point out *the peculiarities* of them, beginning with the

Small Intestines.

The small intestines are much smaller and also more uniform in their caliber than the large, and exceed them greatly in length. They are constituted of three parts or subdivisions, named the *duodenum, jejunum,* and *ileum.*

THE DUODENUM is more capacious than either of the others, especially at its beginning, but in length is much inferior to them: its name* is inapplicable in the horse, for it is nearly twice twelve inches long. I have already given its situation, course, and connections—I have no need therefore to enter again into their detail here; all I wish to repeat is, that it begins at the pylorus of the stomach, and, having crossed the spine, terminates in the jejunum. It not only differs from the others in being larger and shorter, and in being straighter, but in being redder—more vascular than either of them. It is however at once distinguished from *all* the other guts, both large and small, by receiving the ducts of two important glands, situated near it, viz., the liver and pancreas: these tubes terminate by one common orifice upon its internal coat, about the distance of six inches from the pylorus. Unlike the jejunum or ileum, the duodenum receives only a *partial* covering from the peritoneum: the membrane is reflected only upon its inferior and lateral parts; the superior surface being attached to the liver, kidney, and spine, by cellular tissue only. Its motions are exceedingly limited.

THE JEJUNUM, paler, less in caliber, and much longer than the duodenum, is extremely tortuous in its course, floating about loosely within the cavity together with the convolutions of the ileum: there is, in fact, little or no distinction between these guts, except that the latter, by an arbitrary division, is longer by one fifth than the former.

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* DUODENUM. From *duodenus,* consisting of twelve; so called because it was not supposed to exceed the *breadth of twelve fingers:* but as the ancients dissected only animals, this does not hold good in the human subject.—*Hooper's Lexicon Medicum.*

THE ILEUM is the longest of the small (and indeed of all the) intestines: it forms the greater part of that convoluted tube which lies principally in the umbilical region. Probably it is still less vascular (being somewhat paler) than the jejunum. It is certainly less in caliber towards its posterior extremity; which ends, rather abruptly, in the beginning of the large intestines. The jejunum and ileum being attached to the spine by that loose doubling of peritoneum, the mesentery, can move about within the cavity, regulating their movements and relative position according to the volume of the stomach and stage of the digestive process.

Organization. The small intestines are supplied with blood by the *anterior mesenteric artery;* a vessel of large size, that, after having divided and subdivided many times, sends off numerous small branches, which ramify to great minuteness between their muscular and villous coats. Their veins, which have no valves, return the blood into the vena portæ. The nerves come from the mesenteric plexus.

Capacity. The small intestines altogether will contain about eleven gallons of fluid.

Large Intestines.

The large intestines are shorter in length, but considerably more bulky in volume than the small. They also differ remarkably from the latter in their general appearance—in being puckered into numerous plaits or folds. This peculiarity is occasioned by some longitudinal muscular bands, which, not being so long as the rest of the intestine, pucker its coats, and contract them into folds: to these bands are appended numberless little, fatty processes, to which anatomists have given the name of *appendiculæ pinguedinosæ.* Interiorly, the large intestine is divided into many little elliptical pouches, denominated *cells,* with partitions between them; which, though they appear to answer similar purposes as the valvulæ conniventes of the human intestine, viz., the retardation of the passage of the contents and the augmentation of the surface for absorption, differ essentially from them in being constituted of *all* the coats of the gut. In other respects, the structure of the large and small guts is not materially different.

Subdivision. The large intestines, like the small, are three in number, viz., the *cæcum, colon,* and *rectum:* they do not, however, bear the same degree of resemblance, one to another, as the divisions of the small.

THE CÆCUM or blind gut, the first subdivision of the large intestines, originates in a bulky capacious head or receptacle, called the *cæcum caput coli,* or blind head of the colon, from which it extends downward, and terminates in a blind extremity or *cul-de-sac:* from this part, in the human subject, proceeds a slender elongation of gut, about the size of a quill, denominated the appendix vermiformis. Before we proceed further in the description of the cæcum, it is proper to notice the manner in which the small are united to the large intestines. The termination of the ileum projects for some way into the caput coli, and does so at right angles both with it and with the cæcum, so that the contents, having once passed the ileum, are not likely to return: independently of this preventive contrivance, however, there is a valve at this part very like that at the pylorus. This valve, *the valvula coli,* is formed of a doubling of the internal coat, within which is folded a circular band of muscular fibres; and in its shape resembles a half-moon, so that it is not equally prominent at every part: its office is that of permitting certain alimentary matters and all fluids to pass from the ileum, but to oppose their return.

Peculiarities. The cæcum differs from all the other guts, in having but one opening into it; consequently all matters that have once entered it, must reascend into the caput coli in order to continue their route. The exterior parts are braced by *three* longitudinal bands, and puckered by them into three sets of cells internally: these cells, which are abundantly supplied with blood-vessels and absorbents, extend the surfaces for absorption and secretion, at the same time that they prolong the stay of the contained matters. The contents of this gut after death are generally found to be fluid: it would appear, indeed, to be the proper receptacle for fluids; for if we give a horse water to drink, the greater part of it will flow at once through the stomach and small guts, and collect within the cæcum.

Capacity. It will hold about four gallons of fluid.

THE COLON in the horse is a gut of enormous size, being the most capacious and longest of the large intestines.

Capacity. It will contain about twelve gallons of water, a greater quantity than the small intestines will hold, put them all together.

Form and Course. This is an intestine possessing a peculiarity of figure as well as course. It begins at the cæcum caput coli—that voluminous dilatation of gut between the termination of the ileum and mouth of the cæcum—and soon expands into a cavity of greater dimensions than even that of the stomach itself; having attained which prodigious bulk, it begins to contract, and continues to do so gradually during its course around the cæcum, until it has completed its second flexure, where it grows so small, that it scarcely exceeds in caliber one of the small intestines; and though from about the middle of this turn it again swells out by degrees, it never afterwards acquires its former capaciousness: indeed, previously to its junction with the rectum, it once more diminishes, and finally assumes the caliber and general appearance of that gut. Its first flexure has *three* longitudinal bands, which give it a plicated appearance externally, like the cæcum, and form it into very many deep and capacious cells within: its last turn, however, has but *two,* and the cells in it are not only less numerous, but are much shallower as we approach the rectum. This fact tends much to strengthen our opinion of the uses of these cells: for in this part of the alimentary canal, the matters being feculent, no farther absorption is required to be made from them; therefore, of course, they need not be longer detained. Not only, however, are the cells fewer and less distinct at this part, but their supply of blood is diminished; so that the intestinal secretion (which it is believed contributes to the completion of the digestive process) is here probably wanting altogether, or but very sparingly produced.

RECTUM. At the upper part of the circumferent margin of the pelvis, the colon terminates in the rectum. In the horse, this is a comparatively short gut, being continued in nearly a straight line to the anus.

Capacity. It will hold about three gallons of fluid.

Peculiarities. The rectum, independently of its general figure and dimensions, differs from the cæcum and colon in possessing but a partial peritoneal covering and in having no muscular bands, nor cells. Its posterior extremity, more capacious than the anterior part of it, is furnished with a circular muscle—*the sphincter ani;* which, with the adipose matter in which it is cushioned, forms and gives that prominence to the anus so remarkable in the living animal. The use of the sphincter is, by keeping the anus closed, to retain the feculent matter until so much of it be accumulated in the rectum as to excite a desire to discharge it. So that the sphincter is a muscle that is in *constant* action, otherwise the fæces would be continually escaping, and so far it acts *involuntarily;* but in order to expel them, the animal has recourse to a *voluntary* power—to abdominal compression, exerted principally by the internal oblique and transverse muscles;

whose operation is aided by the muscular coat of the intestine itself, which for that purpose is possessed of stronger fibres than the others.

Organization. The large intestines receive their supply of blood from a vessel of less size than the one going to the small; viz. the *posterior mesenteric artery.* It is a branch from the posterior aorta; and its distribution is similar to that of the anterior mesenteric. The veins end in the vena portæ, and possess no valves. The nerves belonging to these intestines issue from the mesenteric plexus.

OF THE LIVER.

The liver is the largest *gland* in the body: it performs the function of secreting bile.

Situation and Connection. Already given at page 247.

Figure. Its figure varies somewhat, but not a vast deal, in different domestic animals; it is convex upon its anterior surface; concave upon its posterior; is thick in substance about its middle parts; but in general declines to attenuated edges around its circumference. It is cleft in various places. These clefts are deeper, and the edges are thinner, in general, in quadrupeds than in the human body.

Colour. A reddish brown: its hue will vary according to the quantity of blood there may be in the gland.

Division. By its clefts or *fissures,* the liver is divided into what are called its *lobes;* of which division there is a great variety in the different species of quadrupeds. In the horse the gland is constituted of two principal lobes, *right* and *left,* united by a *middle* or intervening *portion,* and two *lobuli,* or small or accessory lobes.

Lobes. The right, the larger of the two principal lobes, is situated entirely within the right hypochondrium. Proceeding from its obtuse border, along its concave part, is seen one of the lobules—*the lobulus caudatus*—which is nothing more than a sort of triangular portion of liver included within the fold of the right ligament. The other lobule possessing a circular border with several clefts or fissures through it, whence it may be denominated the *lobulus scissatus,* issues from the anterior and under part of the middle portion. The left lobe, nearly equal in size to the right, has the general outline of an oval: indeed this figure would be perfect, were it not interrupted by the union of the lobe with the middle portion.

Peritoneal Covering. Every part of the liver (with the exception of the spaces occupied by the coronary ligament and posterior vena cava) is so closely invested by peritoneum, that the membrane has the effect of being a distinct capsule: and (though some have described a covering underneath, as separable from it, which they have named the *tunica cellulosa hepatis*) anatomists in general do not admit of any other tunic.

Arteries. The liver, like other true glands, is composed of arteries, veins, excretory ducts, nerves, and absorbents, united together by a particular tissue, to express which we have the term, *parenchyma.* Its artery, the *hepatic,* a branch of the abdominal aorta, is but of small size in proportion to its bulk, and in comparison with others which supply the viscera in the vicinity: *e. g.* if we contrast the splenic artery with the spleen, or the emulgent with the kidney, and then compare them with the hepatic, and contrast the hepatic with the liver, we shall find that the latter are remarkably disproportionately small.

Vena Portæ. In the venous system of the liver we discover a peculiarity, of which no parallel instance is to be found in the animal structure: not only is it furnished with veins that perform the office of returning blood, but it has others for the purpose of conveying blood *to* it, which are to be regarded in the light of secerning *arteries.* The trunk they spring from is called the *vena portæ,* a vessel formed out of the union of the splenic and mesenteric veins, which takes place immediately above the pancreas. Its course lies over the duodenum, on the right of the hepatic artery and duct, to the concave part of the liver: about opposite to the middle of the right lobe, it bifurcates; the right division directly enters the gland; the left continues its course forward, in company with the hepatic artery, and subdivides into two others, which penetrate the middle portion and left lobe of the organ. Their branches spread out in an arborescent manner within the substance of the liver, ramify to great minuteness, and at length radiate into a system of capillary tubes, which, from some peculiarities they exhibit in their arrangement, have been named *penicilli.*

The hepatic veins, the vessels that return the blood conveyed hither by the vena portæ and hepatic artery, are in the horse remarkably small, but exceeding numerous: their orifices may be seen, appearing like so many pin-holes, by slitting open the posterior vena cava.

The hepatic duct, remarkable for the whiteness of its coats, will be found running along the upper and inner edge of the right lobe, and receiving in its course many small ductiform tubes from the interior of the gland: its trunk afterwards accompanies the hepatic artery, to the right of which, and below the vena portæ, it continues its passage to the duodenum. This duct is a muscular tube, having a membranous lining; is large enough to admit of the introduction of the little finger; and is about three inches in length. It pierces the coats of the duodenum, six inches distant from the stomach, in conjunction with the pancreatic duct, but opening by an orifice distinct from the one of that duct: the terminations of both, however, are guarded by the same circular flap, one composed of doublings of the inner and muscular coats of the gut, which performs a valvular function in preventing the intrusion of alimentary matters into these tubes.

The nerves of the liver, neither large nor numerous (for it does not appear to possess much sensibility either in health or disease), come principally from the sympathetic; it receives also a few filaments from the par vagum. Its lymphatic vessels, on the other hand, are extremely plentiful and are readily demonstrated: we have nothing more to do than to insert a small injecting pipe under its peritoneal capsule, and allow quicksilver to diffuse itself, and we shall instantly fill very many of them, making a beautiful, vascular, arborescent display upon the surface.

Structure. The hepatic artery having entered the substance of the organ, disperses its ramifications through every part; and they terminate not only in open nutrient points, but in vessels of communication with all the others: at least, if fine injection be thrown in, it will not only pass into the hepatic veins, but also find its way into the branches of the vena portæ, and those of the hepatic duct as well. In fact, the researches of anatomy appear to prove, that there is free intercommunication between all these different sets of vessels; for if either of the others are injected (except the hepatic veins which have valves,) the same result is afforded. If a piece be torn or broken off the liver, we shall perceive, on close inspection of the lacerated surface, numerous little granulary eminences, to which anatomists have given the name of *acini*: these small bodies, which adhere together by means of a fine cellular web, are composed of the ramifications of some or all of the vessels that have been mentioned; but what their *intimate structure* is, or how or in what manner they are constituted, remains yet to be explained. Again, if we nicely examine the surface of a clean cut into its substance, we shall perceive numerous minute pores, from which a yellowish fluid may be expressed: these are the *pori biliarii,* the radicles of the hepatic duct, which run in company with the arterial and venous ramifications, repeatedly unite and re-unite, until, at length, they all end in a single tube—the hepatic duct.

BILE is a sort of soapy viscid fluid. Its viscidity it derives from gelatine, which a solution of tannin or alcohol will precipitate. By the agency of the latter, the gelatinous matter may be separated, leaving what is called a tincture of bile. Gall-stones are found to consist principally of a sort of spermaceti, that has been used for soap to clean cloth with. The colour and notorious bitterness of bile do not seem to be owing to the presence of anything peculiar; but rather ascribable to some peculiarity of arrangement of its component parts, which is not understood. For if the tincture of bile is exposed to the air, it becomes white; or if nitric acid be dropped into it, that will likewise render it white.*

OF THE SPLEEN.

The spleen or milt is a spongy viscus, of a pyramidal figure, situated in the left hypochondrium, between the stomach and false ribs.

Colour. Its colour is principally owing to the stagnant blood in it. The surface possesses a blue mottled or marble hue, which becomes reddened by exposure to air. It is much darker interiorly—when its contained blood becomes exposed.

Volume and Weight. Though it varies continually in its volume, depending on the condition of the circulation through it, it seldom or never *exceeds* three pounds in weight.

Form. The spleen is adapted in shape to the space in which it is lodged; being concave next the stomach, convex where it is opposed to the ribs. It differs remarkably from the spleen of the human subject in form; for instead of being oval in its circumference, and having an obtuse margin, it is elongated after the form of a tapering pyramid, and at length terminates in a point.

Capsule. It receives a complete capsular envelope from the peritoneum, to the close-fitting and intimate adhesion of which it chiefly owes its feel of solidity and firmness: for, when stripped of this tunic, its texture is discovered to be soft, lacerable, and spongy, and to present all the appearances of glandular arrangement; and as such any one could not fail to regard it who had not made himself previously acquainted with its intimate structure.

Structure. It differs remarkably, however, from a gland, in not having any excretory duct; an appendage for which it has no occasion, as it is not believed to perform any secretory function. It is now generally supposed, that the arteries of the spleen, after having spread their branches within its substance into innumerable ramifications, terminate in cells of a membranous composition, from which veins, about equivalent in number, take their origin. To elucidate this structure, it has been likened to a piece of sponge, or a honeycomb; to which, if blood-vessels were superadded, probably the general fabric bears some resemblance. By regarding it as a spongy or porous body, we can account very satisfactorily for the extreme variableness in the magnitude and weight of this organ; for it is obvious that it will admit of great latitude in its state of distension, and that its volume must greatly depend upon the quantity of blood it may contain. It also possesses nerves, though they are but small; as well as absorbents, which vessels are very numerous, and readily demonstrable by injecting quicksilver under its peritoneal tunic.

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* Abernethy's Lectures, in the 'Lancet.'

Organization. This viscus receives its blood from the splenic artery, a large branch of the posterior aorta, which, in running along the great curvature of the stomach, detaches numerous short ramifications both to it and to the spleen. The splenic veins, much larger than the arteries, unite with those of the stomach, and form a vessel that largely contributes to the production of the vena portæ. Its nerves come from the cœliac plexus.

Importance. The magnitude and organization of the spleen in the higher order of animals, together with the constancy of its presence, are of themselves forcible arguments to establish its importance in the animal constitution, though it would appear, from some facts, not to be equally useful with other abdominal viscera; for, if it be carefully extirpated, the animal will not only survive, but thrive and do well: indeed, in the human subject, it has been found after death so disorganized from disease, as to have been apparently incapable of performing its function during life; and one case is related in which it was cut out without the individual experiencing any great inconvenience from its loss.

From the resemblance in general appearance and structure between this organ and those that are known to be glandular, very diligent search has been made after an excretory duct: no vessel of the kind, however, has yet been demonstrated, though, more than once, have anatomists been led away with the idea that they had discovered traces of one. Seeing, then, that the spleen was without a duct (and, as was observed before, there is no want of one, there being no secretion carried on), physiologists, compelled to relinquish the notion of its being a gland, have attempted to explain its use from what appears to be a faithful description of its structure, connections, and relative situation.

OF THE PANCREAS.

The pancreas or sweetbread is a glandular body lying across the spine in the epigastric region.

Situation and Connection—explained at page 247.

It possesses no peritoneal covering—that membrane simply passes over its inferior surface.

Division. The pancreas has been divided into *head, body,* and *tail;* it has also a fourth part, attached to the right side of the spine, a prolongation from its head, to which the name of *pancreas minor* has been given.

Structure. Anatomists all agree, that there exists a similarity of structure between this organ and the salivary glands; and what tends to confirm this opinion is, the resemblance that the pancreatic fluid bears to common saliva. The pancreas is of a pale red speckled colour, and is composed of many small lobes or rather lobules, which, though they intimately adhere together by a fine cellular tissue, are perfectly distinct from one another in regard to their ultimate organization. For every one of these lobules, or (as some call them) *acini,* appears to be constituted of a set of arteries, veins, and ducts, which vessels have no communication, except through the medium of their trunks, with those of any other; so that a certain quantity of secretion is prepared within, and discharged from, every one of them singly; in fact, every lobule may be said to be a distinct gland of itself, and this is precisely the case in respect to the salivary glands. In the dissection of an injected pancreas, we may trace many arterial twigs into these acini, which are detached at right angles from the principal pancreatic artery as it pervades the interior of the gland. The veins also may be seen accompanying the arteries. The duct, which is the result of two main branches, has a similar mode of ramification. Formed at the extreme end of the gland, by the union of several smaller tubes, it takes its course through the middle of the viscus, receiving in its way other listle ductiform vessels which come from the neighbouring lobules, and contribute to augment its size. Thus formed, the long branch issues from the body of the gland, the short and larger one from the head and pancreas minor: the two then form a single trunk, about an inch in length, which extends directly from the spleen to the duodenum, and pierces the latter alongside of the hepatic duct. The tube is composed of a thin, pellucid membrane of considerable strength, and is large enough in its caliber to admit of the introduction of the finger.

Organization. The pancreatic arteries are derived mostly from the hepatic: several, however, come from the splenic, in its course to the left side of the abdomen; and one or two from the gastric. The veins are tributary to the vena portæ. The small nerves discovered in it are furnished by the cœliac plexus.

SECTION VI.

ABSORBENT SYSTEM.

COMPRISING THE ABSORBENTS AND ABSORBENT GLANDS.

THE absorbents constitute that system of vessels which are employed in *absorbing* alimentary and other matters, and conveying them into the general circulation.

Division. These vessels were, when they were first discovered, supposed to exist of different kinds in the body: hence the appellations *lacteals* and *lymphatics*. It is now, however, ascertained that they exhibit no difference whatever in their anatomy; and also that, although the lacteals are ordinarily employed in absorbing chyle from the intestinal canal, they are equally with the lymphatics, capable of taking up other matters.

The only natural division they appear susceptible of, is, into *superficial* and *deep-seated* absorbents: the former are distributed in great numbers immediately beneath the skin and perforate it through almost every point; the latter are commonly found ramifying in company with the trunks of the blood-vessels, more especially with the veins.

Peculiarities. The absorbents are so minute as to bear no sort of comparison with the blood-vessels, in point of magnitude. To make up for this, however, they are in general vastly more numerous, and have much more frequent anastomosis. They also exhibit peculiar tortuosities in their course, and are everywhere beset with valves.

Glands. The absorbent glands are small oval-shaped bodies, varying in magnitude from a pea to a walnut, found in many unexposed parts of the body along the course of the absorbent vessels. Generally speaking, they exhibit a reddish hue: but there are some that assume a dark blue, and even a black complexion. They exist mostly in groups or clusters—rarely solitary.

Communication. The superficial and deep-seated vessels communicate very frequently with each other, and never fail to send off, in addition, other anastomotic branches to whatever solitary absorbents there may be in the vicinity. The glands, likewise, are linked together by absorbent tubes of inter-communication running from one to the other.

Demonstration. The following different methods of proceeding with a view to demonstrate these minute and ordinarily hardly visible vessels, are extracted from the laborious and accurate researches of the late celebrated anatomist, Mr. Cruikshank:—

In an animal opened alive, some hours after it has been fed, the lacteals are seen turgid with chyle: they may also be made visible by throwing coloured thin fluids into the intestines; or, by making ligatures on the trunk of the anterior mesenteric artery, which will include the trunk of the absorbents. An eye accustomed, readily distinguishes lacteals upon the intestines from arteries and veins, even when they are collapsed and empty: punctures may be made with a lancet, and the vessels injected with quicksilver by means of a tube formed expressly for that purpose. I have sometimes injected lacteals from punctures made by the sides of veins, where I knew they must be, though they were then invisible to the naked eye.

Upon the liver and lungs lymphatics are frequently visible, and may be injected by puncturing one of the small branches; but the valves almost always make the injecting of them from the trunk to the branches impracticable. Pressure in the course of the absorbent circulation will commonly force from the extreme branches into the trunks some little reddish or brownish fluid, making the latter visible, which may then be punctured and injected.—Watery fluids thrown into the arteries, veins, or ducts of glands, very commonly get into the absorbents, and render them visible.—One of the best methods is to previously inject the arteries and veins of the part, and afterwards macerate it for some days: putrefaction then takes place, air is generated in the cellular membrane, whence it gets into the orifices of the lymphatics, and uniformly fills their branches.—The best subject for these injections is one whose limbs are without fat and are dropsical, but not too much so.

In parts where glands are to be found, it is only necessary to puncture the gland, and introduce a tube filled with quicksilver, or push the pipe into its substance without any previous puncture. The mercury thus fills the cells of the gland, and from these the lymphatics. The thoracic duct itself is most successfully injected in the same way, that is, either from glands upon the mesentery, upon the bodies of the lumbar vertebræ, or those upon the inside of Poupart's ligament.—When vessels are injected, and very much resemble lymphatics, the best method of determining whether they are or are not lymphatics, is to trace them to the nearest lymphatic glands: if they terminate in them in the usual manner, they are lymphatics.

No English veterinarian, to my knowledge, has, up to the present day, been at the pains to demonstrate practically the particular distribution of the absorbing vessels of the horse: we have hitherto travelled onward *analogically*, and so, I have a notion, should we continue to do, had not our French professional contemporaries furnished us, as well as themselves, by their praiseworthy exertions in the cause of science, with materials to fill up this lamentable hiatus in veterinary anatomy. Professor Girard, whose '*Traité d'Anatomie Vétérinaire*' does no less credit to the talent and industry of its author than honour to the veterinary school over which he presides, has presented us with an article on the ramifications of the lymphatics, which I shall translate, and take the liberty to transcribe into this place.

The Thoracic Duct.

The largest, longest, and most remarkable of the lymphatic vessels, in which terminate the majority of the lymphatics of the body, is situated within the thorax, on the right side of the dorsal vertebræ, between the aorta and the vena azygos: it receives the lymphatics from the posterior extremities, pelvis, parietes, and viscera of the abdomen, head, neck, withers, and left anterior extremity.

It takes its origin under the loins in a dilatation or sinus, very variable in its form and dimensions, situated at the root of the great mesenteric artery, named the *receptaculum chyli*; it directs its course forward, enters the thoracic cavity by the aortic perforation through the diaphragm, extends along the bodies of the dorsal vertebræ until it arrives opposite to the base of the heart, where it curves downward to cross over to the left side, in its way to the anterior opening of the thorax, and, as it leaves the spine for this purpose, runs obliquely over the trachea and œsophagus; having reached the left side, it stretches forward to the beginning of the anterior vena cava, and terminates against the middle of the anterior border of the left first rib, in the base of the left axillary vein: not infrequently, it ends in the right axillary; in some instances, even in the beginning of the anterior cava. At its termination it dilates and forms a sinus, whose mouth, opening into the vein, is guarded by a broad valve so disposed as to prevent any reflux of blood into the duct:* it has also a ligamentous band around it at this part, which confines it to the vein receiving its contents.

This canal shows but little uniformity in its caliber: in some places it is strait, in others varicose. And it is not uncommon to find it detaching one and even several branches in its course, large or small, which either remain separate, or else, after running a certain distance, rejoin the main channel.

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* Notwithstanding this valve, blood often gains admittance into the canal; this is observable in all cases of violent death, or in which struggles and convulsions attend expiration.

The Receptaculum Chyli.

This reservoir forms the point of general confluence of all the lymphatics of the posterior limbs and abdomen, and that from which originates the thoracic duct: it is maintained by the aorta on one side, and the vena cava posterior on the other; and is formed by the union of five or six large lymphatics, of which two or three come from the entrance of the pelvis, two or three others from the mesentery, a single one from the environs of the stomach and liver.

The Professor here makes a classification of all the lymphatics of the body into those that proceed to the abdominal and those that run to the thoracic portion of the duct.

I. LYMPHATICS DISCHARGING THEIR CONTENTS INTO THE ABDOMINAL PORTION OF THE THORACIC DUCT.

1. *Lymphatics of the Posterior Extremities.*

These are distinguishable into the superficial and deep-seated. The first originate particularly from the skin and subcutaneous cellular tissue. They form divers ramifications which accompany the superficial veins; of which the most remarkable attend the vena saphena major, frequently anastomosing with one another, and forming altogether an anastomotic network. All these lymphatics run to the subcutaneous inguinal glands, which are lodged upon the superior and anterior part of the thigh.

The deep-seated lymphatics take their rise from the foot, ascend along with the plantar veins, continue upward among the muscles in company with the deep-seated veins, corresponding in their principal divisions to those vessels, and proceed to the inguinal glands.

All the lymphatics of the posterior limbs assemble at these glands, and here form a plexus, from which several large branches depart and traverse the iliac glands, clinging to the sides of the iliac vessels, and discharge their contents into the pelvic branch, contributing to the receptaculum chyli.

2. *Lymphatics of the Pelvis.*

The vessels coming from this cavity run in part to the inguinal glands and in part to the internal pelvic glands. The superficial lymphatics about the pubes and the outlet of the pelvis run and join those of the extremity; those of the perineum and anus enter the cavity, and are accompanied by those coming from the croup and tail, both proceeding to the glands within the interior of the pelvis. All the deep-seated lymphatics accompany the veins, make for the pelvic glands, form unions with the others, and run and empty themselves into the main pelvic branch, wherein their lymph mixes with that coming from the inguinal glands.

The lymphatics of the urinary and genital organs, included in the pelvic cavity, also traverse the glands lodged therein, and unite with those of the parietes of the pelvis. Those of the scrotum enter the inguinal glands, as also do those belonging to the sheath and penis. The ramifications derived from the testicle and spermatic chord take the course of the veins, and penetrate one or two of the lumbar glands lodged at the entrance of the pelvis. The lymphatics of the mammæ, which are also divisible into superficial and deep-seated, run to the inguinal glands, and anastomose with the superficial set belonging to the inferior parietes of the abdomen; but, before they reach these last glands, they pervade those of the mammæ.

3. *Lymphatics of the Parietes of the Abdomen.*

These vessels, in general but little developed, for the most part run to the inguinal glands. The superficial set of the lower parietes accompany the cutaneous (inguinal) vein, anastomose with the lymphatics of the scrotum and mammæ, and traverse the glands in the groin: some of them direct their course forward along with the cutaneous (external thoracic) vein of the thorax, unite with the superficial lymphatics of that part, and proceed to the axillary glands. The deep-seated vessels of the belly run in company with the epigastric vein, and go to the inguinal glands, or else they accompany the pectoral vein, and pervade the glands in front of the thorax.

The superficial or subcutaneous lymphatics of the loins join either those of the croup or those of the flanks: the deep-seated, which spring from the peritoneum, muscles, and spinal canal, perforate one of the internal lumbar glands, and pass onward to terminate in the main pelvic branch.

Among the lymphatics of the abdominal surface of the diaphragm, those issuing from the peritoneum and muscular texture make almost all for the main hepatic branch; some others take the course of the phrenic veins, and form a union with those of the thoracic side of the muscle.

4. *Absorbents of the Mesentery.*

The mesenteric trunks, ordinarily two or three in number, the most considerable of which is constantly united to the great mesenteric artery, receive all the vessels continued from the mesenteric glands, as well as those coming from the mesentery and intestines.

The mesenteric absorbents, extremely numerous, are sustained between the layers of the mesentery, where they form a vascular network: many of them issue from the exhalent surface of the mesentery and intestinal tube; others take their rise from the interior of the intestine, from which they imbibe chyle. All these vessels converge towards the lymphatic reservoir, clinging in their passage around the mesenteric veins; some, however, taking a solitary course at a greater or less distance from any blood-vessel: having arrived at the root of the mesentery, they pass through one or two, sometimes three, of the mesenteric glands, and afterwards join the principal lumbar lymphatics. The absorbents of the cæcum and cæcum caput coli run to the glands set at intervals along the intestinal tube, whence they proceed to the receptaculum chyli.

5. *Lymphatics of the Liver, Stomach, Spleen, and Omentum.*

The hepatic trunk comprises the lymphatics issuing from the liver, stomach, spleen, and omentum: the branch of the receptaculum chyli not uncommonly consists of two divisions, and receives in addition to the above-mentioned vessels, many ramifications from the crura of the diaphragm.

The lymphatics of the liver, extremely numerous, are distinguishable into a superficial and a deep-seated set. The first arise more particularly from the exhalent surface of the organ, creep along upon its peritoneal capsule, and there form a plexus of close and intricate network. Those from the anterior surface make one or two large branches which perforate the diaphragm, enter the thoracic cavity, unite with the lymphatics from the chordiform tendon, and proceed to the fore part of the thoracic duct; whilst those of the posterior surface enter the glands placed around the great fissure, where they unite with the deep-seated set.

The deep-seated hepatic spring from the parenchyma of the gland, cling around the divisions of the hepatic artery and hepatic veins, issue from the interior of the viscus by the great fissure, run to the glands there, and afterwards proceed along with the superficial to the main hepatic trunk.

The lymphatics of the stomach, of which the superficial come from the external surface, the deep-seated from its cavity, follow the veins, and are distinguishable into a superior and an inferior set. The former take the direction of the lesser curvature, perforate the glands thereabouts, and go to join the absorbents of the liver: the latter run over the greater curvature, enter the glands arranged along the fissure of the spleen, form communications with the lymphatics of that viscus and those of the omentum, and depart to contribute to the hepatic trunk.

As to *the lymphatics of the spleen,* the superficial, like those of the liver, come from the periphery of the organ and enter into a thick and complicated network: the deep-seated issue from the interior, and contract with the former numerous anastomoses. Along the fissure of the spleen these vessels become united, form large branches which follow the course of the splenic veins, and anastomose with the lymphatics of the great curvature of the stomach: both sets then run to the great fissure of the liver, and there terminate in the hepatic trunk.

The lymphatics of the omentum accompany the venous ramifications, and either join those of the great curvature of the stomach, or the superficial absorbents coming from the cæcum caput coli. Those around the pylorus anastomose with the pancreatic, and accompany them to the hepatic trunk.

The lymphatics of the pancreas also run with the divisions of its veins, and join either those of the liver or those of the spleen: some proceed directly to the common hepatic trunk.

Besides these three portions or lymphatic trunks which constitute the receptaculum chyli, the abdominal portion of the thoracic duct also receives *the lymphatics of the kidneys,* and *renal capsules.* These vessels, distinguished into superficial and deep-seated, perforate the glands placed internally, next to the parts from which they spring, and empty themselves into the superior side of the thoracic duct.

II. Ramifications terminating in the Thoracic Portion of the main common Duct.

This, the terminating portion of the thoracic duct, receives the lymphatics transmitted from the internal dorsal, bronchial, and cardiac glands, and those either from the left axillary glands, or from the sublingual and gutteral glands. In this numerous series we find the lymphatics of the parietes and viscera of the thorax, of the head, neck, and left anterior extremity.

1. *Lymphatics of the Parietes of the Thorax.*

The superficial absorbents of the thorax take their rise either from the surface of the skin or else from the subcutaneous muscles; they form several large branches which accompany the thoracic cutaneous vein, unite with the superficial lymphatics coming from the anterior parietes of the abdomen, and proceed to the axillary glands.

The deep-seated set take divers directions and pass through different sets of glands. The pectoral, which anastomose with ramifications from the abdomen, follow the pectoral vein, and reach one or two glands at the entrance of the chest. *The intercostal* spring from the pleura and intercostal muscles, accompany the intercostal veins, pervade the internal dorsal glands, and terminate by several branches in the thoracic duct. *The lymphatics of the fleshy part of the diaphragm* unite, some with the posterior intercostal, others with the pectoral: those coming from the crura run to the dorsal glands, where they anastomose with the intercostal; those from the chordiform tendon anastomose with the deep hepatic, run forward between the layers of mediastinum, nearly to the heart, and enter the cardiac glands.

2 *Lymphatics of the Thoracic Viscera.*

The absorbents of the different organs contained within the thorax, traverse one or several of the bronchial or cardiac glands, and afterwards form divers branches which end in the thoracic duct. *The pulmonary lymphatics*, very numerous, are distinguished into superficial and deep-seated. The first take their rise from the surface of the lungs, creep along under their enveloping membrane, and make for one or more of the bronchial glands. The deep set, which originate from the air-cells and from the areolæ of the parenchymatous tissue, follow the divisions of the pulmonary veins, run to the root of the bronchial tubes, there unite with the superficial, and perforate one or two of the bronchial glands.

The cardiac lymphatics derive their origin, either from the surfaces (both exterior and interior) of the heart, or from the muscular substance of the organ: they mount upon the curvature of the posterior aorta, and disappear in the cardiac glands.

The lymphatics of the superior part of the mediastinum and of the œsophagus join, some the intercostal, others the bronchial: those coming from the anterior part of this membranous partition, from the thymus, trachea, and œsophagus, unite either with the pectoral, or else with the cardiac and anterior intercostal.

3. *Lymphatics of the Head.*

The lymphatics of the head form two planes, a superficial and a deep one. The superficial pursue the course of the cutaneous veins, and run in part into the sublingual, in part into the guttural glands. The deep vessels, which come from the nostrils, fauces, palate, &c., also run to the sublingual and guttural glands, in which they unite with the superficial. From these two groups of glands, through which pass the lymphatics of the head, depart several large branches, two or three of which descend upon the anterior surface of the trachea; others follow the passage of the deep and subcutaneous veins, unite with those of the neck, and descend to the front of the thorax. Almost all these vessels terminate in the thoracic duct; some few alone on the right side ending in the right axillary trunk.

4. *Lymphatics of the Left Fore Extremity.*

The lymphatics of this member present the same disposition as those of the posterior limbs, and are divided into superficial and deep-seated. The former, consisting of divers ramifications, accompany the superficial veins; the more considerable of them forming a plexus which accompanies the cutaneous (superficial brachial) vein of the limb. The deep vessels originate from the foot, muscles, and bones, pursue the divisions of the deep veins, and plunge into the axillary glands, wherein they unite with the superficial, and whence they all proceed to the thoracic duct.

The right terminating Trunk of the Lymphatics.

This very short lymphatic canal is obliquely situated at the entrance of the thorax, upon the transverse process of the last vertebra of the neck, extending in a direction from above downward and from without inward, and terminating most commonly in the right axillary vein; though in some instances it joins the thoracic duct, or else ends close by the side of it. This lesser trunk is formed by the lymphatics coming from the right axillary glands, and by some from the right lung, and right side of the neck and trachea.

SECTION VII.

URINARY SYSTEM.

COMPRISING THE KIDNEYS, RENAL CAPSULES, URETERS, AND BLADDER.

OF THE KIDNEYS.

The kidneys are two ovoid reddish bodies, occupying the lumbar regions of the abdomen, performing the function of the secretion of urine.

Relative Situation and Attachment. In consequence of the kidneys not receiving the same complete covering from the peritoneum as the abdominal viscera in general,* they have been regarded as *extra* abdominal organs; custom, however, appears to be somewhat capricious in this particular, for they are certainly as much within the cavity as the pancreas* (which, no more than the kidneys, gets but a covering on one side from the peritoneum), and may, anatomically considered, with equal propriety, be included among the viscera of the abdomen. Indeed, they cannot be properly examined *in situ* but from within the abdominal cavity. Herein they are found a little further backward than the pancreas, immediately above (or concealed by, as the horse lies upon his back) the small intestines. They repose, one upon either side of the spine, close to the bodies of the lumbar vertebræ, or rather underneath the psoæ muscles, to which they are firmly attached by a surrounding and enveloping mass of adipose and cellular substance, as well as to the vertebræ themselves. Their anterior ends reach under the last ribs; posteriorly they come in contact with the cristæ of the ilea; and to both these parts they are tied by cellular tissue. They receive some support from the peritoneum as it passes under them, and are attached by it to the contiguous viscera; but their strongest connection is to the spine through the medium of their blood-vessels. The right kidney has peritoneal attachments to the right lobe of the liver, and to the head of the pancreas: the left has a similar connection with the blind pouch of the stomach, from the pressure of which in a state of distension it is pushed a little further backward than the right; the left is also connected with the pancreas and the spleen.

Figure. The figure of the kidney varies remarkably in different subjects; nay, the right is commonly unlike the left, is less elongated and broader: in fact, it is a gland that does not appear to possess any very determinate form. Generally speaking, it may be said to represent an irregular flattened oval: but it is an imperfect oval; one side is interrupted by an inlet or deficiency of substance, technically called *the notch,* into which the blood-vessels are received.

Magnitude. The magnitude of the gland, not less undeterminable than its form, estimated by its weight, may be stated in round numbers to average about forty ounces.

Division. The kidney may be divided into its upper and under surfaces, its border, and its notch. *The under surface,* the part covered by peritoneum (underneath which is interposed

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* Vide 'Reflection of Peritoneum,' p. 249.

a layer of soft yellow fat), is partially divided into two unequal lobes by a fissure running directly across from the notch towards the circumference: in many subjects the upper division is in part subdivided by a smaller fissure, which also proceeds transversely from the notch, into two portions: still it is one continuous or *conglobate* body, which is not the case in bears and in the cat tribe, where these lobes, being perfectly distinct, constitute it a *conglomerate* gland. *The under surface* has likewise a middle transverse fissure, but it is less in extent: sometimes we find two or three others, but small and unworthy of notice. This is the part bedded in adipose matter: the quantity of adeps, however, though considerable in very fat subjects, is inferior to what is found in the herbivorous ruminant, in whom it concretes after death into a remarkably white, firm mass, well known by the name of *suet*. Now, that the gland is inverted, the *notch* is brought more into view: in some subjects this forms a considerable breach in the body of the gland, in others it makes only a part of the transverse fissure aforementioned: it is designed, like the porta of the liver, to give ingress to the blood-vessels and egress to the duct belonging to the gland. *The border*, thick and rounded, narrows and describes the segment of a circle anteriorly; broadens and extends into a larger arc posteriorly: by adverting to this circumstance, and attending to the distinguishing characters of the surfaces, the kidney of one side may be known from that of the other, although both should have been removed from the body.

Capsule. The kidney has a capsule of its own, everywhere adherent to its surfaces through the intervention of a very delicate cellular tissue, which tissue may be traced in places into the glandular substance itself: at the notch also processes leave the capsule to accompany the renal vessels and nerves throughout their ramification, and serve at once as an additional tunic to them, and a suitable connecting medium between them and other parts.

Structure. The interior substance of the kidney is most broadly exposed to view by carrying a horizontal section through its middle in the line of its long axis. The surface exposed by this section exhibits two distinct shades of colour, united by a broad intervening circle of dark red: the outer part has a brownish-red tint, and is denominated the *cortical substance*, because it surrounds the *medullary* or *tubular substance*, as it is called, which has a carnation hue, growing lighter as it extends inward. These substances not only differ in hue; they differ in consistence, in disposition, and in structure. The cortical part possesses a uniformity of aspect something like that of the liver, and a texture comparatively soft and easily lacerable: the medullary is much closer and tougher in its composition, and evidently exhibits a fibrous texture. The two substances are not conjoined in any regular line; but dark-red denticular prolongations of cortical, shoot in between the lobulated portions of medullary substance,

Though the ultimate or intimate structure of the kidney may not be demonstrable with absolute certainty, it would appear, from the results of researches of anatomists in general, that there is less speculation interwoven with the accounts commonly rendered of it, than is but too often found blended with those of other complicated glandular organs. Injections sent into the emulgent arteries colour the cortical substance, but are not to be detected in the medullary; a simple fact that has led to the conclusion, that the former is principally composed of blood-vessels; at least this is the common result of the experiment. To pass over the detail of the means, however, whereby we have attained our knowledge, the minute structure of the kidney appears to be this:—The several divisions into which the emulgent artery splits in penetrating the substance of the gland, end in a multiplied number of smaller arteries; and these form arches within the cortical substance from whose convexities a still smaller set come off; which minute vessels proceed inward, few (if any) of them reaching into the medullary part, and end in little globular bodies that have been resembled to the acini of the liver, and named the *corpora globosa;* a sort of arterial arrangement altogether that has been compared to grapes as they grow upon their slender stalks. The corpora globosa were at first supposed to be cellular: but later researches afford us reason for believing that they are constituted of the vessels running into them: instead of terminating within them, they are continued and coiled into these globular forms. From the corpora globosa proceed inward, in convergent radii, fasciculi of minute vessels, named, from their office, the *tubuli uriniferi;* which fasciculi are so disposed in sets (commonly six or seven in number) as to admit of a resemblance to so many paps or dugs, and hence have been denominated the *processus mammillares.* These conical fasciculi, which take their rise in the cortical part, constitute the *medullary* substance of the kidney. The *papillæ,* the apices of the mammillary processes, are received into little membranous sacs, varying in form and size, denominated the *infundibula,* into which the secreted fluid is distilled through the orifices of the tubuli uriniferi perforating the papillæ: the number of infundibula, however, is not regulated by that of the processus mammillares, for one sac may embrace two or even three papillæ. The infundibula (each one contracting in its course) converge towards a common centre, and open commonly by three canals into the pelvis, whose orifices are large enough to admit the small end of a common blowpipe. The *pelvis,* then, is the common receptacle of the fluids transmitted through the infundibula: it is a cavity in the centre of the gland, almost surrounded by medullary matter, and consists of a dense, firm, membranous substance, forming an extended sac, which is continuous towards the interior with the infundibula, but towards the notch contracted into a small funnel-shaped outlet, having one continued passage with the ureter. This continuity of component parts has led some to consider the infundibula, pelvis, and ureter as one and the same extended structure: whether this be the case or not, they possess a common mucous lining that puts on the same aspect, examine it in which of these parts we may.

THE URETER (the tube conveying the urine from the kidney into the bladder), emerging from the posterior end of the pelvis, makes its exit through the notch, and then suddenly turns backward under the posterior extremity of the gland, passing between it and the capsula renalis; it then takes its course directly backward, a little distance laterally removed from the bodies of the lumbar vertebræ, crossing obliquely the psoas parvus and afterwards the great iliac vessels; here it enters the pelvis by a sweep upward and outward (embracing within its concavity the vas deferens and ligamentum rotundum), and becomes included within the fold of the ligamentum latum, by which it is conducted to the lateral and superior part of the bladder: latterly, it runs in close connection, from the middle of the bladder half-way to its neck, where it imperceptibly vanishes between its tunics. Though we insensibly lose sight of the tube, however, it does not end here; for after having obliquely penetrated the muscular coat, it travels onward for the space of an inch between that and the internal coat, and at length terminates by piercing the latter in the same oblique line of direction. The diameter of the ureter near its origin is equal to that of a large-sized black-lead pencil; from which it so insensibly diminishes in caliber throughout its course, that we are only assured of the fact by comparing the anterior with the posterior portion. That part of the tube not included within the broad ligament, is invested with cellular and adipose tissue binding it down in its course. The ureter is composed of *two tunics.* The *external* one is thick, resisting, and longitudinally fibrous, and is believed to be muscular: the *internal* is soft and fine in its texture; is commonly rugose lengthwise; is loosely adherent to the other;

and is constantly besmeared within with a mucous secretion, to shield it from the acrimony of the urine.

Organization.—The emulgent arteries, right and *left,* arise immediately in front of their respective glands from the sides of the posterior aorta: each enters the notch, and there divides into three, or four, or even five principal branches, which, unlike the trunk, become flexuous in their course and then penetrate the glandular substance: the outer branches turning in contrary directions, one forward, the other backward, to enter the cortical part at once; those in the middle traversing the tubular to arrive at it; in which they all subdivide and ramify to terminate as afore described.

The emulgent veins, which exceed in volume, though not ordinarily in number, the arteries, correspond in their ramification to those vessels: their terminating branches, three, four, five, or upwards in number, converging within the notch, there unite into one trunk, which accompanies its artery and ends in the posterior vena cava.

The nerves supplying the kidney are derived principally from the renal plexus, and very numerous they are: notwithstanding their numbers, however, and notwithstanding the acute pain which accompanies active inflammation in it, the organ in the healthy condition is by no means remarkable for its sensibility.

OF THE CAPSULÆ RENALES.

These are two small, elongated, irregularly formed, brownish bodies, a *right* and a *left,* placed opposite to the kidneys, between those glands and the spine. The right, the longer one, lies in contact with the posterior vena cava, and reaches forward to the liver; the left, the broader one, and rather obliquely placed, is opposed to the aorta; and, anteriorly, is contiguous to the pancreas: they are respectively connected to these several parts by loose enveloping cellular substance, and are furthermore retained in their places by the peritoneum, which covers their under surfaces. Their *magnitude* varies with age: in early fœtality they are equal in volume to the kidneys themselves; their subsequent growth, however, being less rapid than that of the kidneys, this equality in the course of time becomes destroyed. Their outward borders are partially cleft by several little notches, giving them a lobulated appearance. They possess tunics of their own of condensed cellular tissue, processes from which penetrate their substance and enter into their composition.

Structure. Divided by a perpendicular section, the renal capsule shows a palish brown substance above and below, interspersed with vessels and nerves, soft and uniform in its texture, and constituting full two thirds of its whole; and, in the middle, a longitudinal whitish part, which, though of a very loose texture, is evidently not a vacuity; for, after some yellowish fluid it commonly contains is expressed, there still remains some internal cellular structure. The fluid expressible from this part is said to vary in its appearance and quantity with the time of life: in the fœtus it is said to be red and abundant; yellowish and sparing in the adult; yellower still and more scanty as age advances. This body receives two or three small vessels, either from the emulgent artery or the aorta, or from both; and these have their full proportion of veins. It has also an adequate supply of nerves coming principally from the renal plexus. What the disposition or arrangement of these several component parts may be, remains yet to be developed. M. Girard says, concerning them, that, although these bodies are plentifully furnished with blood-vessels and nerves, "ils n'offrent dans leur organisation aucune disposition qui puisse faire presumer une sécrétion particulière."

The physiology of the capsulæ renales remains to this day an unsolved problem. Not one fact has been broached to lead to any rational hypothesis. All that Haller's indefatigable research and penetrating mind could discover for certain about them, was, that they secrete a fluid more required in fœtal than adult life, and that their functions are probably important since they are found in so many animals.

OF THE BLADDER.

The musculo-membranous bag that receives the urine from the ureters.

Situation. The bladder occupies the middle and inferior regions of the pelvis, taking the oblique axis of that cavity, and resting upon the symphysis pubis, with the rectum above it in the male, the vagina in the female. In the undistended state, this viscus is wholly confined to the pelvic cavity; but when full, its fundus advances before the pubes into the abdomen, the advancement being in ratio with the degree of distension: in the fœtus it rises still more into the abdominal cavity, as a necessary consequence of its proportionally greater development, as well as of the narrowness and shallowness of the pelvis at that period.

Figure. In a state of distension the bladder is pretty regularly pyriform, and its parietes are thin and semi-transparent; but when completely empty, it assumes the spheroid figure, becomes thick in substance, and exhibits no vacuity internally: in fact, it is (in that state) a little, white, round, firm, and, I may add, solid body.

Volume. Its capacity will vary much in different subjects; and this we have some reason to ascribe (from a correlative fact in human anatomy) to the habit the animal had of retaining the urine: for it is found that women (whom we know from motives of delicacy are oftentimes compelled to restrain their inclinations to void their urine) have generally larger bladders than men; and now and then in such subjects, bladders are found of extraordinary volume.

Connections. The bladder is connected by loose cellular adhesions to the pubes, the walls of the pelvis, the rectum in the male, the vagina in the female; and is kept and balanced in its proper place and position by two broad productions of peritoneum expanded across the cavity from its sides to the walls of the pelvis, called its *broad ligaments.* These ligaments are formed thus:—the peritoneum being reflected upward from the recti muscles upon the body of the bladder, about its middle, proceeds forward upon the fundus, then turns back again and covers still more extensively the upper surface; at the sides, these (under and upper) layers of the membrane, meeting together, unite, and afterwards proceed in union to the walls of the pelvis, where they once more split and take opposite directions. The middle portion of the upper layer of peritoneum is reflected upward from the hind part of the body of the bladder upon the rectum in the male, the vagina in the female, and thus a peritoneal pouch is formed between the two. In addition to these connections, the neck of the bladder is attached to the pubes by a thin fibrous expansion, denominated the *triangular ligament;* and the fundus receives the insertion of two round chords which run within the folds of the broad ligaments, named the *round ligaments.*

Division. The bladder may be distinguished into its *fundus, body,* and *cervix* or *neck. The fundus* is the round prominent part presented forward, completely covered by peritoneum, occasionally protruding into the abdomen, receiving the attachments of the round ligaments, and the insertion of the degenerated urachus (which is in the fœtus a urinary conduit continued along the umbilical chord to the membranes of the womb). *The body* is the bulky or capacious part of the bag. Only one third of its under surface is covered by peritoneum; nearly the whole of its upper. It is supported by the broad ligaments; has along its sides in the male the vesiculæ seminales and vasa deferentia; and behind, grows suddenly contracted, and ends in the neck.

The cervix is the small, circular, posterior part of the bladder. It has a light-pinkish hue, and is comparatively thick and substantial to the feel. The triangular ligament attaches it to the pubes, and it is continuous at the posterior end with the urethra.

Structure. The bladder has three coats: an external one, which is derived from the peritoneum; a mucous membrane, to which it mainly owes its integrity and consistence; and a diffuse fibrous texture interposed between the two, which is of a muscular nature. *The peritoneal coat,* which forms but a partial covering, is smooth, polished, and moistened with serous exudation externally; but found rough and pilous internally, when torn from its adhesions with the muscular: in a word, it in no wise differs in its properties from the peritoneal tunics of the abdominal viscera in general. It serves to hold the bladder in its proper place and position, and to a certain degree to counteract preternatural distension.

The muscular coat, though it may be demonstrated through the pellucid peritoneum, is brought more distinctly into view by stripping off that membrane, to which it is closely and firmly attached by fine cellular tissue. Pale fasciculi are then seen running irregularly in a longitudinal manner; and, underneath them, others which are smaller, taking an equally irregular course in the circular direction: in the empty or half-distended state of the organ, however, both these orders of fibres assume spiral courses; which enables them to bear considerable extension without the risk of rupture, while their cellular connections, being loose, admit of their being drawn apart with equal facility. The longitudinal fasciculi are thickest about the fundus, where they all converge to its central point; the circular are strongest around the cervix: the former exert a special contraction in forcing the urine towards the neck, constituting what has been called the *detrusor urinæ:* the latter, which are mingled with cellular tissue and some small veins, giving them the feel of greater substance than they really possess, form the *sphincter vesicæ* of those who (with no more reason in my opinion) make a separate muscle of this part. By the simultaneous contraction of both orders of fibres the parietes of the bladder may be drawn towards one common centre, so as to diminish its capacity gradually in every part, until the cavity is even altogether annihilated.

The mucous coat shows itself exteriorly in the interspaces between the fasciculi of the muscular, covered only by the interposed cellular tissue which serves as the common uniting medium of all three tunics. While the bladder remains empty, the contractions of the muscular coat throw this one into *rugæ,* and in cases of extreme contraction these folds assume rather a remarkable appearance; the cellular tissue interposed between this and the middle tunic being loose enough to admit of this. It is this same cellular intertexture which, from its being pressed into a pretty regular layer wherein the vessels and nerves ramify, has been described by some as the *nervous coat.* The internal membrane is white, soft in its texture, and highly organized. It possesses numerous follicles from whose excretory pores issue a plentiful mucous secretion to defend it from the acrimony of the saline matters contained in the urine: this mucous matter being perpetually washed off the surface by the urine, is kept continually renewed; and it is occasionally voided in considerable quantities, especially when any calculi or other irritants are within the bladder. About an inch anterior to the cervix, in the sides of the bag, are seen the orifices of the ureters, whose oblique insinuations in perforating the parietes operate in preventing any reflux of the urine at the time that the bladder is contracting, and thereby possess all the effect of valves.

SECTION VIII.

GENERATIVE SYSTEM.

COMPRISING THE MALE AND FEMALE ORGANS OF GENERATION.

MALE ORGANS OF GENERATION.

THE male animal, although the part he appears to contribute towards the work of procreation appears but insignificant, when contrasted with the lengthened, tedious, critical process performed by the female, is, nevertheless, provided with an assemblage of organs whose individual structures and functions may be ranked among the most complicated in the system. These organs consist of *the testicles*—whose office it is to prepare the fluid necessary for impregnation; of *the vasa deferentia* and *vesiculæ seminales*—canals and receptacles for this fluid; and of *the penis*—the instrument by which this same fluid is transmitted into the parts destined for its reception in the female body.

OF THE TESTICLES AND SCROTUM.

The *testes* or *testicles* (the truly essential organs of procreation in the male species) are the two oval glandular bodies suspended from the hollow between the thighs, within a case or bag, denominated *the scrotum.*

THE SCROTUM, or *purse,* as it is sometimes called, is mainly constituted of a loose production of the common integuments, which is, on either side, continuous with the skin covering the flanks and thighs; in front, with the sheath of the penis; and behind, with the *perinæum:* a term under which may be comprehended the space included between the scrotum and anus. The skin forming the scrotum is thin and soft in its texture, generally black, and is clothed with fine downy hair, long and bushy around its sides, short, scanty, and hardly perceptible about its inferior parts. The testicles, by their prominences, produce a longitudinal crease along the middle of the scrotum, named the *raphe,* of which a faint trace extends into the perinæum: this crease denotes the line of attachment of the septum scroti. Prior to the appearance of the testicles, the purse is comparatively small and insignificant, consisting merely of some loose folds of skin: during their descent from the belly it is that the scrotum becomes gradually developed, and the wrinkles, in consequence of its extension, as gradually effaced.

Dartos. On cutting through the integuments of the scrotum, we expose a pale, yellowish, fibrous layer of substance, which by some is regarded and described as a muscle, and named the *dartos;* while others view it but as a continuation of the faschia superficialis abdominis. Its fibres, which run longitudinally, are strongest where they cover the testes. Anteriorly, they are continued into the cellular substance of the sheath, wherein they are lost: posteriorly they are spread upon the root of the penis. This substance loosely adheres to the skin by cellular membrane, and is still more loosely connected by the same tissue to the parts within. It is certainly distinctly fibrous in composition, but its fibres possess a density and toughness and a yellow cast, which, to my eye, accord more with the properties of ligament than muscle: to which I may add, I am acquainted with no physiological fact that warrants such an inference. The scrotum of the horse does not corrugate from the application of cold or other stimuli, as that of a man is known to do; we cannot, therefore, avail ourselves of the *contractile* power of the scrotum—at least not to the same extent as some human anatomists have done—to strengthen suppositions of the presence of a dartos. The fibrous substance is most loose and abundant along the middle of the bag, where its expansions from either side unite and become reflected upward in inseparable union with each other, through the interspace between the testes, forming in this manner a partition through the middle of the purse, denominated the *septum scroti*; which consequently extends from the raphe to the under and posterior part of the penis, and serves to prevent one testicle from encroaching upon or interfering with the other.

Cellular Structure. The cellular membrane of the scrotum (which may be considered as the third layer of substance entering into its composition) is interposed in the greatest abundance between the fibrous expansion and the peritoneal coverings of the testicles. Being very long and loose in its texture, and destitute of any adipose matter, the parts it connects are extremely moveable upon each other, at the same time that it admits itself of considerable extension.

Testicles.

Coverings. The first or external covering of the testicle, one common both to it and the chord, is a borrowed one from the peritoneum, known as the *tunica vaginalis.* The acquisition and reflection of this covering will not be clearly understood until the descent of the testicle has been explained; though it may be observed here, that it is a production of peritoneum formed into a loose vagina or sheath, which originates at the internal ring, proceeds with and loosely envelopes the chord, and, lastly, covers, in the same lax manner, the testicle and epididymis; so that if the bag (it forms) be punctured, and air or liquid be impelled into the cavity, the fluid will not only distend *it,* but mount into the abdomen, since both cavities have a free communication at the internal ring. The elongated membrane, however, does not end in single investment of the testicle. Along the superior and anterior border of the epididymis, we find it firmly attached, but not terminated; for here it becomes reflected, first upon the epididymis itself, next over the testicle, and lastly upon the chord, so as to give them all a *second* covering, which only differs from the first in being everywhere in close adhesion with the parts it invests: this last production is called, by way of distinction, the *tunica reflexa* or *tunica vaginalis* TESTIS: it must not be forgotten, however, that they are both *peritoneal* productions—one and the same continuous membrane. The vaginal cavity possesses a smooth polished surface, and this is constantly bedewed with a limpid, colourless, serous fluid, which in the operation for castration spirts out the instant the knife or cautery has penetrated the tunica vaginalis. It is an accumulation of this fluid that constitutes *hydrocele*; a disease that has no existence, I believe, in the horse, abstractedly from abdominal dropsy.

THE TESTICLES, with their appendages, *the epididymes,* constitute the glandular apparatus for the secretion of the male sperm or semen; the penis, as was stated before, being simply the instrument of transmission. We have already seen that these bodies, although loose and pendulous, are not *unattached* within the cavity of the scrotum: we have found them enclosed within peritoneal tunics; confined by cellular and fibrous envelopes; and fenced in their respective apartments by the septum scroti.

Figure, Magnitude, Division. The general figure of the testicle is that of an oval flattened at the sides; the magnitude, that of the egg of a hen: M. Girard says, that the left is generally a little larger and more pendent than the right. The testicle is suspended within the scrotum by the spermatic chord; and in such a position, that its long axis corresponds to that of the body. It possesses, therefore, *anterior* and *posterior ends:* to the latter is joined the termination of the chord, while the vas deferens departs from the *globus major* of the epididymis, which is attached by a ligamentous band to the former. It has also an *inferior* or *convex border,* along which are seen the tortuous windings of the spermatic artery; *a superior* or *straight border,* to which is attached the epididymis; and *two convex sides,* free and unconnected.

The Spermatic Chord, the substance by means of which the testicle is connected with the abdomen, and by which it is suspended within its scrotal cavity, is composed in the following manner:—1st. It has four coverings:—there is, immediately underneath the skin, the faschia superficialis; next, the cremaster; thirdly, the tunica vaginalis; and, lastly, the tunica vaginalis reflexa. Within the cavity formed by the vaginal tunics it is that the intestine is protruded in inguinal and scrotal herniæ: the hernial coverings, consequently, exclusive of the sac, will be the faschia and the cremaster muscle. 2dly. The constituent parts of the chord itself are—*a.* THE ARTERIES, which are two in number:—*the artery of the chord,* a small branch of the external iliac, which ramifies and expends itself upon the chord; and *the spermatic artery,* which, as soon as it reaches the internal ring, enters the inguinal canal, runs down the posterior part of the chord, growing tortuous as it descends, serpentines along the superior border of the testis, between it and the epididymis, winds round the anterior end of the gland, and lastly reaches the convex border, where it becomes extremely convoluted, and whereto its branches are principally distributed. In its descent it detaches small unimportant twigs to the adjacent parts; and as it approaches the testicle becomes surrounded by an assemblage of venous vessels. *b.* The VEINS accompany their correspondent arteries; and they indeed may be said to make up the principal bulk of the chord, for they are not only numerous, but large and flexuous, and, as they approach the testicle, form a sort of plexus which has got the name of *corpus pampiniforme:* they return their blood into the posterior vena cava. *c.* The NERVES, which are derived from the hypogastric plexus, also accompany the spermatic artery: they are small, but sufficiently numerous. Though the testicle does not possess any very great sensibility in health, we may vouch for its being acutely sensitive in a state of disease. *d.* ABSORBENTS exist, both large and numerous, in the chord. They are readily found alongside of the venous trunks; and not infrequently may be filled by introducing mercury into the spermatic artery. *e.* The VAS DEFERENS, though a constituent of the chord, takes at first a solitary course, remote from the blood-vessels. The duct issues from the summit of the head of the epididymis, beginning in a series of convolutions gradually unwinding as it proceeds; it takes an oblique course nearly as high as the external ring, where it joins the blood-vessels, and continues to accompany them posteriorly through the inguinal canal: at the internal ring it leaves them, turns inward and ascends into the pelvis, where we find it creeping along the side of the bladder infolded in peritoneum to get to the cervix, crossing under its course first the unbilical artery and then the ureter; at length it terminates by rather a contracted orifice within the mouth of the duct of the vesicula seminalis, just behind a little eminence in the urethra—*the caput galinaginis,* about an inch posteriorly to the cervix of the bladder. Within the inguinal passage the duct is accompanied by *the artery of the vas deferens,* a long slender branch of the epigastric. Its canal, flexuous until the duct has joined the chord, but straight in its subsequent course, is not uniform throughout in caliber; the area of its tortuous part is large, but as it becomes straight it grows contracted: having entered the pelvis, it gradually enlarges again, and acquires unusual volume in running along the side of the bladder; and the canal of the enlarged portion presents a reticulated structure, which gives its exterior an irregular, tuberculated appearance; the most contracted part is that in union with the duct of the vesicula seminalis, which is a comparatively small cylindrical conduit. The parietes of the duct are so remarkably thick and firm to the feel, that we distinguish it at once by the fingers from the other parts of the chord: they consist of two tunics; the external one (in which its main thickness consists) is white, fibrous, and approaches in appearance to cartilage; the internal one is thin and fine in texture, muco-membranous in its nature, and here and there incloses a reticulated structure. The different constituent parts of the chord are connected altogether by cellular substance, destitute of any fat; and from the circumstance of the parts in general being more bulky below the ring, the chord increases in breadth and thickness as it approaches the testicle.

Close Coverings. The close or intimate tunic of the testicle is perfectly distinct from its vaginal coats, and from its conspicuous whiteness is called the *tunica albuginea.* Though it may be stripped off in places by the forceps, and the separation may be also effected by diffusing quicksilver into the cellular texture uniting them, the tunica reflexa so intimately and uniformly adheres to this tunic, that, the former being transparent, they appear to constitute but one and the same covering. The albuginea, however, is much denser and firmer in its nature, and much resembles other fibrous membranes, particularly the dura mater, both in appearance and texture: like that membrane, it is extensile and contractile, but neither suddenly nor greatly so, and imparts a compactness and firmness of feel to the inclosed structure which the latter, deprived of it, is not found to possess. Over the convex part of the gland this tunic is perforated by numerous holes for the transmission of the spermatic blood-vessels. Internally, it is connected to the substance of the testicle, by these vessels, by a fine cellular web, and by numerous little processes that traverse the gland perpendicularly, serving to hold the internal parts together, as well as aiding to preserve the form of the whole, and which are generally described as the *septa* or *septulæ tetis.*

Structure. On cutting into the testicle, we find that it consists of a soft pulpy substance of a pale brown colour, and that this, by being nipped and drawn out by the forceps, is extensible into numerous whitish threads of extreme exility, which may occasionally be elongated to a considerable degree: it is believed that these are *the seminiferous tubes.* Like other secreting organs, the testicle receives into its composition congeries of arteries, veins, nerves, and absorbents, the peculiarity of structure chiefly residing in the *arrangement* of the secretory and excretory parts of the apparatus. It is imagined, in the instance before us, that this consists in many vascular coils or complexures which are only separated from one another by the septulæ, and that these, independently one of the other, possess the power of secretion. After the spermatic trunk has dispersed its ramifications over the albuginea, numerous twigs are transmitted through that tunic into the interior of the gland: from these, capillary arteries spring, which, it is presumed, communicate with the *tubuli seminiferi,* but in what manner anatomists have not been able to detect; for in the old subject these tubes are constantly plugged with secretion, and so foil all our attempts to inject them: and in the young subject, before they begin to secrete, they are not sufficiently developed to admit of the examination. If quicksilver be suffered to pervade the arteries by its own weight, it is found to return by the veins; and in a preparation of the testicle of a dog at present before me, the absorbents have been filled from the same source. Towards the posterior end of the testicle, the seminiferous tubes assemble from the different parts of the interior, and unite into a set of larger tubes of the same description, disposed after the manner of network, and hence have got the name of the *rete;* then, from the rete proceed another set of similar tubes, still larger (about a dozen, I believe, in number), from the testis to the epididymis, constituting the sole medium of communication, and the principal one of connection, between the two: these are the *vasa efferentia.* In addition to these minutiæ, we may notice that the superior border of the testicle is marked by a broad *white line:* this denotes the situation of a supposed canal, and is generally mentioned as the *corpus Highmorianum.*

THE EPIDIDYMIS is extended along the superior border of the testicle, upon which it rests, and to which it is connected by the tunica vaginalis reflexa. Its ends are bulky in comparison to its middle: that receiving the vasa efferentia, the smaller one, is the *caput* or *globus minor;* the other, giving rise to the vas deferens, is the *globus major*—the part farriers call the *nut.* The interior of this appendage to the testicle exhibits a structure entirely vascular. The vasa efferentia unite and re-unite until they form a single duct, of whose numberless and very remarkable convolutions the globus major is entirely constituted: these tortuosities (which, when squeezed, freely emit semen) will admit of being unwound for a considerable extent, so as to have the length of the duct calculated with very tolerable exactness from beginning to end, which has been found to amount to several yards. It is small at its formation, but grows imperceptibly larger in making its manifold windings and turnings, until at length it assumes the size of the vas deferens, in which it ends. Its various convolutions are connected together by cellular membrane, and are interspersed with a sparing supply of blood-vessels.

The course of the semen is this:—It is secreted by the capillary coils of the spermatic artery, from which it is received by the tubuli seminiferi: these tubes carry it into the rete, and the rete discharges it through the vasa efferentia into the epididymis, from which it is conducted by the vas deferens into the urethra.

Formation and Descent. It is a singular fact, that the organs whose structure we have been investigating, are originally formed in a situation remote from that in which they are destined to carry on their functions: "the colt has *no* testicles," is the common observation of the uninformed on these matters; and we know ourselves that the purse is without them, but we know, in addition, that they exist ready formed within the abdomen, and that they will descend at a certain period of age into their proper receptacle, the scrotum. During the fœtal state, we find them more or less developed, tinged with a blush of red, lodged underneath the psoæ muscles, in contact with the inferior borders of the kidneys, covered and retained in their situations by peritoneum, and concealed by the intestines around them. Here they receive their arteries from the contiguous trunk—the posterior aorta; the vasa deferentia run forward to them; and the cremasters likewise turn forward instead of backward: there being at this time no such thing as a spermatic chord. Thus placed, the testicle may be regarded as one of the glands of the abdomen: indeed, it has considerable similarity to the kidney—receiving its vessels from the same contiguous source, and sending a long duct backward into the cavity of the pelvis: nor does there appear any conclusive reason why it should not perform the same office in that situation that it does in the scrotum, and particularly since it is known that in birds they remain within the belly during life. From the part where the blood-vessels enter, we find growing a whitish substance, extended backward, diminishing in breadth as it recedes, passing through the ring, where the fibres of the cremaster may be traced upon it, and whence it is prolonged into the scrotum, growing narrower and narrower until it vanishes: this substance, regarded by some simply as a ligament, was considered by Mr. Hunter as the *gubernaculum* or pilot, by means of which the testicle is directed in its passage from the abdomen into the scrotum. Quitting the spot where it has been formed and matured, the testicle gradually retrocedes, guided by the gubernaculum, until it arrives at the internal ring, which, at this time (like every other part of the parietes), is closed by peritoneum: this temporary obstruction it overcomes by drawing the membrane down along with it through the ring, and carrying the pouch made thereby down into the scrotum; the gubernaculum at the time undergoing a complete inversion. This accounts for the production of the tunica vaginalis, and explains how that membrane comes to be doubled or reflected: the testicle, receiving originally (as an abdominal viscus) one close and adherent peritoneal tunic, and acquiring another, which forms a loose covering, as it passes through the ring, must necessarily have *two*; and since both are derived from one and the same membrane, it follows that one must be a continuation of the other. These elongations of membrane, though everywhere in contact, are prevented from adhering together by a continual exhalation of the natural serous secretion. Any interval that might subsist between them, in course, communicates with the cavity of the abdomen, through the ring, a part that remains open through life: this, however, is not the case with man—in his body the communication is cut off, after the testicles have descended, by a natural contraction and obliteration both of the ring and the inguinal passage. In many instances, one, in some few, both of the testicles, are known to have remained within the belly through life. As we are unacquainted with the immediate cause of their descent, so we are unable to give any rational explanation of this phenomenon. I have understood, that in many of these cases the glands have been found to be but *imperfectly* developed: this, however, is not without exception.

Period of Descent. Most animals have their testicles within the scrotum at the period of birth. In the human fœtus they begin to move about the seventh month; about the eighth they reach the groins; and before birth arrive in the scrotum. In the horse, they pass through the ring about the sixth or seventh month before birth, and are found within the scrotum at the period of parturition. In some cases, one testicle will not make its appearance for some time after the other; and as the operation for castration is seldom long delayed, this will account for the *rigs* (as horses having but one testicle are called) with which we meet every now and then. Again, instances are not wanting in which one testicle has descended to the ring and there remained through life.*

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* In a communication I have been favoured with from Mr. Brettargh (which I have inserted in the second volume of THE VETERINARIAN), is contained the following information on this subject:—"Colts are foaled with their testicles in the scrotum, which remain there (in ordinary cases) until the fifth or sixth month, when they are taken up between the internal and external abdominal rings, and there remain until the eleventh, twelfth, or thirteenth month, all depending upon the degree of keep, as in some that are well fed the testicles can at all times be found in the scrotum. Were the testicles drawn up into the abdomen, they would be too large to pass through the internal abdominal ring at the time they are wanted to prepare for secretion; which is occasionally the case, and at once accounts for our meeting with horses that are said to have but one stone. I have seen one instance where both were wanting in the scrotum at four years old."

The Vesiculæ Seminales

Are two oblong, membranous sacs, placed contiguously to the terminations of the vasa deferentia, which have been so denominated from a supposition that they were receptacles for the semen. They occupy the lateral intervals left between the bladder and the rectum, with their internal prominences, while their external are opposed to the sides of the pelvis. They are principally sustained in their places by the bladder. In relation to each other, they represent *in situ* the two sides of a triangle: for their posterior extremities are nearly in contact, while their bases diverge as they advance, and leave a considerable breadth of interspace. The longitudinal channel between the bladder and vesicula is occupied by the vas deferens. The vesiculæ are confined in their situation by cellular connections with the bladder and rectum, the walls of the pelvis, and the vasa deferentia.

Form and Structure. These bodies have a near approach to the pyriform. Anteriorly they present broad round bases, which are elongated posteriorly into contracted circular necks, and the necks end in ducts of some length, which may (to carry the resemblance on) be said to represent the stalks of the pears: they incline, however, to convexity superiorly and to flatness inferiorly, and their surfaces are rendered uneven by some tubercular eminences. The parietes of the vesicula are distinguishable into two textures. The external one, when cleared of the enveloping cellular substance, is white, and, though soft to the feel and not so thick as the outer tunic of the vas deferens, possesses considerable density and toughness, and in some parts, particularly around the base, assumes a fibrous texture: these fibres are described as muscular, and certainly the functions attributed to the vesiculæ appear to warrant such a supposition, even were we unconvinced of its truth from anatomical inspection—which, I should say, we certainly are. This tunic is lined with a membrane, whose surface is of the papillary description—everywhere presenting to view (through a magnifying-glass more plainly) numerous pinhole-like perforations, the orifices of subjacent follicles furnishing the whitish, viscous, jelly-like secretion peculiar to these bodies. Their ducts are of considerable volume, not greatly inferior even to the urethra itself: both proceed backward in a convergent direction in union with the vasa deferentia, alongside of the membranous part of the urethra, and terminate behind the *verumontanum.*

OF THE PENIS.

The *penis* or *yard* is an organ of large dimensions in the horse species, capable of projection and retraction, but ordinarily concealed within a loose and pendulous doubling of skin, at the inferior and posterior part of the belly, known by the name of *the sheath.* It is not only destined for the important office of impregnation, and made the seat of that enjoyment experienced by the male during the copulative act, but it serves the subordinate purpose of a convenient conduit for the discharge of urine.

THE SHEATH (in which the penis is inclosed, and by which, unless it be in a state towards erection, it is concealed from view) is nothing more than a prolongation of the common integuments, with one part drawn within the other, and puckered so as to form a sort of corrugated bag—corresponding to the prepuce in man—whose dimensions vary with the degree of retraction of the penis. Posteriorly, the sheath is continuous with the scrotum; anteriorly, it is cleft, and has two large pendent folds of skin, proceeding from the sides of the *vagina propria penis,* with a broad deep furrow between them, which extends along the belly as far forward as the navel. In most horses, these parts are either dark-coloured or black: in some they are clothed with fine, long, downy hair; in others they are inferiorly almost bare, having but a few scattered short hairs which are only perceptible on close inspection. But there is so much variety in these unimportant particulars, that any single description, accurately and minutely drawn, will not apply with precision to another individual. Near the borders of reflection of the sides of the sheath—in the ordinary state of the parts—grow two small papillæ or teats, resembling the dugs of the mare, presenting, in a less perfect degree, the same internal structure, and being perforate at their apices: they are not to be found, however, I believe, in all horses, and it is the practice of some cutters to take them off at the time of castration; Girard observes, with truth, that they are largest in the ass species. *The internal sheath*—the *vagina propria penis,* exhibits two large, circular, tegumental plications: the *outer* and larger one is formed by an involution of the external vagina, and exhibits internally numerous corrugations, which, though by no means regularly ranged, for the most part run in circles around the *inner* plication, the veritable *preputium glandis penis,* whose internal surface is also puckered into circular corrugations, but smaller, and still more numerous, and more irregularly disposed than those of the former. These plications are nothing but a continuation of the common integuments disposed after this manner to admit of the projection and erection of the penis—a state in which they, together with their corrugations, are extended and annihilated; though the skin composing them is of a kind remarkable for its fineness and softness of texture, for its black or marbled complexion, and for the excretory pores of myriads of little subjacent glands, which are so closely packed that it is hardly possible to introduce the point of the scalpel through it without penetrating one or more of them. These involutions of skin are supported in their corrugated form and connected to the body of the penis by an interposed stratum of cellular substance, which is so loose and abundant as to readily admit of their sliding over each other, and of the penis being protracted and retracted with the greatest facility.

Reflection. From the inner plication the skin is reflected upon the penis, extending forward and giving a complete covering to the part named the *glans penis.* This part exhibits a very remarkable corrugated aspect, which I cannot resemble to anything so nearly as to the leaf of a curled cabbage: its cellular substratum is shorter and more condensed than that of the sheath, it not being designed to be protracted beyond the penis; and, like the inner plication, it is destitute of those glands with which the outer is so thickly studded.

The glandulæ odoriferæ are numberless little brown follicular bodies set in the internal part of the outer vaginal fold, for the purpose of discharging a white caseous matter through their excretory pores upon the surface. This secretion, which has a peculiar odour, preserves the sensibility of the parts, and facilitates their slipping backward and forward. It is occasionally found collected in considerable masses between the outer and inner plications, even, it has been said, so as to plug the orifice of the urethra, and cause retention of urine: knowing this, will put us upon our guard, and lead us to inspect the part in cases where the cause of retention is not very apparent. The surfaces covered by the inner plication are lubricated by a mucous secretion.

Cul-de-sac. There is yet another involution of the skin. This takes place at the extremity of the organ, where a little *cul-de-sac* is formed, in the centre of which protrudes the end of the urethra, a part also covered by a reflection of this thin, hairless, corrugated integument. Around the end of the urethra is a little recess, partially divided into two chambers, commonly containing concreted masses of a peculiar unctuous secretion; the use of which excavation is not very apparent.

Faschial Covering. The penis, inferiorly, receives a covering from the *faschia superficialis abdominis,* lateral portions of which descend from the flanks, and unite along its middle: as we approach its root the faschia grows stronger, and exhibits a fibrous texture. The organ derives considerable support from this covering.

THE PENIS is constituted of five distinct parts, which appear to view without the aid of any dissection or disarrangement of the organ: viz., the *two corpora cavernosa,* which form the middle and sides, the largest proportion of the body; the *glans penis* or *head,* forming the anterior protuberance; the *corpus musculosum urethræ,* making up the inferior portion; and the *plexus venosus,* surmounting the corpora cavernosa.

The muscles belonging to the organ having been described (at page 128), we proceed to the CORPORA CAVERNOSA PENIS, the principal parts in respect to bulk in the constitution of the organ; parts whose erectile capacity fits it as the instrument of copulation, extending from the ischial arch to the glans penis, and insinuating their extremities for some little way under the flattened portion of the latter. They are attached by means of two branches, the *crura penis,* to the pósterior ends of the tuberosities of the ischia, and to the sides of the ischial arch, where they are clothed by the erectores penis; from which attachments they converge along the branches of the ischium, and under the summit of the ischial arch form a union. The attachment of the penis to the pelvis is considerably strengthened, just below this union of the crura, by two *suspensory ligaments,* which fasten the sides of the cavernous bodies to the pubes. These cylindrical bodies, joined together in one common tunic, continue their passage forward to the glans penis, within the substance of which they terminate by two rounded protuberances.

Structure. The corpora cavernosa are composed of a ligamentôus case, of unusual thickness and toughness, common to them both, whose fibres, running in every direction, are so interlaced and matted together, that it not only defies our industry to unravel it, but is even impenetrable; unless when sharp instruments, and they with no ordinary force, are made use of. It is not everywhere uniform in thickness, however: it is comparatively thin over the crura and where it is opposed to the urethra, those parts being sufficiently supported and protected by their muscular coverings. The internal structure of these bodies, spongy, reticular, or honeycomb-like in its arrangement, is found to involve three different textures. *First,* numberless little tendinous chords, which are processes detached from the ligamentous case, unequal in size, run irregularly from one side to the other: these are crossed in the middle by a perpendicular set, broader and stronger, and so arranged as to resemble the teeth of a comb; on which account, these last, forming the partition between the two corpora, have been collectively named *the pecten.* Thus, preternatural distension of the organ, and consequent liability to rupture, are guarded against both laterally and perpendicularly. *Seçondly,* the interspaces are filled with a pale-red spongy substance, in which may be distinguished cylindrical processes taking a longitudinal course: these M. Girard pronounces to be "évidemment musculaires;" and I see reason for so considering them; though I think it is a point which demands confirmation from physiological or experimental inquiry, and not entirely to be decided upon anatomical evidence. *Thirdly,* these cylindrical bands are surrounded and connected together by a cellular structure, that would appear to be the result or product of some peculiar venous arrangement: at least, the small veins, which are here far more numerous than the arteries, have everywhere the freest communication with these apparent cells.

Organization. The cavernous structure is especially supplied with blood by a large vessel, *the internal pudic artery,* a branch of the obturator artery, which enters the crus, giving off several small branches to the other parts of the organ. *The pudic nerves,* two in number, springing from under the ischial arch, are seen entering the corpus at the same place, one before, the other behind the artery. *The internal pudic veins,* which are large and numerous, divide here into two sets, one accompanying the arteries, the other the nerves, after they have quitted the penis.

THE GLANS PENIS is the large, irregular, fungus-like protuberance, forming the fore part of the organ, vulgarly called its *head.* This part puts on a very different appearance when distended from the state in which we find it in the dead animal: it then presents a broad surface anteriorly, surrounded by a prominent inflected border, which is turned back for some distance above, but altogether deficient below, where there is a notch or division of the glans. The lateral portions are prominent, incorporated in one superiorly, separate and divergent inferiorly: posteriorly, they are terminated by a contracted circular part, whose prominent border forms the *corona glandis.* From the corona extends along the dorsum penis, a flattened substance of an oblong oval figure: this is the *posterior* or *terminating portion* of the glans. In the middle of the glans is a prominence, in front, marking the termination of the corpora cavernosa; and below this is a circular fossa having in its centre the projecting orifice of the urethra. Altogether, the glans may be regarded as a part by which the penis is surmounted in order to enable the animal to direct the semen with more certainty into the womb of the female; the mouth of that organ being precisely its counterpart in form.

Structure. The internal corrugated production of sheath, as well as the reflected portion by which the glans is immediately covered, have already been described: underneath this last we find a fibrous case, of a ligamentary and cellular texture, holding together the internal structure. The interior exhibits a honeycomb appearance, being throughout composed of a soft, spongy tissue, in a high degree distensible and elastic, which some are of opinion is nothing more than a congeries of veins: whether this be wholly or in part true, venous vessels are found running among the cells, becoming large and more conspicuous towards the posterior parts, from which spring those veins that afterwards so suddenly enlarge and multiply upon the dorsum penis, forming thereon that remarkable venous conglomeration, the

PLEXUS VENOSUS PENIS, a structure that may, to all appearances, be regarded as a development of the glans; and one that, when distended with blood, in the erect state of the organ, constitutes no inconsiderable part of its volume. Though the veins composing it have free and frequent communication, yet, being furnished with valves, this communication is not such as will permit us to fill them with common injection contrary to the course of the blood; so that, when we mean to distend them with wax, we introduce the pipe into the substance of the glans. Towards the root of the penis these venous convolutions diminish in number and volume, and at length coalesce in front of the symphysis pubis in three or four veins of ordinary size, which are here joined by the epigastric and superficial femoral veins, and then proceed into the pelvis to end in the trunk of the internal iliac vein.

THE URETHRA is a membranous canal extended from the bladder to the extremity of the penis, to afford a passage for the urine and seminal fluid. Arising from the neck of the bladder, the urethra, in its way to the outlet of the pelvis, runs at first horizontally backward, with a slight curve downward, between the lobes of the great prostate, embraced superiorly by the portio media of that body, and arrives at the small prostates, which are situated upon its sides: this intermediate portion is called the *membranous part;* incorrectly, however, for we find that it is encircled by some of the fibres of the triangularis penis. Behind the small prostates the urethra suddenly bulges or swells in volume, which part is named *the bulb:* it is here that the accelerator urinæ begins—the muscle that incloses the canal during the remainder of its course, and is, in fact, a part itself of the urethra. Leaving the bulb, the urethra suddenly curves downward, and shortly after turns sharply forward, passing under the ischial arch—the tuberosities bounding it laterally—at which place it is joined by the crura and subsequently surmounted by the corpora cavernosa. At the extremity of the penis the canal is enveloped in the glans, terminating in the centre of the front of that body—within a prolapsus of membrane covered with a reflection of fine skin—by an open orifice, which is insulated from the glans by the fossa running around it. In turning round the ischial arch, the urethra has extensive cellular attachments to the bone; but it is principally retained at its curvature by the suspensory ligaments of the penis. The length of the urethra is nearly two feet. It is a canal also of considerable caliber, so that I can with facility introduce the handle of the scalpel into the orifice, though that is the smallest part; for, after it has passed the bulb, it pretty regularly diminishes in caliber all the way to the orifice: the canal at the curvature measuring, when distended with wax, *four* inches in circumference; near the orifice, not more than *two*.

The interior of the canal exhibits a smooth, polished, lubricated surface, having a pale blush upon it. In structure it does not materially differ from other mucous membranes, unless it be that its follicles are larger and more numerous, and that their orifices are called *lacunæ*. It is continuous, and appears to be one and the same texture with the mucous membrane of the bladder. About an inch and a half from the neck of that viscus, within the membranous part of the canal, is a little eminence named the *verumontanum* or *caput galinaginis*, at whose root open the ejaculatory ducts: the use of this tubercle (which I believe has not been noticed) appears to me to be, to *perform the office of a valve* to the orifices of these ducts, preventing any influx of the urethral fluids. Upon either side of it are many small perforations through the membrane: these are the excretory openings of the ducts of the great prostate. A little in the rear of the verumontanum are several small papillary eminences, perforated through their centres, and longitudinally ranged in two distinct sets; these are the openings through which the ducts of the lesser prostates discharge their secretion.

The bulb of the urethra is a longitudinal prominence, beginning immediately behind the lesser prostates, and proceeding with the canal around its curvature; not indeed ending there, for it may be traced on, though considerably shrunk in volume, even to the glans penis: the continuation of it being the part corresponding to the *corpus spongiosum* in human anatomy, a name it hardly merits in this instance. It has a cellular arrangement internally, which we may regard in the same light as the spongy structure of the glans itself: indeed, if I might be allowed here to draw a comparison between these parts in a man and in a horse (the spongy body being more developed in the penis of the former, the glans in that of the latter), I should say, that the glans was an expansion of the corpus spongiosum, and that the glans in the horse and the corpus spongiosum in man bore strong evidence of some peculiar venous arrangement.

OF THE PROSTATE GLANDS.

These bodies are three in number: a single large one situated around the neck of the bladder, corresponding to the gland of the same name in the human subject; and two small ones, which answer in situation to two little glandular bodies occasionally met with in man, named, from their discoverer, *Cowper's glands*.

THE GREAT PROSTATE embraces the neck of the bladder and incipient portion of the urethra, both superiorly and laterally, being placed between those parts (by which it is supported) and the rectum. It is firmly attached to the parts it surrounds by cellular tissue; and has also a cellular connection in front with the vesiculæ seminales, and above with the rectum. We distinguish in this gland two *lateral lobes*, and a uniting *middle portion;* which, in man, Sir E. Home has described as the *third lobe*, in consequence of its assuming frequently the lobular form when in a state of disease. The lobes are enveloped in incompact cellular cases, have exteriorly a conglomerate disposition, and are of a palish brown colour. Internally, they possess a spongy or cellular structure, diffused through which are sets of thin membranous tubes, very large for the size of the gland, which are readily inflated, and then are seen to open, through orifices before described, around the base of the verumontanum. The gland secretes a whitish liquor resembling thin mucus, and this mingles with the sperm at the time of its ejection; but for what particular purpose has not been satisfactorily determined.

THE LESSER PROSTATES are situated against the sides of the urethra, contiguously to the posterior part of the bulb, where they lie upon the branches of the ischium. Each of them is about equal in bulk to one of the lateral lobes of the large prostate. They are included in loose cellular sheaths, that are continuous with the substance of the triangular muscle. In figure, they are flattened ovals. In colour, they are likewise a pale brown; but it is a lighter shade still than that of the large one. Their exterior is even, and such as indicates their structure to be of the conglobate kind. The interior exhibits a more uniform appearance: a longitudinal section through the middle displays an arborescent membranous structure, which is demonstrated (by the use of the blowpipe) to be the system of excretory ducts, whose papillary terminations in the urethra have been already pointed out. These glands likewise secrete a peculiar fluid, and that is also ejected in commixture with the sperm.

FEMALE ORGANS OF GENERATION;

CONSISTING OF EXTERNAL AND INTERNAL PARTS, AND APPENDIX.

EXTERNAL PARTS.

SUCH as can be examined without the aid of dissection: comprehending *the Vulva, the Clitoris,* and *the Meatus Urinarius.*

OF THE VULVA.

THE VULVA, or *pudendum*, is the broad slit included between two prominences of the common integuments, extending from a little below the anus down in a perpendicular direction between the supero-posterior parts of the hind quarters. It is constituted of the *fissure,* in the middle, denominated the *fissura magna;* of the two lateral prominences, or *labia pudendi;* and of two angles, superior and inferior, called *the commissures.*

THE FISSURA MAGNA, or *sinus pudorus.*—The external orifice of the vagina, several inches in extent, is largest in mares that have borne foals, in consequence of the extension it undergoes in parturition. The short interspace between the fissure and the anus is termed *the perineum.*

THE LABIA PUDENDI are composed exteriorly of doublings of the common skin, which here exhibits a particularly fine and soft texture, is hairless, and in most mares black, and is preserved moist and supple by a sebaceous secretion continually exuding from minute pores in their opposed surfaces. But the labia owe their bulk principally to adipose substance; which accounts for the variations in regard to prominence they undergo in conformity with the age, as well as the *embonpoint* of the animal. With the fatty substance is blended a fibrous texture, and so intricately, that the one cannot be demonstrated separately from the other, nor can their mutual connection and arrangement be at all accurately made out: which fibrous texture it is that gives the labia their firmness, resistance, and elasticity. Interposed between this mixed substance and the skin, we find scattered fasciculi of pale fleshy fibres: these come from the perineum, grow larger and more conspicuous as they descend, and form a union below the inferior commissure, with similar fasciculi coming from the opposite labium. Some consider these fasciculi, collectively, as forming a distinct muscle, and give it the name of *sphincter vaginæ.* They will, unquestionably, perform such an office; but I know of no occasion on which they appear to be so manifestly called into action, as when a mare, just after staling, is ejecting the stagnating drops of urine from the vagina by repeated eversions of the labia and os vaginæ. The labia are lined by a mucous membrane (the same as that which lines the vagina), which is continuous with the skin covering them externally, has a smooth humid surface, a pinkish hue (unless it be at the season of the venereal œstrum, when it is deeply reddened), and is perforated by the discharging mouths of numberless mucous follicles.

THE COMMISSURES are the angles uniting the labia, above and below. *The superior commissure* is extended into a sharp angle, and joins the perineum; *the inferior* is obtuse or rounded off, and is bounded by a hollow, named the *fossa navicularis,* at the bottom of which is lodged the

CLITORIS.—This miniature resemblance of the male organ is brought into view by simply dilating the vulva. Not only in its appearance is it strikingly like the penis, but it is found to bear the same close analogy in structure. Its extremity is invested in a doubling of thin and delicate skin, which is hairless, and commonly marbled; or, if not, black, or entirely white: a part that corresponds to the prepuce of the penis. It is firmly attached to the pubes by two short ligamentous prolongations, forming its roots. These unite into a cylindrical body, from two to three inches in length in a state of distension, and this consists of two spongy canals, separated by a pectinated fibrous partition, and inclosed within a dense, firm, white tunic: in fact, it is a structure altogether the counterpart of the *corpora cavernosa penis.* To this is added a bulbous termination similar in form and composition to the glans penis; and through it is a perforation out of which may be squeezed a sebaceous matter that serves to anoint the part, and preserve its aptitude for that sensual enjoyment of which it (as well as the glans penis) is known to be peculiarly susceptible. To the clitoris belong a pair of muscles, named the *erectores clitoridis;* they will be found described at page 130.

THE MEATUS URINARIUS is also a part that can be shown without the aid of dissection, and this is a stage of inquiry in which we ought to make ourselves well acquainted with its situation: but, as it is blended in composition with the vagina, I shall postpone the consideration of its structure until that canal has been described.

INTERNAL PARTS.

THE VAGINA, UTERUS, FALLOPIAN TUBES, FIMBRIÆ, AND OVARIES.

OF THE VAGINA.

THE VAGINA is a musculo-membranous canal of large dimensions, extending from the vulva to the uterus.

Situation and Connection. It is situated within the cavity of the pelvis, having the bladder below and the rectum above it; to both of which it has broad cellular attachments, in addition to the reciprocal connection of all three parts through the reflections of peritoneum. To the rectum it is closely and firmly attached, by cellular membrane, along its upper side; to the cervix, and to the upper half of the body of the bladder (which is not covered by peritoneum), its inferior and anterior part is connected by a broader and looser cellular band; and the extreme parts of the canal in front, both superiorly and inferiorly, are applied against the peritoneal pouches formed between the uterus and rectum above, and the uterus and bladder below.

Figure and Volume. The figure of the vagina (when distended) is that of an oblong cylinder; but in the collapsed state its sides fall into contact, and it will then vary its form according to the full or empty condition of the bladder and rectum: when they, especially the latter, are distended, the long axis of the canal will prove from side to side, with the exception of its orifice, which will have the long vertical diameter still preserved by its union with the vulva. The most capacious part of the canal is the posterior; there it even exceeds the dimensions either of the bladder or rectum: the part joined to the meatus urinarius is considerably contracted, but from thence it gradually widens to the outlet.

Length and Course. The length of the canal is about eighteen inches. Its course is horizontal; its axis, however, does not exactly preserve the straight line; it rather shows an inclination to a curve, the same as the rectum does.

Corpora Cavernosa Vaginæ. The vagina at its commencement from the vulva is much thicker in its parietes than elsewhere; a circumstance partly owing to a coating of strong muscular fibres, and partly to two cellular or cavernous membranous bodies, one upon either side, which have some resemblance in structure to the interior of the glans penis. They are inclosed in membranous coverings, enveloped in adipose substance, and show signs internally of having, in life, contained blood. I know of no appellation in use for these bodies: M. Girard calls them *"bulbes vaginals."* I see no impropriety in naming them the *corpora cavernosa vaginæ.*

Structure. The vagina in composition is partly muscular and partly membranous. The orifice of it is bound by the strong, red, circular, fleshy band forming the sphincter vaginæ; and the adjoining part of the canal is also encircled by some considerable fleshy fasciculi: but the part most compacted, and most thickly and regularly coated with muscular fibres, is that which is contracted—which receives the urine as it flows from the meatus urinarius; though the fasciculi hereabouts are not so red, nor so strong, as those blended with the sphincter. Farther forward than this, the vagina is *substantially* composed of membrane. There are, indeed, to be found colourless fibres taking various directions scattered over its surface; but they present no very unequivocal marks of muscularity, though they are commonly considered to be of that nature: fibres apparently similar to these are likewise discoverable underneath the red fasciculi posteriorly; but there they take a longitudinal course.

The membrane of the vagina, the part of which it is integrally constituted, is one of the mucous class, and one that possesses considerable density, extensibility, and resistance. Its exterior surface is rough and flocculent from the adhesion of muscle and other parts. Its interior is smooth and polished, humid from secretion, and has a very pale pinkish cast; unless the mare be under the influence of the venereal œstrum, and then its redness is considerably heightened and its secretion abundantly augmented. In the ordinary state this membrane is thrown into folds, larger in breeding mares than in others, technically called *rugæ,* which continue without much regularity from its outlet to its uterine end. Follicles furnishing the mucous secretion are scattered about underneath the membrane; and their orifices are generally most conspicuous within the more capacious part of the canal.

MEATUS URINARIUS.—Considerably in advance of the clitoris, altogether about four inches in the collapsed state from the entrance of the vulva, is an opening leading from the lower part of the vaginal canal, large enough to admit with ease any one of the fingers: this is the *orifice of the meatus urinarius,* and it is a part with the situation of which we cannot be too familiar, as upon such knowledge will principally depend our skill in passing the catheter. The conduit—*the meatus*—into which it leads is about two inches in length; and its course is downward and forward: it is surrounded below by the muscular fasciculi of the vagina, and covered above by its lining membrane. The instrument therefore (which should have more curve than is commonly given to it) must be introduced so as to follow this oblique direction, which will be accomplished by elevating the handle of it as soon as the point is pushed into the meatus. The orifice of the meatus is guarded by a doubling of the vaginal membrane, hanging over it like a curtain, and serving the purpose of a valve. Care must be taken to elevate this by means of the instrument; or, should there be any difficulty experienced in doing this, the left hand may be carried *per vaginam* to the part itself as an assistant.

The large and conspicuous cauliflower protuberance at the bottom of the vagina, is the *cervix uteri:* it will be described with the uterus.

OF THE UTERUS.

The uterus or *womb* is a hollow musculo-membranous organ, united to the anterior part of the vagina, destined for the reception of the fruits of impregnation.

Figure and Volume. The uterus of the mare is one of striking and peculiar figure. Its *body* (which is the bulky, oblong part) bifurcates anteriorly into two *cornua* or *horns.* I hardly know what the whole is like in figure, unless the vagina be taken with it, and then (in a mare that has never been fecundated) the *tout ensemble* very much resembles an insect of the beetle tribe: the vagina representing the bottle or body; the uterus, the head and neck; and the cornua, the horns. But, during the period of gestation, the womb undergoes an almost incredible augmentation in volume; and it never afterwards recovers either its identical original form or virgin state of contraction.

Division. We distinguish in the uterus, *body, horns, neck,* and *mouth.*

The body is the oblong or cylindrical part, growing out of the anterior portion of the vagina, into the centre of whose cavity it is presenting its posterior termination, the *os uteri,* while it is giving origin in front to *the horns.* Its upper and under surfaces are convex, and most prominent towards the middle; its corners or angles are round, it being evidently formed altogether for the purpose of giving capaciousness within. This part of the uterus lies wholly within the pelvis, between the bladder and rectum, and is entirely covered by peritoneum.

THE CORNUA or *horns*, rising from the body at an acute angle with each other, take a progressively divergent course to the loins, under the broad plates of the ilea; they are consequently not entirely confined to the pelvic bason. Their length and volume will be much greater in breeding mares than in others, though their increase will be less than that of the capacity of the uterus: indeed, in virgin mares, the diameter of a single horn is little exceeded by that of the womb itself. In figure they are cylindrical; they bend upward in their course, and they terminate in round extremities; to which is loosely appended the ovaries, through the medium of the Fallopian tubes.

THE CERVIX or *neck* of the uterus is the rugose portion protruded backward into the cavity of the vagina. From its flower-like appearance, the French have fantastically named it "la fleur epanouie:" it is a part, however, that can only be said to be demonstrable in a virgin uterus in the undistended state: inflate the womb, and the cervix will disappear; also one that during gestation undergoes very remarkable changes. The vertical slit or oval-shaped aperture in its middle is the *os uteri* or *mouth of the uterus.* The peculiar florulent aspect of the cervix is owing to its being enveloped in a prolongation from the lining membrane of the uterus which is uniformly puckered into many *rugæ* as it passes through the os uteri: around the sides of the cervix these rugæ become continuous with those of the vaginal membrane. This is a part that receives an especial abundant supply of mucous secretion.

Ligaments. Independently of its connection with the vagina, the uterus is confined in its place by two broad productions of peritoneum which attach it to the sides of the pelvis, named its *broad ligaments.* They are formed in this manner—one portion of peritoneum reflected from the bladder covers the under parts of the body and horns of the uterus, their upper parts receiving a similar covering from another portion of the same membrane derived from the rectum; the two portions subsequently unite at the sides of the uterus, and continue in union to the opposite parts of the pelvic parietes: by which arrangement the membrane really divides the pelvis into two cavities, or rather blind pouches, one existing between the uterus and bladder, the other between the uterus and rectum; at the same time that it serves to connect these parts mutually to one another. The cervix consequently receives no peritoneal covering. These ligaments serve to sustain between their layers the vessels and nerves belonging to the organ; to preserve its equilibrium during gestation; and to aid in retaining it in its proper centrical situation.

Structure. Underneath the peritoneal tunic of the uterus, intimately united with it by a short cellular tissue, is a dense fibrous structure, possessing a considerable degree of strength and extensibility, and generally considered to be muscular: and the fibres certainly assume that appearance, though their direction is very various, some running circularly, others deeper-seated longitudinally, and others, again, decussating these. But, about the cervix in particular, where the fibres are strongest, most collected, and often have a pale bloody tinge, the muscular structure is palpable. Still, however, were this disputed, proofs of its muscularity might be drawn from a physiological as well as an anatomical source. During the period of gestation, this tunic not only experiences considerable extension, but may be proved to undergo veritable accretion. Inwardly, the muscular is opposed and adherent to the internal tunic; but their connection, which is also cellular, is looser than that existing between it and the peritoneal covering.

Cavity. The cavity of the uterus, having the same irregular form as the exterior, has three outlets—one of considerable magnitude communicating with the vagina, through the os uteri; two others of very small size, through the extremities of the cornua, leading into the Fallopian tubes: the situations of which are denoted by two little whitish eminences visible upon the internal surface. The membrane lining the cavity is one of the mucous description. It assumes a more vascular and villous aspect than that coating the vagina, but, like it, is thrown in the collapsed state of the organ into numerous rugæ, which pervade the cornua as well as the body, and bear some comparison to an irregular network: these rugæ are larger and looser in mares who have bred foals. The surface is everywhere copiously furnished with mucous secretion by subjacent follices, whose orifices are here visible to the naked eye.

OF THE FALLOPIAN TUBES.

The Fallopian tubes are two trumpet-shaped or conical canals, running with a remarkably serpentine course, within the folds of the ligamenta lata, from the extremities of the cornua uteri to the ovaries.

Course. The tube on either side commences by an aperture in the cornu, encircled by an elevated whitish margin, which is scarcely large enough to admit a small silver probe: from this it proceeds forward, folded in peritoneum, extremely convoluted in its course, until it reaches the ovary, to which it attached; it then begins to enlarge in its diameter, grows less convoluted, and serpentines along the posterior side of the ovary, in order to reach the fissure of that body; at which part it ends in a fringed doubling of membrane, named the *corpus fimbriatum,* by a funnel-shaped irregular opening, turned backwards, and large enough to admit an ordinary-sized black-lead pencil.

Structure. These tubes, when stripped of their peritoneal envelopes, show a fibrous texture; and when opened, exhibit a rugose, villous, mucous surface, very similar to that of the internal membrane of the uterus. They are amply supplied with blood-vessels, which make their way to them between the layers of the broad ligaments.

OF THE FIMBRIÆ.

THE FIMBRIÆ, or *corpora fimbriata,* are, then, nothing more than the fringed terminations of the Fallopian tubes, formed by doublings of the enveloping membrane around their open orifices. They spread over the ovaries, concealing the posterior or cleft parts of those bodies from our view; but are perfectly unattached and loose, and consequently can follow the ovaries in any movements of place or position occasioned by visceral commotion within the abdominal cavity.

OF THE OVARIES.

THE OVARIES, or *female testicles,* are two egg-shaped bodies, situated further forward than the Fallopian tubes, within the cavity of the abdomen, at the distance of an inch and a half from the cornua uteri. They receive close coverings from the anterior portions of the broad ligaments, by which they are loosely attached to the spine, in their situation beneath the ilea, and a little behind the kidneys; indeed, the left ovary has a peritoneal attachment to the left kidney. So that if it were our intention to extract them, the incision should be carried along the crista of the ileum, and the hand introduced in a direction backward and inward.

Magnitude and Form. These bodies are about the size of walnuts. They are not regularly oviform: they have deep fissures in their posterior sides, which are occupied by the corpora fimbriata. Taking them and the Fallopian tubes together, they bear a striking resemblance, at first view, to the testicles and their ducts in the male..

Structure. Underneath their peritoneal coverings, the ovaries have whitish fibrous tunics, dense and inelastic in their texture, and which warrant the comparison generally made of them to the albugineous tunics of the testicles. Internally, the ovaries are composed of a whitish spongy substance, in which are, in some instances, found little vesicles containing a yellowish glairy fluid, in others one or more dark yellow or brownish substances, named *corpora lutea:* the vesicles are the *ova,* which from impregnation take on further development; the corpora lutea denote the parts from which vesicles have already burst, and consequently only exist in the ovaries of mares whose organs have been engaged in the generative process. Prior to the age ripe for sexual intercourse these bodies are small and white; but as soon as the time for copulation arrives, they grow large, redden externally, and present many yellow spots or streaks through their substance within.

Organization. The arteries supplying all these parts are—1. The *vaginal artery,* a branch from the internal iliac, which accompanies the obturator artery, and afterwards dips down by the side of the vagina, upon which it branches out in various directions, sending some ramifications in its way to the rectum, and transmitting others to the uterus and bladder. 2. The *uterine artery,* a branch from the external iliac, coming off after the ilio-lumbar, and distributing its branches principally upon the cornu uteri. 3. The *spermatic artery,* coming from the aorta, is convoluted in its course, and supplies the ovary, fimbriated body, and Fallopian tube.

The nerves are derived from the hypogastric plexus. Both the vessels and nerves take their passage between the layers of the broad ligaments, insinuate themselves underneath the peritoneal covering, obliquely pierce the substance of the muscular tunic, and ramify extensively between it and the internal membrane.

APPENDIX

TO THE GENERATIVE ORGANS.

THE UDDERS.

Although not immediately concerned in the process of generation, these organs co-operate towards the same important end—*the continuation of the species.*

THE MAMMÆ, or *udders,* are two flattened oval-shaped bodies, formed for the purpose of secreting milk.

Situation. They depend between the thighs from the postero-inferior part of the belly, in quadrupeds in general; but in the human species, and in the ape tribe, they are attached to the breast. The advantages resulting to the quadruped (who has no power of erecting himself or handling his young) from this situation of the mammæ, are—that they are well protected, by the trunk above and the thigh on either side, from external injury, that they are conveniently placed for the foal, and that they do not in the least interfere with progression.

Volume. In fillies and virgin mares the udders are so small that there hardly appears to be any; and in mares who have not had more than one or two foals, they likewise regain nearly their original flatness; but in this last instance the teats are commonly left larger, looser, and more pendulous than before, in consequence of the reiterated extension of them by the foal; a circumstance on which we may rely with tolerable certainty for a knowledge of this fact. In mares who have had several foals, the udders continue prominent and pendulous, and possess a flabby feel; and this is a state we cannot well mistake. Towards the latter end of gestation this part undergoes further evolution, swells and grows firm to the feel, and becomes distinctly visible as we stand behind the mare. Within a few days of parturition secretion begins, and the udders grow turgid with milk: they do not, however, acquire their full distension until the foal has drawn them for a few days, from which time they maintain their volume with little variation during the period of lactation. Soon after the foal begins to forsake the teat, the secretion of milk diminishes; and this is followed by a contraction of the bag, which goes on gradually until it has resumed nearly or quite its former flatness. In a state of full evolution, the udders assume a hemispherical form, and acquire a firm, plump feel; at other times they are soft, flabby, more or less pendulous, and possess neither definite figure nor volume.

Coverings. The outer covering of the udders is an extension from the common integuments of the belly. This is thin and fine in its texture, is commonly black, and is clothed with a few long downy hairs, growing thinner as they approach the teat, immediately around which the skin is without any hair. Underneath the skin, adhering to it by intervening cellular membrane, is spread over the gland a white, elastic, ligamentous covering, interspersed with several fibrous bands, which is derived from the faschia superficialis abdominis: this serves to give support and compactness to the glandular structure, and, in consequence of detaching processes into the interior among the lobules, to strengthen their inter-union one with another.

Structure. The interior of the udder exhibits a light-yellowish aspect, and evidently possesses a lobulated structure, held together by a fine cellular tissue, here and there interspersed with granules of fat. It is constituted of glandular masses, irregular in magnitude and form, and loosely connected one with another, each of which masses is composed of a number of lobules closely compacted and united together: a composition altogether that accounts for the loose or knotty feel which the gland is well known to possess. These insulated lobulous portions receive small arteries in numbers from the parent arterial trunk, from whose terminations arise (we do not precisely know in what manner) the *tubuli lactiferi*. These numberless little tubules, by repeatedly conjoining one with another, become at length several demonstrable canals, radiating from every part to assemble in the teat: still uniting one with another in their course, and occasionally dilating into considerable reservoirs for holding the secretion. The lactiferous conduits are continued through the substance of the teat, wherein during its relaxation they are so serpentined or coiled, that milk cannot spontaneously flow from them; but in the distended state of that body, or when it is drawn out in the act of suction or milking, these ducts are rendered straight, and the milk, either in consequence of internal or external pressure, readily runs out.

THE PAPILLA, *teat*, or *dug*, depending from the most prominent part of either udder, near its middle, is conical, black, and hairless. Its tegumental sheath is of the same description as that covering the bag from which it is derived, only it is perforated at the apex by three holes, to give issue to the milk; and underneath this is a second tunic, which comes from the elastic ligamentous covering, also of the gland. Through these openings (one of which is commonly conspicuous for its size) the milk is discharged from the conduits of the lactiferous tubes. When the udder becomes charged with milk, it flows into the teat, and distends it; and as the secretion is probably influenced in animals (as it is in the human subject) by anxiety for the young, the animal evinces this feeling by a state of distension of these parts. The papilla, as has been remarked before, enlarges during the season of lactation, and it does not afterwards recover its original volume so nearly as the udder itself does: a fact, I repeat, that may lead, when the first sign is wanting, to the discovery of mares that have bred.

Sucking is apparently an operation purely mechanical. The teat is seized, and so closely compressed by the lips of the foal, that the imbibing effort which follows has a tendency to produce a vacuum in the lactiferous tubes, now rendered straight from extension: this is counteracted by the pressure of the atmosphere upon the surface of the udder, and the consequence is, that the milk is forced from its reservoirs into the mouth, on the same principle that water is impelled into the barrel of a syringe by raising the piston.

SECTION IX.

NERVOUS SYSTEM.

COMPRISING THE BRAIN; THE SPINAL MARROW; THE NERVES; AND THE GANGLIA.

OF THE BRAIN.

THE brain is the soft white mass filling the cavity of the cranium.

Magnitude. In no animal is the cranium so large, in relation to the face, as in man; consequently, in none other is the brain (whose volume is always in uniformity with that of the cranium) of such magnitude. In horses the brain is but small, compared with the general bulk of the animal; and though there exists some difference in the dimensions, as well as form, of the heads of horses of different breeds, they are too trifling, in an anatomical point of view, to merit notice here.*

Division. In the brain are distinguished three *divisions*, though all three are continuous in one and the same substance: *the cerebrum*, so large that it occupies at least three fourths of the interior of the skull; *the cerebellum*, or little brain; and *the medulla oblongata*. That portion of medullary substance which extends from the brain through the whole length of the spinal canal is called *the medulla spinalis*, or spinal marrow.

Situation. No viscus in the body is so well defended from external injury as the brain: on every side it is enclosed by bony walls, well constructed to make great resistance, and more especially so at those parts where external violence is likely to be received. The interior of the skull is variously furrowed and indented by the more projecting parts of the organ, to which, in every particular, its figure is nicely adapted; for it is by the shape of the brain that that of the cranium is moulded, inasmuch as the formation of the one precedes that of the other. The relative situation of the divisions of the brain differs in the horse from that of the corresponding parts of the brain of the human subject; though both organs, in regard to the bones of the cranium, are similarly lodged: *e. g.*, the cerebrum, which forms the upper and anterior portion in the human subject, constitutes the lower and anterior in the horse; while the cerebellum, which in the former is placed below and behind the cerebrum, in the horse is placed above and behind it. This difference, however, is but imaginary, being entirely referable to the position of the head; for if we place the horse's head upon a table, so that it rest upon the branches of the lower jaw, we shall find no difference whatever in the relative situation of these parts.

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* "The brain of the shark does not weigh 3 ounces, although the animal itself is generally 300 lbs. in weight. The brain of the sheep, with respect to the whole weight of the body, bears the proportion of 1 to 150. In a dog the proportion is less: it is as 1 to 100. As we ascend in the general scale of rational beings, the magnitude of the brain bears an increased and strongly marked proportion to the size of the system in general. In the African, it is as 1 to 54. In an European, as 1 to the 50th part of the system altogether."—SAUMAREZ'S 'System of Physiology.'

Coverings. The brain has three coverings, called its *membranes* or *meninges; the dura mater, the pia mater,* and *the tunica arachnoides.* Of these, the exterior is the

DURA MATER.—Though called a *membrane,* this outer covering is a substance, dense, tough, and inelastic in its texture, its component material being chiefly tendinous fibre. It is firmly adherent to the interior of the cranium, offering considerable resistance to the elevation of the skull-cap, even after the bone has been completely divided; which union is the result of many little processes shooting from the membrane in between the teeth of the sutures of the cranium, as well as of numerous small blood-vessels passing from it into the pores of the inner table of the bone, to which it supplies the place of internal periosteum.

Surfaces. The *external* exhibits a smooth, dry, opaque, reddish aspect, rendered uneven by the subjacent prominences of the brain. The *internal* is lighter in shade, shiny and slippery, and moist from the exudation of a serous secretion. It has no connection with the membrane underneath; at least, no other than it has with the brain itself—by means of the vessels passing between them.

Organization. The blood-vessels of the dura mater are not numerous, but of sufficient magnitude to admit of coarse injection. The membrane itself affords a good example of the truth of the observation, "that the capillaries are not abundant in fibrous texture." By some, nerves are denied to exist in the dura mater: others conceive that they have discovered nervous filaments in its texture. In a sound state, the membrane appears to possess very little if any sensibility; for it may be cut or irritated in various ways without seeming to cause the animal any pain whatever.

Processes. The dura mater sends off detached portions or *processes,* which are extended across the cavity of the cranium, for the purpose (it would seem) of more steadily and effectually supporting the brain, and guarding against the pressure of one part or division upon another. These processes are *two* in number, and each consists of a duplication (or two layers) of the membrane. They are named the *falx* and the *tentorium*.

THE FALX, or longitudinal process, so called from its being resembled to the blade of a scythe (and indeed the comparison is a striking one), is that expansion of the membrane which descends for a short distance between the lobes of the cerebrum. It takes its rise from the crista galli, including the projection between its laminæ, from which it curves forward and upward, adhering in its way, first to the frontal, then to the entire length of the sagittal suture, growing broader as it proceeds: at length it terminates upon a thin transverse plate of bone, a process of the os occipitis anterior, where its laminæ split, diverge, and end in continuity with the tentorium. Whatever may be the *use* of the falx, it seems to be a part whose presence can be dispensed with, for I have a cranium now before me in which it may be said to be deficient; at least, all such appearance consists in a small triangular piece of membrane which does not project more than an inch from the tentorium: and this cranium belonged to a young horse who was perfectly free from any phrenetic disorder. The falx is commonly said, however, to stay one lobe of the cerebrum from falling or pressing upon the other when the head is inclined to one side.

THE TENTORIUM, or transverse process, is extended, after the manner of an arch, from the cerebral plate of the os occipitis, along the sides of the cranium, to its base; whence, greatly diminished in breadth, it may be traced onward to the body of the os sphenoides, where it vanishes in the common covering of the dura mater. It is composed of two laminæ: one is continuous with the falx; the other joins that portion of the membrane which covers the cerebellum. The tentorium is equally divided by the falx into two lateral portions. There is some variation to be seen in different subjects in the figure and extent of this process, but I have not remarked that it is ever deficient. It forms a transverse intersection within the cavity of the cranium, or partial septum between the cerebrum and cerebellum, and appears to be of service in fencing these important parts in their proper places, and keeping them, during the various motions and positions of the head, from pressing upon each other.

Sinuses. These are triangular spaces, or cavities, found to exist between the two layers of membrane forming the processes. There are several of them. Those most worthy of notice are the following:—first,

THE SUPERIOR OR LONGITUDINAL SINUS, which runs within the duplicature of the falx, along its superior border. It begins in a narrow channel, gradually widening and assuming a triangular figure as it extends backward, and terminates with the falx, at the cerebral process, where the lateral sinuses and it conjoin their canals. Internally, this sinus presents to view an uneven surface, upon which the veins are seen terminating by large open orifices discharging their blood in the same direction that the stream takes within the sinus itself. Here and there are seen slender chords, crossing the canal from side to side; which serve to strengthen its parietes and prevent over-distension.

THE TWO LATERAL SINUSES are formed within the duplicature of that part of the tentorium which is attached to the temporal and occipital bones; one extending to the right side, the other to the left side. They begin at the cerebral process, where the longitudinal sinus ends; and they terminate at the foramina lacera basis cranii in the jugular veins. Their canals are also triangular, and are intersected by fibrous filaments. They receive veins both from the cerebrum and cerebellum.

THE CAVERNOUS SINUSES, so named from the cavernous appearance of their interior, which includes a structure having some resemblance to the corpus cavernosum penis, are formed out of the dura mater upon the body of the os sphenoides. These cavities are remarkable from receiving some important nervous trunks in their passage from the brain, and from lodging the terminations of the internal carotid arteries. They commonly communicate with the

SUB-OCCIPITAL SINUSES.—These are likewise of the same formation, and are found upon the cuneiform process of the os occipitis, running longitudinally to the foramen magnum. They receive veins from the cerebellum and posterior parts of the cerebrum.

THE PIA MATER is the membrane immediately investing the brain, sending processes into its substance which separate the *cortical* portions of its convolutions, and having a further connection with the organ through the medium of the numerous interpassing blood-vessels. The reticular arterial ramification we descry upon it, is for the purpose of transmitting vessels of minute dimensions into the interior of the brain; which, though they can be traced by us no deeper than the cortical, are ultimately destined for the cerebral substance. The pia mater not only clothes the convoluted part of the cerebral mass, passing from one hemisphere to the other, but it gains admission into the ventricles, and gives them a lining. It differs altogether in its aspect and structure from the dura mater; presenting a smooth surface exteriorly, but a rough and villous one next to the brain, and being composed of a beautiful network of blood-vessels, united together by a delicate cellular tissue: it is, in fact, the immediate source from which the brain derives its blood, and, at the same time, the medium through which the unexpended blood is returned to the sinuses of the dura mater.

THE ARACHNOID MEMBRANE (so called from being resembled to the spider's web) is of a texture so fine, and of a nature so perfectly transparent, that, under ordinary circumstances, it is hardly demonstrable from the pia mater underneath it, to which it is everywhere closely and intimately applied, excepting that it does not (like that membrane) dip down between the convolutions. With pains, it is occasionally demonstrable in places about the base of the brain. Physiologically considered, we have no right to doubt of its being organized; although, hitherto, the most successful injections have not demonstrated the existence of blood-vessels in it. In the human subject (in whom these parts are more developed) it has been said to have shown vascularity in cases where the membranes have recently undergone the effects of inflammation. Concerning its use, no writer has been bold enough to speak: physiologists are unable to say for what purpose so delicate and transparent a structure is here interposed .

Vascular communication. From the vascular connection which subsists between the scalp, upon the exterior of the skull, and the dura mata, upon its interior, we have at once an explanation of that apparent anomaly in pathology, viz., that external injuries of the skull frequently induce symptoms of inflammation of the brain, or its membranes: in the human subject, such wounds are always considered, on this account, as dangerous, and, indeed, it not very unfrequently happens that they prove mortal. Though we have never seen a case of this description in the horse, there does not appear to be any good reason why we should not be cautious how we make or treat wounds of such a nature.

Effusion. A fluid, differing from serum in its properties, though like it in appearance, is occasionally effused between the dura mater and tunica arachnoides, or, more commonly, underneath the latter membrane (as well as within the substance of the brain itself), constituting a disease, termed *hydrocephalus:* it rarely happens in horses; but in the human subject, and more especially in children, it is by no means an unfrequent cause of dissolution.

BRAIN.—Having already given an outline of the *situation* and *division* of this organ, I shall now make some general observations in regard to its structure.

Structure. If a vertical section is made of any part of the brain, we perceive that its interior presents two substances of different colours: the outer of these, of a dirty grayish hue, is called the *cineritious* or *cortical* part; the inner, which is white, and of which the chief bulk of the organ is composed, the *medullary*. The cortical part (which is, proportionately to the medullary, more prevalent in the brain of the horse than in that of the human subject) is not always the outer—in some places, the relative disposition of the medullary and it being reversed—it is that, however, in which the blood-vessels of the organ are most conspicuous: for, in consequence of being closely invested by the vascular pia mater, it receives the numerous ramifications of arteries transmitted by that membrane for the nourishment of the interior parts of the brain. On the other hand, in the medullary portion, the blood-vessels, which in health only convey the colourless parts of the blood, are so minute that they escape notice: unless, occasionally, here and there, when it has been inflamed, the bloody specks upon its divided surface denote the division of those that have become of sufficient magnitude to admit the red globules.

According to the investigations of the most accurate anatomists, the brains of animals appear to be of a fibrous nature; and in many parts of the human brain (which is larger than that of any other animal) the disposition and course of its fibres have been traced: such inquiries, however, have, unfortunately, not led to any elucidation of the sensorial functions, nor are we aware that they have been attended with any advantageous result in regard to its pathology. After all, the truth is, that the *intimate structure* of this organ is still unknown to us. With regard to the cineritious or cortical part, there is much reason to believe, that it is almost wholly constituted of the ramifications of blood-vessels of extreme exility; from which others, still more minute, are distributed to the substance of the medulla.

It is here worthy of remark, that in no instance does Nature so invariably present us with the same structure and arrangement of parts as in this viscus: in almost every other in the body, we can discover some little variation, in this respect, in different subjects; but in the brain, the same uniform appearances ever present themselves on dissection: so intimately united do structure and function seem to be in this organ.

Duplicity. The cerebrum is divided into two halves, called *hemispheres*, each of which is formed of parts precisely similar, in every particular, to each other; so that, in fact, every part of the organ may be said to be *double*, *i. e.*, its two halves are constituted of several small portions, which are not only perfectly alike in structure, but are of corresponding symmetrical forms and dimensions: a remark that not only applies to the brain itself, but one that holds good, likewise, with regard to the spinal marrow. An animal, therefore, has, to all intents and purposes, *two* brains: and, probably, for the same reason that he has two eyes, two ears, and a double tongue.

Arteries. The arteries which supply the brain, are the two vertebrals, besides two other considerable branches from the carotids, called the internal carotids: its blood is returned from the sinuses of the dura mater by the vertebral and jugular veins. It is on the supply from the vertebral arteries, however, that this organ mainly depends for the preservation of that energy essential to the support of life: for if ligatures be put on these vessels, the animal speedily dies; whereas both the carotids may be tied without occasioning any apparent ill effects.

We shall now examine the divisions of the brain (viz., the cerebrum, cerebellum, and medulla oblongata) separately; commencing with the

Cerebrum.

The largest portion of the brain, and that which presents itself to our view immediately on raising the skull-cup, is the cerebrum. It is lodged in that capacious elliptical chamber which is formed, in front, by the parietal bones: behind, by the ethmoid, sphenoid, and posterior occipital bones; laterally, by the temporal bones: inferiorly, by the roofs of the frontal sinuses, and by the ethmoidal plates: and, superiorly, by the tentorium. The *visible* surface of it (as the cranium is ordinarily sawn open) may be said to represent a convex semi-oval, of which the broader end is turned upward. It is equally divided by a longitudinal fissure along its middle, into which the *falx cerebri* descends; and its divisions, which are perfectly symmetrical, both internally and externally, are denominated *hemispheres*.

Corpus Callosum. In parting the hemispheres, so as to admit light between them (by which a few small interpassing vessels and some weak cellular connections become lacerated), we perceive a white longitudinal body, covered by pia mater, uniting the hemispheres at the bottom of this fissure: this is the *corpus callosum*. Each hemisphere, separately regarded, has an *outer surface*, waved or convoluted, which is adapted to the undulated concavity of the skull-cap: an *inner perpendicular plane*, which is opposed to the one of the opposite hemisphere; and *a base*, divided into lobes, the description of which I shall postpone until the interior parts have been examined.

Centrum Ovale. In the dissection of the brain I shall pursue the customary method of the schools of anatomy; and in describing its several parts, preserve the names used in human phrenology so long as I find them applicable to correspondent appearances. The first step consists in making a clean horizontal section of the brain, parallel to its present convexity, by laying the knife flat upon the surface of the corpus callosum, and making a sweeping cut (with its edge first inclined a little upward, afterwards a little downward) through one hemisphere at a time. There being no distinguishable parts in the abscised portions, they may be cast away; but the surface which their removal has exposed being one that presents the greatest superficial extent of medullary substance that can be shown at one view, the appearance altogether has been described as the *centrum ovale.** The form and disposition of the *corpus callosum* become now demonstrable. It is placed in the centre of this medullary convexity, with which it is continuous in substance. It is narrower below than above. It unites the medulla of the two hemispheres in the middle. Inferiorly, it passes between the hemispheres, turns backward and terminates at the base of the brain, in the crura cerebri; superiorly, it joins the fornix, and spreads upon the hippocampi; and anteriorly, it may be said to form the roof of the lateral ventricles. Running aloug its surface are seen two prominent lines of medullary matter, between which exists a longitudinal linear depression, named the *raphe.*

Lateral Ventricles. By making a longitudinal incision through the corpus callosum, on either side of the raphe, we penetrate a cavity occupying the innermost part of the brain, which, with its fellow within the opposite hemisphere, constitute the two *lateral ventricles.* Having freely opened it, we find a watery fluid within, which serves to keep its parietal surfaces constantly wet, and to prevent (it is said) adhesion of them. The figure of the ventricle, both from its construction and from the inequalities of its contents, to which it is adapted, is extremely irregular. Its cavity extends as far forward as the front incurvation of the corpus callosum, from whence a winding canal is continued forward and downward to the base of the anterior lobe of the cerebrum, where it ends in a small circular conduit that leads into the ethmoidal ventricle: this canal, from its being represented to wind in its course like a horn, has got the name of the *inferior cornu.* From the superior part of the cavity, another flexuous passage, smaller than the former one, taking a direction at first outward, then downward, and lastly forward, leads to the base of the brain, through the substance of the middle lobe, and there ends in a blind termination: from which circumstance, and from its cylindroid figure, some call it the *digital cavity,* others the *superior cornu.* The two ventricles are lined (and the parts within them covered) by an extension of pia mater, which finds its way into them along with the vessels forming the choroid plexus. By this membrane, whose vascularity appears to be lower than that of the pia mater elsewhere, the watery fluid, it is supposed, is secreted: unlike serous cavities in general, however, the ventricles appear to hold water during life; for, if an animal is put to death suddenly, and these cavities are opened with all possible expedition, water, and not vapour, is uniformly found contained.

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* The cortical matter, however, cannot be all pared away,—it will intrude in places, and interrupt the uniformity of the surface: indeed, the horse's brain will less admit of being carved into such an aspect, in consequence of the proportionably greater quantity of cortical substance in its composition.

Contents. We now come to what are considered as the *contents of the lateral ventricles.* They are—*the corpora striata, the hippocampi, the plexus choroides, the fornix,* and *the thalami nervorum opticorum.* But a view of all these parts cannot be obtained until we have reflected the corpus callosum; prior to which being done, that body should be cautiously raised, in order to show the

Septum Lucidum, the translucent medullary partition between the ventricles, which extends perpendicularly along the corpus callosum in front, and is attached to the fornix behind. It is broad inferiorly, grows gradually narrow superiorly, where it ends in a point, at the angular junction of the corpus callosum with the fornix. It consists of two thin laminæ of medullary matter, included between and supported by the membranous linings of the ventricles, in the middle of which is a fissure or small cavity, by some described as the *fifth* ventricle, but more generally known as the *fossa Sylvii.* Sometimes this fissure is very demonstrable, glistening interiorly with moisture; at other times it is hardly perceptible.

Corpora Striata. When the corpus callosum is turned back, four large and remarkable eminences present themselves, two upon each side of the septum lucidum. The two inferior, and most bulky, are the *corpora striata.* They rise out of the lower and back parts of the ventricles, projecting into the middle of the cavities, where they become broad and approach the septum; growing narrow and receding from each other, above; below, extending along the anterior cornua. Externally, they have a thin lamina of medullary matter; but this is partly obscured by the cortical substance of which their interior is exclusively composed.

Hippocampi. The two superior eminences, smaller and whiter than the last, whose anterior extremities lie between the posterior of the corpora striata, are the *hippocampi.* These bodies, remarkable for their prominence and whiteness, occupy the superior spaces of the ventricles, where they lie in contact with the septum; but, in proceeding backward, they diverge, stretch first outward, then downward, and lastly forward; in fact, they descend into the superior cornua, and there end in bulbous extremities, called the *pedes hippocampi.* This descent or elongation, which may be denominated the *crus hippocampi,* is continuous above with the crus fornicis, but below it gets to the outward part of the crus fornicis, and gives off a thin, plaited, medullary border, which may be said to be an extension of the corpus fimbriatum. Their medullary covering appears to be continued from the corpus callosum; their internal cortical substance, which is interspersed with medullary striæ, originates from the very middle of the hemispheres. If sliced, they will be found to consist of alternate laminæ of medullary and cortical matter.

Plexus Choroides. Deeply lodged in the channel between the corpus striatum and hippocampus, lies a red, soft, vascular substance, consisting of a plexus or collection of minute blood-vessels, invested in an extension of pia mater, called the *plexus choroides.* This plexus first makes its appearance from behind the fornix: inferiorly, it ends abruptly in a round bulbous mass; superiorly, it sends down a process into the superior cornu. The arteries composing it come from the posterior arteries of the cerebrum: they enter the interior of the brain along a fissure, which in one place is a complete canal, existing between the posterior lobes of the cerebrum, and gain admission into the ventricles around the sides of the fornix. Its veins assemble and form a large branch, the *vena Galeni,* which branch unites with a similar one coming from the opposite plexus: the two conjoined make a single trunk, and that proceeds upward, along the above-mentioned fissure.

The fornix is that part which receives the posterior border of the septum lucidum. It is extended, after the manner of an arch, between the corpora striata, below, and the heads of the hippocampi, above; where it forms a junction with the corpus callosum, which it meets at an acute angle. It has four processes or *crura.* The two *inferior crura* spring from the corpus albicantium, at the base of the brain; in their course forward from which, they approximate and unite into one main crus or pillar: thus united, they wind upward, describing an arc, and, as soon as they make their appearance within the ventricles, constitute the body of the fornix. The *superior crura,* which are comparatively slender, proceed from the upper end of the fornix, wind upward, and then descend into the superior cornua of the lateral ventricles, where they grow tapering, and at length end in sharp-pointed extremities. Their anterior or concave edges, which are thin, unattached, and somewhat uneven, have been named the *corpora fimbriata;* their posterior borders are continuous with the crura hippocampi: along their fimbriated edges run the lateral processes of the plexus choroides. The middle part or arch of the fornix is unattached; but its superior or broad part is contiguously applied behind to the thalami, and adheres to them through the intervention of a fine membrane, investing the vessels of the choroid plexus which are ramifying hereabouts, named the *velum interpositum:* from the circumstance of the back of the fornix being imprinted by these vessels with many minute linear grooves, mostly running obliquely, this surface of it is commonly described as the *lyra, psalterium,* or harp.

Thalami. Having divided and reflected the fornix, and turned back the heads of the hippocampi, we bring into view the *thalami nervorum opticorum.* These bodies are also said to be *in* the lateral ventricles: more properly speaking, they form the upper and back parts of those cavities. They are white and conoid in form; narrow and approximated, inferiorly, where they lie between, and rather behind, the corpora striata; broad and directed opposite ways, superiorly; in front, they are opposed to the fornix, which they in a measure support; and behind, they contract into medullary bands—the *tractus optici,* which turn round the crura cerebri to the base of the brain. Upon these bodies the separate portions of the plexus choroides unite into a single vascular chord, which takes its course along the canal between them, and makes its exit from the brain through the fissure left between the posterior lobes of the cerebrum. The thalami are firmer in their composition than the corpora striata: like those bodies, however, they are cortical within, thinly striated with medullary matter.

Tænia. In the groove between the thalamus and corpus striatum, partly covered by the plexus choroides, runs a conspicuously white, medullary band, designated the *centrum semicirculare geminum,* vel *tænia semicircularis.*

Commissures. The contiguous parts of the thalami, flattened and closely applied, are united in one broad circular place by pulpy cortical matter, which union is called their *commissura mollis.* Immediately behind the fore part of the fornix, runs a fine medullary chord, which is extended in a curved direction, on either side, into the substance of the corpus striatum: this forms a band of connection between the hemispheres, and takes the name of *commissura inferior cerebri.* Superiorly, above the commissura mollis, is another medullary chord, similar to the one last mentioned, but shorter and smaller, which is the *commissura superior cerebri.*

Foramen. Just over the commissura inferior, between it and the commissura mollis, between and in front of the optic thalami, under the arch of the fornix, is a triangular hole, called the *foramen commune inferius.* Now, since the lateral ventricles communicate underneath the arch of the fornix, it is evident that both of them must open into this foramen; and since this foramen leads into the *third* ventricle, it follows that this cavity and the lateral sinuses must reciprocally communicate through its medium.

Between the commissura mollis and the commissura superior is another foramen, which would also be one of like communication were it not covered and closed by the velum interpositum, which is here spread over the surfaces of the thalami, and traversed by the vessels of the choroid plexuses.

The third ventricle, as it is called, is nothing more than the fissure existing between the thalami, in consequence of their partial divergence, below and behind the commissura mollis, in the medium line of the brain. The floor or back part of this narrow oblong cavity is constituted of the crura cerebri.

Infundibulum. Leading from the inferior part of this ventricle, is the *infundibulum,* a passage small at its commencement, but gradually enlarging to its termination, which takes place in a blind extremity, in front of the corpus albicantium, at the pituitary gland. Superiorly, under the superior commissure, is a passage leading from this cavity into the *fourth* ventricle (situated within the cerebellum), the *iter a tertio ad quartum ventriculum.*

Pineal Gland. Over the third ventricle, deeply lodged between the summits of the thalami, above and rather before the superior commissure, we find the *pineal gland*—a little, conoid, greyish body, marked by a slight depression along its middle; enveloped in pia mater, derived from the vessels of the choroid plexus; and attached by that membrane to the thalami, and to the tubercula quadrigemina, which are placed behind it. From its base or inferior part proceed two little *peduncles* or foot-stalks, which run along the top of the superior commissure, and are implanted into the crura cerebri. The structure of this little organ remains unknown. It is possessed of considerable firmness, and is deeply reddened and highly vascular within; but I have not remarked that it contains earthy matter, as is the case so frequently with that of the human brain.

Nates and Testes. Above the third ventricle, behind the pineal gland, and immediately over the iter a tertio ad quartum ventriculum, are four considerable eminences, the *tubercula quadrigemina*—or rather *bigemina,* since they are divided into the TWO *nates* and TWO *testes.* The *nates,* the foremost and by much the largest of these bodies, separated by a groove from the testes, and by a deep perpendicular fissure from each other, present semi-oval exteriors, of a mixed composition, cineritious and medullary, and are in intimate union with each other and with the testes. The *testes,* much smaller than the nates, are also ovoid in figure, but their long diameters are placed contrariwise—transversely. In their composition they are alike also, as well as in their connections, both being joined to the crura cerebri, by which they are supported.

Cerebellum.

In order to guard against a common misconception of the relative position of this part, I shall repeat here what I took occasion to lay some stress upon in a former place—that the three divisions of the horse's brain are similarly lodged, *in regard to their cranial case,* to what the correspondent parts in man are : but that when we view them as the animals naturally stand, their relative situation is altogether altered. The cerebellum (as in man) occupies that compartment in the basis of the cranium which is formed, above and behind, by the anterior occipital bones ; laterally, by the petrous portions of the temporal bones ; and superiorly and anteriorly, by the tentorium : that septum being deficient inferiorly and anteriorly, to give passage to the crura cerebri to form a junction with the cerebellum ; while the vacuity admits also of the projection of the anterior vermiform process, which is the only portion of the latter that does not rest upon the tentorium.

Peculiarities. In volume, figure, and aspect, the cerebellum is at once distinguishable from the cerebrum. It is only one-sixth of the volume of the cerebrum. Its figure is irregular—it has two oval ends, placed transversely, united in the middle by a broad and prominent vermiform belt, its lateral dimension exceeding its longitudinal. Its aspect is lobular or convoluted: but, in addition, it is everywhere so striated with deep transverse fissures, that its appearance is altogether different from any other part of the brain.

Lobes. The cerebellum is superficially divided into three oblong *lobes*—a *middle lobe,* and two *lateral lobes.* The lateral lobes, which are opposed to the posterior lobes of the cerebrum, are small and ovoid. The middle lobe is prominent, arched, and subdivided into lobuli by several *sulci,* conspicuous for their depth, crossing its upper and under surfaces. The anterior and more prominent part of this lobe, which is received into the great fissure of the cerebrum, is denominated the *anterior vermiform process;* the continuation of it, along the summit of the head, forming the *posterior vermiform process.*

Arrangement of component Substances. In the cerebellum, the disposition and proportionate quantities of medullary and cortical matters are reversed, with regard to the cerebrum. Herein the cortical substance exceeds the medullary in quantity, and, instead of forming the outward parts, pervades the innermost. Slice the cerebellum horizontally, and these substances present a laminated appearance: on the other hand, make a vertical section of it, and they are found so disposed as to give the surface an arborescent representation, usually denominated the *arbor vitæ.*

Fourth Ventricle. Within the cerebellum, or rather between it and the tuber annulare and medulla oblongata (which two last form its back part), is situated the *fourth ventricle.* Beginning above the testes, where it is perforated by the *iter a tertio,* it extends upward and backward to the extremity of the medulla oblongata, where it ends in a sharp angular point, which, with a groove issuing from it and continued along the floor of the ventricle, anatomists have resembled to a pen, and thence called the *calamus scriptorius.*

Valvula Vieussenii. Extended across the inferior and anterior part of the ventricle, closing the cavity between the testes and lower extremity of the anterior vermiform process is a membrano-medullary curtain, the *velum* vel *valvula* VIEUSSENII. It is supported at the sides by two medullary productions, remarkable for their whiteness, the *processus a cerebello ad testes,* which some regard as the *columns of the valve.*

The choroid plexus of the cerebellum is found, lying crosswise, within the posterior part of the fourth ventricle, between the cerebellum and medulla oblongata. It no wise differs in its composition from the plexuses of the lateral ventricles. It is distributed into three principal divisions: one lies in the middle of the calamus; the other two (lateral) are lodged within fissures in the cerebellum, occupying the spaces between it and the tuber annulare.

Base of the Brain.

The *base* or posterior part of the cerebrum is divided into six lobes: two *inferior* or *anterior*, reposing upon the alæ of the ethmoid bone; two *middle*, upon those of the sphenoid; and two *superior* or *posterior*, lodged in the fossæ of the squamous portions of the temporal bones.

Over the middle lobes are two broad prominences whose surfaces are remarkably even and smooth: these are the bases of the corpora striata, the parts from which the olfactory nerves are seen taking their origin.

Crura Cerebri. Above these bodies, again, in the middle of the brain, are two oblong medullary eminences, intimately united together: these are the *crura cerebri.* They rest upon the alæ of the sphenoid bone. They take their rise from the inferior and middle lobes of the cerebrum, and are continued into an ovoid protuberance above them, named the tuber annulare. Though medullary without, the crus, when cut deeply into, exhibits a cineritious hue, and the part of the interior the most darkly shaded has been termed the *locus niger.*

Corpus Albicantium. Seated between the crura, is a small, hemispherical, medullary eminence, distinguished as the *corpus albicantium.* In the human subject this body is double; and there is some appearance of a depression along its middle in the horse. It is medullary without, but has a tinge of cortical matter within.

Tractus Optici. Winding obliquely downward, around the crura, proceeding from the terminations of the thalami, are the *tractus optici:* they are to be regarded as the roots of the optic nerves, with which they are continuous. They are entirely medullary.

Crura Cerebelli. Higher up and more outward than the crura cerebri, are the *crura cerebelli*—two stout, cylindroid, medullary chords, joining the lateral lobes of the cerebellum to the tuber annulare. These parts consist of a prolongation of that portion of medullary substance which forms the trunks of the arbor vitæ.

The tuber annulare vel *pons* VAROLII (whose situation now need not be pointed out) may be said to be constituted of the united substances of the crura cerebri and crura cerebelli: it is, in fact, the common termination or medium of junction of the cerebrum with the cerebellum. It is supported by the cuneiform process of the posterior occipital bone. Its surface is marked by a shallow depression along its middle, which gives it the appearance of having lateral eminences. Internally, the tuber exhibits a mixture of cortical and medullary matter.

Foramina Cæca. Above and below the tuber, centrically situated, are little round depressions or blind holes, which are generally described as the *foramina cæca, superior et inferior.* They serve as places of lodgment for small plexuses of the blood-vessels.

Still higher than the tuber is placed the

Medulla Oblongata.[*]

The smallest division of the cerebral mass; more properly speaking, it is *the commencement of the spinal marrow.* It rests upon the cuneiform process of the occipital bone, and is continued upward and backward to the foramen magnum. Regarded in an excised or separate state, it is of an oblong, quadrilateral figure. It has a deep fissure along its middle (in which runs the basilar artery) that divides it into lateral portions. Contiguous to this fissure, rising from the sides of it, are two longitudinal eminences, called the *Eminentiæ pyramidales.* From the lateral parts project two other eminences, named the *Eminentiæ Olivares.* The upper surface of the medulla oblongata forms, with the tuber annulare, the floor of the fourth ventricle. Though, like the tuber, it is composed internally of a mixture of cortical and medullary substances, its shade is lighter than that body.

Lastly, remains to be considered the

Pituitary Gland.

A reddish body, of an ovoid form, seated upon the sella tursica, within a fold of the dura mater. It has a membranous capsule, surrounded by cellular adhesions, by which it is firmly retained in its place; whence it is not dislodged, even though the cerebral mass be taken out. It has the appearance of being highly vascular; it is, however, of a lighter colour internally than externally, and assumes, in places, a mottled aspect. The ancients entertained a notion that it imbibed some fluid from the brain, which they called *pituita,* through the infundibulum, and transmitted it to the nose; but we find that these parts have no communication whatever: in short, its real use is unknown.

OF THE SPINAL MARROW.[†]

The medulla spinalis, or *spinal marrow,* is that extended cylinder of brain-like substance which is continued from the posterior part of the medulla oblongata through the entire length of the spinal canal. Lodged within a cavity whose form is continually undergoing more or less variation, it neither fills nor fits that cavity: in some places it swells in volume, in others it grows contracted; everywhere it has the appearance of having shrunk from, or of being disproportionably small for, the canal, in which it is contained.

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[*] "*The seat of power* which controls the respiratory motions is the medulla oblongata."—"He who holds the medulla oblongata in his hand, has the key to the nervous system."—*C. Bell, F.R.S.*

[†] "In animals which do not breathe by an uniform and general motion of their bodies, there is no spinal marrow, but only a long compound and ganglionic nerve, extending through the body for the purpose of sensation and motion. This chord in those creatures does not actuate the animal machine with alternate dilatation and contraction."—'The Nervous System,' by Charles Bell, F.R.S.

Coverings. It is inclosed in the same membranes that envelop the brain; but, in addition to them, the *superior ligament* of the spine serves as a covering and defence to it below. To this, and to the periosteum lining the canal, its proper theca is loosely attached by cellular, adipose, and gelatinous matter. Its dura mater is derived from that which covers the brain: in being continued through theforamen magnum, the membrane is contracted into a cylindrical sheath, which loosely incases the marrow, and is generally described under the denomination of *theca vertebralis.* About the beginning of the sacrum, the theca narrows; it recedes from the sides of the canal, and, having inclosed the termination of the marrow, is extended into a point and lost upon the cauda equina. The dura mater is connected to the membranes underneath—the membrana arachnoides and pia mater, by a fine cellular tissue; and these coverings have the same relation to the marrow that the same membranes have to the brain—of which, indeed, they may be considered prolongations.

Structure. The spinal marrow, stripped of its membranes, is cylindroid in form, but flattened along its upper and under surfaces, each of which is marked by a longitudinal linear fissure: these fissures, of which the inferior is the more conspicuous one, are continuations of those that traverse the medulla oblongata—dividing the marrow into two *lateral portions,* and serving as convenient tracts for the spinal blood-vessels. In places, also, some transverse fissures or little wrinkles are apparent, which are evidently for the purpose of admitting of certain degrees of elongation and contraction, in order to guard against extension or laceration of the marrow under any motion or altered position of the spine. The marrow varies in its dimensions at different parts; and, also, somewhat in its form. At its continuation from the medulla oblongata, it is large, from which to the fifth cervical vertebra it gradually grows less in circumference; here it swells again, but again diminishes in entering the first dorsal vertebra. Along the back it is small, and nearer approaches the form of a perfect cylinder; but in the loins it grows flatter than ever, and, a third time, increases in size, until it reaches the last lumbar vertebra; from which it begins to taper, and continues so to do until it at length ends in a pyramidal point, within the second piece of the sacrum. Around its termination come off several large nervous chords, which are continued along the canal, and extend, some of them, into the coccyx: altogether, they have been resembled to a horse's tail, and thence denominated *cauda equina*.

In the year 1808, Mr. Sewell conveyed, in a letter to Sir E. Home (which was afterwards read to the Royal Society), the particulars of what he conceived to be a *canal* running from the fourth ventricle through the whole length of the spinal marrow, containing a limpid colourless fluid, and lined by the *membrana arachnoides*, or a membrane very like it; but, since this, M. Bellengeri, of the College of Medicine of Turin, has proved that this supposed canal is, in truth, a *median furrow*, dividing the spinal marrow into six columns: he has likewise shown, that the roots of the spinal nerves, both anterior and posterior, are triple. More recently, Sir Charles Bell has discovered, that of the three tracts or columns contained in each lateral portion, the inferior column is for motion, the superior for sensation, and the middle one for respiration. The two former extend up into the brain, and are dispersed or lost in it; but the latter stops short in the medulla oblongata.

Origin of Nerves. The nerves given off by the spinal marrow are twenty-nine pairs. They originate from the superior and inferior columns, by superior and inferior *fasces*, or bundles of filaments, piercing the theca vertebralis in several places, from which they derive sheaths in their egress. The cervical and dorsal nerves, for the most part, arise from the marrow opposite to the foramina, through which they make their exit from the spine; but the posterior lumbar and sacral nerves proceed obliquely backward before they turn out; and some of the latter, and all the coccygeal nerves, run longitudinally down the canal before they quit it. The filaments composing the fasces are themselves small; they bear a proportion in size and number to the nerves of which they are the roots. Threads of communication may be seen, oftenest in the neck, running from one fascis to another. The superior fasces are separated from the inferior ones by a strong, white, fibrous band, which runs along the side of the marrow, and has a puckered attachment in one particular place to the theca, between every pair of nerves, on either side; inwardly, it being intimately joined to the pia mater. This band, which is denominated from its several pointed connections, the *ligamentum denticulatum*, prevents any such injurious extension of the nerves, when the spine is forcibly flexed, as might occasion laceration of their medulla. In the space between the vertebræ, the superior set of filaments converge and form a ganglion, from the opposite side of which many filaments arise, and proceed with the inferior and join them, and thus form the trunk of the nerve.

OF THE NERVES.

The nerves are dense, white, fibrous chords, proceeding from the brain and spinal marrow to all parts of the body.

Number. From the brain issue *ten pairs,* denominated *cerebral nerves;* from the spinal marrow, *thirty-six,* termed *spinal:* making, altogether, *forty-six pairs.*[*]

Magnitude. In some animals (among which may be numbered the *horse*) the nerves, taking them generally, are of larger size than they are in the human body, although the brain of the latter far preponderates in volume. According to Richerand, "the spinal marrow and the nerves, in the different animals furnished with them, are larger in proportion to the brain, according as the animal is more distant from man in the scale of animation."

Coverings. The nerves are covered by the same membranes as cover the brain: the one may be traced from the other. The pia mater, indeed, enters into the composition of the nerve, forming minute sheaths in which the nervous matter is contained. *These* external coverings, however, seem to proceed only to a short distance; for if we examine the outer cases in which they are subsequently inclosed, we shall find them to be nothing more than condensed cellular membrane. It is to the external covering that the compactness and density of a nerve are entirely owing; when deprived of it, but a slight degree of pressure will destroy its texture: indeed, there are some nerves whose exposed situation would subject them to perpetual contusion and laceration, were it not for the protection afforded them by this compact cellular envelope.

Structure. The substance of the nerves is pulpy; and their pulpy matter is contained within minute membranous sheaths or tubes (composed either of simple cellular membrane or of pia mater), constituting in this manner so many filaments or *funiculi,* which form one continuous tract from their exit from the brain to their ending in the skin or muscle. Every one of these filaments or tracts of nervous matter (as we learn from the celebrated labours of Sir Charles Bell) "has its peculiar endowment, independently of the others which are bound up along with it; and this same endowment it continues to have throughout its whole length."

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[*] "In the view which I have taken of the nerves of the (human) body, there are, besides the nerves of vision, smell, and hearing, four systems combined into a whole. Nerves entirely different in function extend through the frame: 1st, those of *sensation;* 2dly, those of *voluntary motion;* 3dly, those of *respiratory motion;* and, lastly, nerves constituting *the sympathetic system,* which from their being deficient in qualities that distinguish the three others, seem to unite the body into a whole, in the performance of the functions of nutrition, growth, and decay, and whatever is directly necessary to animal existence. Of these, the first two are bound together through their whole course; the third are partially joined to the two former; and the last are the most irregular of all."—Such is a *coup d'œil* of the new arrangement of the nervous system introduced by Sir Charles Bell.

Elasticity. It has been generally supposed, that nerves are inelastic in themselves, and that any extension or contraction they admitted of, arose from the elasticity of their component cellular membrane. Sir E. Home, however, has proved, by some ingenious experiments, that they possess a power of retraction when divided in the living body: a circumstance which, of late, cannot altogether have escaped the observations of those who have performed the operation of *neurotomy*. This retraction does not seem entirely to depend on any inherent contractility of tissue, otherwise extension of the nerve would be a necessary preparative; on the contrary, it happens under the most complete state of relaxation: an effect that will not take place in the dead subject under similar circumstances.

Mode of Origin. A nerve is said to have two extremities—a *cerebral*, and a *sentient*: the former is that part by which it is connected with the brain, or spinal marrow; the latter, that by which it terminates in the various structures of the body. It has been usual to say, that the nerves arise, or have their *beginning*, from the brain, though it would appear, from some recent investigations into their composition and functions, that we might, with equal propriety, regard them as deriving their origin from the organs to which they are said to be distributed, and as *ending* in the sensorium. Supposing, however, that they do issue from the brain, there still remains unsolvable mystery respecting their beginning or roots. Some nerves may be followed through a tract or streak of pulpy matter, distinguishable from the surrounding medullary substance, until at length we lose the tract, from its vanishing in the cineritious substance. So that, although we continue, for the sake of anatomical definition, to assign certain parts of the brain as the beds or origins of certain nerves, we are still, in truth, ignorant of the veritable sources of their original or radical fibres. It would appear, from many familiar facts (the result of experiments and pathological observations) that the nerves distributed to one side of the body arise from or are connected with the opposite side of the brain; and if this be true, there must be somewhere a decussation of them: if an injury be received on the left side of the skull, the right side of the body will become paralytic; an effect that could not happen unless there was a ready communication between one side of the brain and the nerves of the opposite side of the body, by means, in all probability, of direct continuity of fibre. If one of the lateral halves of the spinal marrow be cut through, the animal will become paralytic, not on the opposite, but on the *same* side; a fact which, although it at first view appears contradictory to what we have just stated, in truth tends to confirm this opinion: for the medulla spinalis being composed of lateral portions, the fibres decussate each other in the same manner as those of the nerves are supposed to do.

Ramification. The nerves of motion, before eutering the mnscles, form various communications with others in the vicinity; in many parts, by such frequent intercourse, that a kind of nervous network is formed, to which the term *plexus* is applied. And the plexus is intricate in proportion to the number of muscles to be supplied, and the variety of combinations into which the muscles enter.* In their course, the nerves generally proceed in straight lines to the parts to which they are distributed; deviating only (like the arteries) for their own safety, or for some wise and evident purpose.† Sometimes they run with the blood-vessels, sometimes alone; we commonly find a nervous trunk, and in some places two, accompanying the principal arteries and veins of the extremities. The branches of the nerves, for the most part, come off at acute angles: those springing immediately from the trunk send off others of smaller size, until filaments of such minuteness are formed, as to be invisible to the naked eye.

Termination. The twig-like ramifications of nerves end in two different ways: either by inter-communication—which is similar to the anastomosis of arteries, or by sentient extremities within the substance of those organs to which they are distributed. In the retina (a part of the eye entirely composed of the expanded termination of the optic nerve) an extremely delicate tissue, of a pulpy consistence, and semi-pellucid yellowish appearance, is observable; from which it has been conjectured, that the extremities of other nerves may be somewhat similar: but, to confess the truth, we do not know what form they actually assume—we think it very probable, that their mode of termination may vary according to the nature and texture of the part in which they are expended.* The nerves are very unequally distributed to different parts: the organs of sense, the skin, muscles, and mucous membranes are plentifully supplied with them: the serous, fibrous, and medullary membranes receive but few; and none have yet been detected in either cartilage or tendon.†

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* 'The Nervous System.' By C. Bell, F.R.S.

† There is no such thing as *irregularity* in the nervous system. The term may be applicable to arteries or veins, because it signifies not whether a part be supplied with this or with that branch, so that arterial blood is furnished. But one nerve cannot supply the office of another. (The property dispended resulting from the *source* from which the nerve is derived.) There is no such thing as a nerve deviating or being found wanting (an occurrence frequent in the vascular system) without the loss of some essential faculty.—*C. Bell, F.R.S.*

Ganglion. A ganglion is a little knot or swelling upon a nerve, perfectly natural to it. We find them in various parts of the body; more especially about the neck, chest, and abdomen. They will be pointed out in tracing the distribution of those nerves to which they appertain. Bichat discovered that neither the sympathetic nerve nor the ganglia it forms, possess sensibility.

Origin and Distribution of the Nerves.

It has been observed, that the ten pairs of nerves connected with the brain are denominated *cerebral;* while the thirty-six pairs connected with the spinal marrow, are contra-distinguished as the *spinal.* All the nerves being symmetrical in number and distribution, on either side of the body, take their origins by pairs, and these pairs are numbered, and so distinguished from one another, according to the order in which they rise—proceeding from below upward within the head, from before backward within the spine. In addition to this distinction of ordinal number, however, every pair of cerebral nerves has obtained a particular epithet significant of the specific purpose they serve, the part they supply, or else some peculiarity in their division or distribution.

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* Wherever we trace nerves of motion, we find that before entering the muscles, they interchange branches, and form an intricate mass of nerves, or what is termed a *plexus.* The filaments of nerves which go to the skin, regularly diverge to their destination.—'Nervous System.' By C. Bell, F.R.S.

† And yet the granulations of these parts possess sensibility of which I have had very marked evidence, in the case of broken-knee. The horse has never failed to snatch up the leg, every time the granulating edges of the extensor tendon were touched with the probe.

TABLE OF THE CEREBRAL NERVES.

NERVES.	CEREBRAL CONNECTION.	DISTRIBUTION.		
1st Pair.—*Olfactory*	Corpora Striata	To the Nose.		
2d Pair.—*Optic*	Thalami Nervorum Opticorum	To the Retina of the Eye.		
3d Pair.—*Motores Oculorum*	Crura Cerebri	To the	Ophthalmic Ganglion Levator Oculi Obliquus Inf. Oculi Adductor Oculi Depressor Oculi.	
4th Pair.—*Pathetic*	Tubercula Quadrigemina	To the Sup. Oblique Muscle of the Eye.		
5th Pair.—*Trigemini*	Crura Cerebelli	Ophthalmic	Lachrymal	To the Forehead Lachrymal Gland—Conjunctiva—Ciliary Glands
			Supra-orbitar	To the Forehead Sup. Eyelid
			Lateral Nasal	To the Membrana Nictitans False Nostril and Ala Nasi Ophthalmic Ganglion.

NERVES.	CEREBRAL CONNECTION.	DISTRIBUTION.		
5th Pair (*continued*)	Crura Cerebelli	Sup. Maxillary	To the Under Lid and Lachrymal Duct	
			Antrum and Molar Teeth	
			Sphæno-palatine	To the Nasal Chamber Sinuses and Roof of the Mouth
			To the Velum Palati	
			Palato-Maxillary	To the Soft Palate Upper Lip
			Pes Anserinus—Dispersed upon the Face.	
		Inf. Maxillary	Reflected Branch to the Portio Dura	
			Buccal	
			Pterygoideal	
			Gustatory	Medullary Dental Terminating in the Papillæ of the Tongue
			Terminating Branches to the Under Lip.	
6th Pair.—*Abducent.*	Medulla Oblongata	To the Abductor Oculi—Branches also to the Retractor.		
7th Pair.—*Portio Mollis*	4th Ventricle	To the Internal Ear.		
Portio Dura	Union of Medulla Oblongata Tuber Annulare Crus Cerebelli	Chorda Tympani		
		Eustachian Branch		
		Ant. Auricular—Ant. Auricular Plexus		
		Post. Auricular		
		Int. Auricular		
		Parotideal		
		Masseter		
		Facial.		

NERVES.		CEREBRAL CONNECTION.	DISTRIBUTION.		
8th Pair.—	*Glosso-pharyngeus*	Corpora Olivaria	Reflected Branch—to the Portio Dura		
			Pharyngeal		
			Lingual.		
	Par Vagum	Corpora Olivaria	Branch to the Cervical Ganglion		
			Pharyngeal	Œsophageal Sympathetic Pharyngeal	
			Carotid		
			Laryngeal		
			To the Tracheal Plexus		
			To the Cardiac Plexus		
			Recurrent	To the Pulmonary Plexus To the Cardiac Plexus To the Post. Cervical Ganglion Tracheal and Œsophageal Terminating in the Glottis.	
			To the Ant. Pulmonary Plexus		
			To the Post. Pulmonary Plexus		
			Œsophageal		
			Terminating in the Stomach.		
	Accessory	Medulla Spinalis.	To the Par Vagum		
			To the Ant. Cervical Ganglion		
			To the Sub-occipital		
			Terminating Branches	Anterior Posterior	To the Muscles.
9th Pair.—*Lingual*		Corpora Olivaria	Hyo-glossal		
			Lateral Lingual		
			Terminating Lingual.		
*10th Pair.—*Sub-occipital*		Union of Medulla Oblongata Medulla Spinalis	Sup. Branches	Superficial Muscular Deep Muscular Anterior Auricular	
			Inf. Branches	Deep Muscular	
				To the Anterior Cervical Ganglion	
				To the Lingual Nerve	
				Terminating	In the Thyroid Gland.

First Pair, or Olfactory Nerves.

These arise from the corpora striata, along the posterior borders of which bodies the medullary bands or roots of them may be traced as high up as the middle lobes of the cerebrum. These are the largest of the cerebral nerves: are bulbous at their origin; pulpy in texture; and exhibit, when cut into (comparatively to their size) large cavities, which are walled in by a layer of medullary matter, inclosed within a thinner one of cortical substance. These cavities some (erroneously) describe as *ventricles of the brain:* but they evidently belong exclusively to these nerves. They are conical in figure; are capacious inferiorly, and generally distended with fluid; but contract upward into small circular canals, which lead through the trunks of the nerves into the anterior cornua of the lateral ventricles. Girard calls them the ethmoidal sinuses: but, as this would create confusion in our nomenclature, it would be better to name them the *olfactory sinuses.* This, the tubular portion of the nerve, is sheathed in dura mater. From its abrupt or truncated termination against the cribriform plate of the ethmoid bone, are transmitted numerous, soft, nervous filaments, which pierce the foramina of this bony plate, and enter the nose; where they undergo a further subdivision, and are at length widely dispersed over the schneiderian membrane.

Second Pair, or Optic Nerves.

If we may be allowed to estimate the importance of nerves by their volume, the optic will hold the *third* rank among those of the brain, being exceeded in size only by the first and fifth pairs. They take their rise from the posterior, contracted, and incurvated parts of the thalami nervorum opticorum. At first they wind forward and downward, around the crura cerebri, which incipient parts of them have obtained the name of *tractus optici:* in doing this they approach each other (in which relative course they are singular, all other pairs diverging), and at length form a junction—an intermixture, some say a decussation—of their fibres (in which they are also singular), just below the corpus albicantium. After this, they become again two separate nerves, proceed downward and forward through the foramina optica, and enter the cavities of the orbits. Here each nerve continues the same oblique course, surrounded by the muscles of the eye, and penetrates the inner, inferior, and posterior part of the eyeball, within the interior of which it expands and forms the retina. In its whole course, it is inclosed within a sheath, prolonged from the dura mater, forming one more peculiarity in its distribution.

Third Pair, or Motores Oculorum,

Take their origin, by several filaments, from the inward parts of the crura cerebri, about their middle. The trunk of either nerve, thus formed, first runs obliquely outward, across the back of the crus, then turns downward and enters the cavernous sinus, wherein it is covered by a sheath of dura mater, and continues its course through the foramen lacerum orbitale, inwardly placed to the other nerves, into the orbit. In entering the cavity, the nerve divides into two branches. The smaller is generally received by a single muscle—the levator oculi. The larger branch subdivides into several others: the longest of these runs round the eye-ball and penetrates the obliquus inferior: the two or three others run to the adductor and depressor muscles.

Ophthalmic Ganglion. Upon the outward side of the optic nerve, between it and that part of the motor oculi from which the branch nerves spring, is situated the OPHTHALMIC GANGLION. This little body is principally constituted of branches from the third pair; but it also receives a filament or two from the sixth. The nervous threads transmitted by the ganglion, surround the sheath of the optic nerve, and, pursuing their course over it, penetrate the globe of the eye, and run to be dispersed upon the iris.

Fourth Pair, or Pathetic.

These, the *slenderest* of the cerebral nerves, take a filamentous origin from the summits of the testes, whence they proceed outward between those bodies and the crura cerebelli, creep round the cura cerebri, and are seen at the border of the tentorium entering the cavernous sinus. Having coursed the anterior boundary of the sinus, encased in dura mater, the nerve takes refuge again in a small bony canal, constructed for its passage, in front and rather to the outward side of the foramen lacerum, which conducts it into the orbit. Its destination is the superior oblique muscle of the eye, to which it exclusively distributes its ramifications.

Fifth Pair, or Par Trigeminum.

These are the *largest* of the nerves of the brain. They take their beginning by a multitude of filaments from the crura cerebelli, and forthwith run for security into the cavernous sinuses, where they are covered and protected by distinct sheaths of dura mater. Each nerve within the sinus suddenly swells in bulk, and thus is said to form a *ganglion:* and certainly the enlarged portion is darker coloured than the nerve itself, albeit, it does not put on the common appearance of, nor is it of the same texture as, those little knots or swellings in other parts which we are in the habit of calling *ganglia*. Waiving this remark, however, and calling it a ganglion, we say that three nerves depart from it; and to these we give names from the parts they are destined principally to supply, viz., the *ophthalmic*, the *superior maxillary*, and the *inferior maxillary nerve*.

THE OPHTHALMIC NERVE, the smallest of the three divisions, proceeds for a short way down the sinus in union with the superior maxillary; inclining forward, however, it soon leaves that nerve, and takes its passage through the foramen lacerum orbitale into the orbit. As it emerges from this opening it splits into three branches—the *lachrymal*, the *supra-orbitar*, and the *lateral nasal branch*.

The lachrymal branch, at its origin, comprehends two divisions. One is a long single nerve that ascends behind the muscles of the eye, through the fatty matter at the bottom of the orbit, winds over the angle formed between the zygoma and the frontal orbital process, and ends in subcutaneous and anastomosing branches about the forehead. The other consists of several filaments which run forward over the fatty matter enveloping the eye, and are distributed to the lachrymal gland, conjunctiva, and ciliary glands of the upper eyelid.

The supra-orbitar branch takes the same superficial course across the roof of the orbit to the inner angle of the orbitar ridge, where it passes through the foramen supra-orbitarium, and afterwards ramifies upon the skin covering the forehead. It gives off a twig or two to the adipose matter of the eye, and sends a branch to the upper lid.

The lateral nasal branch, the largest of the three, makes a sudden turn inward, and runs between the levator and retractor oculi; and, after having detached a considerable branch to the membrana nictitans, enters again the cavity of the cranium, through the foramen orbitale internum, from which it takes its passage, through one of the holes in the cribriform plate, into the chamber of the nose. Herein it creeps along the top of the anterior turbinated bone, within a bony and membranous canal, immediately covered by the more prominent part of the os nasi; and sends its ultimate branches to the false nostril and wing of the nose. Near its origin, this nerve sends a twig or two to the ophthalmic ganglion.

THE SECOND DIVISION, or *superior maxillary nerve*, much larger than the ophthalmic, leaves the cranium through the foramen rotundum of the sphenoid bone, and takes its passage along the canalis infra-orbitarius, whence it emerges, covered by the levator labii superioris, upon the face: here it splits into several large branches, denominated the *facial nerves*; or, altogether, from their being imagined to sprout from the trunk, after the manner of the claws of the foot of a goose, the *pes anserinus*. But, prior to its entering this canal, it detaches several branches of importance. 1. A branch which pursues the same course, along the floor of the orbit, to the inner canthus, where it sends twigs to the under eyelid and lachrymal duct, and disperses its remaining ramifications upon the contiguous skin. 2. Several long filaments, which descend upon the tuberosity of the superior maxilla, penetrate the bone, and furnish twigs to the antrum and the two superior molar teeth. 3. The largest branch is the *spheno-palatine* or *lateral nasal nerve*, to which the foramen spheno-palatinum gives passage into the nose, wherein it divides into two sets of filaments. One of these fasces is spread over the lateral parietes of the nasal cavity; the other ramifies over the sinuses, and transmits a filament of considerable length along the posterior border of the septum, which passes through the foramen incisivum superius to the roof of the mouth. 4. A slender branch to the velum palati. 5. *The palato-maxillary nerve*, a considerable branch traversing the canal of that name in company with the palatine blood-vessels, and dispersing the majority of its ramifications over the soft palate; though some of its longer ones may be followed through the foramen incisivum inferius into the upper lip.

The terminating or *facial branches* of this division, which remain to be described, in general comprehend, at their exit from the foramen infra-orbitarium, two large and two small nerves. *The principal branch* descends in a straight line upon the side of the face, and, about midway between the foramen and front of the lip, shoots forth into many smaller branches, which are dispersed over the side and surrounding border of the upper lip. These nerves receive communicating filaments from the anterior facial branch of the portio dura, and, with them, form an intricate and important plexus upon the fore and lateral parts of the face. The branch next in size to this takes a similar course, anteriorly, to the last, and distributes its ramifications to the nares and muscles, clothing them externally. It detaches one long filament, which turns round the smooth crescentic border of the superior maxillary bone, and goes to the muscles internally situated. One of the *small branches*, which takes its course anteriorly to all the others, runs directly to the levator labii superioris. The smallest branch of the four is one of communication with the portio dura.

THE THIRD DIVISION, *the inferior maxillary nerve*, the largest of the three, leaves the cranium through the lowermost nook in the foramen lacerum basis cranii, and runs forward, defended by the branch of the posterior jaw, across the middle of the pterygoideus, and enters the foramen maxillare anterius. Its branches are—1. A *reflected branch* which runs up in front of the parotid gland, and joins the portio dura as the latter turns round the border of the masseter. 2. *The buccal nerve,* which pierces the superior portion of the pterygoideus, crosses behind the tuberosity of the superior maxilla, penetrates the buccinator, and buries itself in the substance of the cheek, through which it may be traced into the lower lip. 3. Twigs to the pterygoideus. 4. *The gustatory nerve,* a branch nearly equal in size to the trunk itself. This, which by itselfmay be consideredas a trunk, and one of importance too, descends by the side of the tongue, penetrates that organ about its middle, and vanishes in its tip. *a.* Its first branch is a long one, that takes the same direction as the main (maxillary) trunk, and enters a medullary foramen in the branch of the jaw. *b.* The gustatory then gives off the *dental,* a long slender nerve which courses the side of the inferior maxilla, concealed by the submaxillary gland (to which it sends twigs) as far as the symphysis, where it enters a small foramen, and sends its ultimate ramifications to the roots of the incisive teeth. *c.* Many twigs detached laterally by the nerve as it courses the substance of the tongue: they take an oblique direction, and are destined for the supply of the gustatory papillæ.

The inferior maxillary nerve itself, having entered the interior of the bone, takes a longitudinal course close to the roots of the teeth, into the fangs of which it detaches branches as it passes them, while others ramify in the diploe. Through the foramen maxillare anterius, the remaining portion of this nerve emerges from its bony conduit, and then splits into two branches; of which the superior subdivides into several smaller ones, which ramify upon the integument of the under lip: the inferior runs for some way without giving off a single twig; it then ends in four or five long filaments, which expend their ramifications in the substance of the lip.

Sixth Pair, or Abducent,

Arise, by radical filaments, from the medulla oblongata, by the side of the fissure along its middle, near to its junction with the tuber annulare. This nerve penetrates the cavernous sinus behind the fifth pair, and therein, running between them and the carotid artery, it meets with the ophthalmic nerve, and accompanies it through the foramen lacerum into the orbit. Here, it gives off two or three filaments to the retractor oculi; but its principal destination is to the abductor, among the fleshy fasciculi of which its ramifications are pretty equally distributed.

Seventh Pair, or Auditory.

This pair includes two separate nerves on either side: one, from its remarkable softness, is denominated the *portio mollis;* the other, in contradistinction, the *portio dura.*

THE PORTIO MOLLIS takes its rise from the floor of the fourth ventricle, by the side of the crena of the calamus scriptorius. It turns round the medulla oblongata, and then passes directly outward, and enters the foramen auditorum internum. Having gained admission into the vestibule of the internal ear, it resolves itself into divers pulpy filaments, which pierce a perforated bony plate, and ramify over the various parts of the labyrinth.

THE PORTIO DURA arises from the place of union of the medulla oblongata, tuber annulare, and crus cerebelli; and takes its passage through the foramen auditorium internum, inclosed in the same sheath of dura mater along with the portio mollis. At the bottom of the meatus auditorius internus, it detaches two slender but important branches. 1. The *chorda tympani,* a long slender filament which proceeds into the cavity of the tympanum, crosses therein the neck of the malleus, makes its exit again by a small foramen, and, descending to the root of the tongue, forms a remarkable union with the lingual nerve. 2. The other also runs in the vicinity of the tympanum, but subsequently pursues the course of the Eustachian tube: deeply seated within the fauces at its exit, its branches become distributed over the parts in the immediate vicinity.

The portio dura leaves the internal ear through the spiral canal, and is deeply buried at its issue underneath the parotid gland, giving off there the auricular nerves, of which there are three principal divisions. 1. The *anterior auricular nerve* ascends over the fleshy root of the front of the ear, where it detaches some branches which unite with others coming from the lachrymal branch of the first division of the fifth pair, and form a sort of plexus—*the anterior auricular plexus.* Its remaining branches are dispersed upon the skin thereabouts. 2. The *posterior auricular nerve,* less in size, mounts the back of the ear, in company with the blood-vessels, distributing branches to the muscle about its root, and vanishing in ramifications upon the skin of the ear. 3. The *internal auricular,* the least considerable of the three, enters the concha for the supply of the parts contained in the external ear. 4. *Parotideal branches,* two, three, or four in number, ramifying within the substance of the gland,

and transmitting other smaller filaments to the superjacent skin. Against the articulation of the posterior jaw, the portio dura is joined by a considerable branch from the posterior maxillary nerve. Augmented in size by this contribution, the portio dura emerges from the substance of the gland and turns round the cervix of the jaw, along the outward side of the temporal artery. Having mounted upon the masseter, it divides into two principal branches. The *posterior* one obliquely crosses the muscle a little anteriorly to its middle, enveloped in cellular membrane, detaching many filaments in its passage to the fibres of the muscle, but more and larger ones to the skin, and some few of communication with the anterior branch, and ultimately ramifies subcutaneously upon the muscles of the lower lip, and side of the lower jaw. The *anterior branch* descends over the fore part of the masseter, a little posteriorly to the zygoma, likewise clothed in cellular substance, furnishing, in its course, muscular, cutaneous, and communicating filaments. Leaving the masseter, it inclines forward, undiminished in size, from the ramifications it has already issued, and, shortly after, ends in an arborescent expansion, which spreads its fibrils over the inferior and anterior parts of the face. It sends some twigs to the muscles thereabouts, and to the upper lip; but the principal ramifications run to join those of the anterior maxillary nerve.

Eighth Pair, or Par Vagum.

This pair is constituted of two nerves on either side, so that it may be said to be double:—the accessory, or additional one, is denominated the *glosso-pharyngeus;* the other is the proper par vagum. They arise by many filaments from the corpora olivaria, and make their exit through the *foramina lacera basis cranii,* in company with the nerves next to be described. Having left the skull, we find them lodged, secure from injury, along with the nerve of the ninth pair, in a hollow space to the inward side of the condyloid process of the occiput.

THE GLOSSO-PHARYNGEUS, by much the smaller of the two, now quits the par vagum, and, turning round the internal carotid artery, runs forward and downward upon the side of the pharynx, insinuating itself among the constrictors, whence it proceeds to the root of the tongue, and there disappears. Its branches are—1. At its origin, a reflected branch, which joins the portio dura just before that nerve pierces the parotid gland. 2. Two branches to the constrictors of the pharynx. 3. Before it reaches the tongue, the nerve splits into three or four branches, which ramify and vanish in the base or root of that organ.

THE PAR VAGUM, being disunited from the glosso-pharyngeal nerve, proceeds downward and backward to join the carotid artery, in the same cellular sheath with which, to the outward side of the vessel, it takes its course along the neck to the chest. Its cervical branches are—1. Two or three twigs, to the superior cervical ganglion. 2. The *pharyngeal branch*, reflected upon the side of the pharynx; whose filaments are—*a*. To the œsophagus. *b*. One received from the sympathetic. *c*. The continuation of the nerve, which is expended in the substance of the pharynx. 3. Two slender branches to the carotid artery, upon the coats of which they ramify, unite, and ultimately split into twigs, forming a sort of plexus around the vessel at its bifurcation, from which other filaments are sent along the parietes both of the external and internal carotids. 4. The *laryngeal branch*, crossing above the carotid artery, then winding downward upon the side of the pharynx, in its way to the larynx, and entering a perforation through the posterior ala of the thyroid cartilage.

Along the posterior part of the neck the par vagum inclines upward, and is found *above* the carotid artery, between which vessel and the axillary artery it continues its course, through the space between the first two ribs, into the chest. Having entered the thoracic cavity, it runs within the superior mediastinum; but it has a somewhat different relative situation on one side from what it has on the other: the right nerve adheres in its passage to the side of the trachea, crosses above the root of the right lung, alongside of the œsophagus, and gains the under surface of that tube before it leaves the chest; whereas, on the left side, the nerve accompanies the anterior aorta, and crosses the root of the posterior aorta to reach the œsophagus, to the left and upper side of which it pursues its course as far as the diaphragm.

Its branches within the chest are—1. Filaments to the *tracheal plexus*, consisting of an assemblage and intercommunication of nerves, mostly from the sympathetic, around the lower part of the trachea, within the space between the first two ribs. 2. Two or three smaller branches to the cardiac plexus. 3. A single branch, of considerable importance, denominated the *recurrent nerve*. 4. Branches to the anterior pulmonary plexus. 5. Reflected branches to the posterior pulmonary plexus. And, on the *right* side, in addition to these, the nerve furnishes a still larger branch, which is directed forthwith to the heart: in its passage it subdivides into two chords, and these branch out as they approach the base of the organ, and penetrate the parietes of the auricles.

THE RECURRENT NERVE of the left side originates from the par vagum, by the side of the anterior aorta, and coils round the root of the posterior aorta, including that vessel in a sling as it were; but, on the right side, it leaves the trunk as the latter passes the first rib, winding forward within the angle formed between the anterior aorta and its first large branch—the posterior cervical artery. The recurrent nerve (so denominated from its retrograde course) then takes the first part of its reflected passage, situated above and outwardly to the par vagum; by degrees, however, in running up the neck, it approaches the trunk, gains the inner side of it, and along the anterior half of the neck is found concealed between the carotid artery and the trachea. Having reached the top of the air-tube, it spreads into many fine terminating branches, several of which run to the muscles of the larynx, though the principal of them creep along the sides of the thyroid cartilage, and end in ramifications upon the membrane of the glottis. Its branches are—1. Twigs to the pulmonary plexus; and, on the left side, some also to the cardiac plexus. 2. Twigs to the posterior cervical ganglion. 3. Long slender ramifications both to the œsophagus and trachea, in its passage up the neck.

THE PULMONARY PLEXUSES, *inferior* and *superior*, consist of networks of nervous filaments, some of which are of large size, surrounding the great vessels constituting the roots of the lungs. They are composed of branches and threads of nerves from the par vagum and recurrent on one side, and of similar ramifications from the opposite side: the *inferior* plexus clings to the trachea at its division, and spreads under the bronchial tubes and pulmonary vessels; the *superior*, which receives several reflected branches from the par vagum, lies behind the roots of the lungs, and is less considerable than the inferior. From these plexuses the numerous nervous filaments are derived which cling to the bronchial ramifications and pulmonary vessels, for the supply of the parenchymatous and vascular structures, and lining membrane of the lungs. Moreover, the par vagum, in the chest, detaches many twigs to the œsophagus, which interlace its muscular coat by uniting with others from the opposite nerve: in this manner another plexus is produced, which is named the *œsophageal*.

The par vagum having entered the abdomen, clinging to the sides of the œsophagus, the nerve on one side is differently distributed to that on the other. They both run to the stomach; but the left nerve, prior to reaching it, divides into two sets of branches. One of these pursue their course backward, and spread over the upper part of the organ, sending some twigs to the cardia, others along the small curvature, which communicate with the ramifications of the right nerve: the other set cross above the stomach to the left side, taking the course of the gastric artery, and join the great semilunar ganglion. The right nerve, smaller than the left, as soon as it reaches the cardia, splits into many branches which traverse the small curvature, where they form communications with the left, and spread their ramifications upon the under part of the organ: some of them run to the pylorus likewise, and others go to join the hepatic plexus.

Accessory Nerves to the Eighth Pair.

These nerves are considered as accessory to the two former, in consequence of their being all three found together in close connection at their issue from the cranium. The accessory nerve itself is formed within the vertebral canal, by the concurrence and union of several filaments derived from the side of the medulla spinalis, one or two of which may generally be traced down to the place of origin of the fourth or fifth cervical nerve. Along its course into the head it receives many other fine threads from the marrow, and in the cranial cavity joins the par vagum; with which, and with the nervus glosso-pharyngeus, all inclosed in one and the same sheath, it descends through the foramen lacerum basis cranii. Beneath the atlas, the accessory nerve leaves its companions, and splits into two divisions. *The anterior division* runs downward and forward, and penetrates the belly of the sterno-maxillaris, among the fasciculi of which it may be followed, transmitting numerous lateral twigs in its course, down to the very origin of the muscle. *The posterior division* turns round the transverse process of the atlas, and takes a waving course between the levator humeri and splenius, obliquely across the side of the neck, to the top of the scapula; where it plunges into the rhomboideus brevis, and vanishes in the muscular substance. This division receives filaments of communication from several of the cervical nerves, and furnishes ramifications to the muscles over which it passes. The branches of the trunk of the accessory nerve are—1. To the par vagum, at its exit from the skull. 2. Some twigs to the anterior cervical ganglion. 3. A filament of communication with the sub-occipital nerve.

Ninth Pair, or Lingual,

Arise, behind the eighth pair, from the corpora olivaria; pass out of the cranium through the foramina condyloidea anteriora; and are first found, in company with the par vagum, against the inward sides of the coronoid processes. This nerve takes its course obliquely downward, along the branch of the lower jaw, runs between the pterygoideus and the larynx, and afterwards insinuates itself between the muscles forming the root of the tongue. Having penetrated the substance of this organ, the nerve pervades its middle, accompanied by the lingual artery, and ends in a ramous expansion in its tip. The branches of this nerve are—1. Some small ones in its course to the hyo-glossus longus; one of which, remarkable for its length, runs to the termination of that muscle, detaching many twigs in its way. 2. Lateral branches, which come off in a half-penniform manner, within the substance of the tongue, and ramify extensively among the fibres of the other lingual muscles.

Tenth Pair, or Sub-occipital,

Possessing all the attributes of a *spinal* nerve, probably should rather be considered as the first of the *cervical.* It has a filamentous origin from the place of junction at the medulla oblongata with the medulla spinalis, and passes out through a foramen in the anterior part of the body of the atlas. It then splits into a superior and an inferior division. *The superior division,* larger than the inferior, we find deeply buried in muscle upon the transverse process of the atlas, where it spreads into several small branches, of which two only are worthy of remark, the others being quickly expended in the contiguous muscles. One of these is a deep muscular branch, which penetrates the mass of muscle upon the occiput. The other ascends over the vertex, and ramifies upon the inner and back part of the ear.

The inferior division, the longer one, turns round the transverse process of the atlas, and runs through a foramen in the anterior wing of the bone; after which it turns down towards the trachea, transmitting its ulterior ramifications to the thyroid gland, top of the trachea, and some lymphatic glands in the vicinity; also to the sterno-maxillaris and sterno-thyro-hyoideus. Its branches are—*a.* Some to the deep-seated muscles in front of the atlas. *b.* Two or three to the anterior cervical ganglion. *c.* One of communication with the lingual nerve.

SPINAL NERVES.

The thirty-six pairs of spinal nerves are divided into classes correspondent with the vertebræ composing the spine, viz., *cervical, dorsal, lumbar, sacral,* and *coccygeal.* Likewise, the several pairs of nerves in each class are numbered according to the order in which they originate, so that the number and name of the nerve corresponds to the vertebra, *posterior* to which it makes its exit from the spinal canal. Furthermore, every pair of nerves in the several classes present two divisions or *fasces,* a *superior* and an *inferior fascis.*

CERVICAL NERVES,

Consisting of seven pairs.

First Cervical Nerve

Makes its exit from the spinal canal by that large intervertebral gap existing between the atlas and vertebra dentata. The *superior fascis* of it consists of several branches: I shall notice only one, however, which is larger and longer than the rest—the others speedily penetrating the contiguous deep-seated muscles. This branch is reflected backward upon the side of the second vertebra, and is continued obliquely upward under the complexus, to which muscle its ramifications are distributed. It sends backward a ramus of communication to the second cervical nerve. *The inferior fascis* is composed of two principal branches. The superior branch, more considerable than the inferior, turns forward and becomes superficial. It crosses the transverse process of the atlas, and there sends a subcutaneous ramification along the panniculus, to the angle of the jaw. The main branch is then continued upward, detaches another—a posterior ramification—to the panniculus, and ascends to the root of the ear: where it ends in several small branches, the shorter of which supply the muscles of that part, while the longer creep up the concha, and ramify upon its outward surface. In its course it communicates with the accessory nerve. The inferior branch passes downward and forward upon the longus colli, to which it sends filaments, leaves that muscle to ramify in the levator humeri, and ultimately disappears among the fibres of the panniculus. This branch has also a communication with the

Second Cervical Nerve.

This is a nerve whose distribution is involved in a degree of complexity, owing to the number and diversity of its ramifications. *The superior fascis* includes three or four branches of considerable size. 1. Is found ramifying over the inward surface of the splenius. 2. Runs to the spinalis colli. 3. To the complexus. 4. To the first cervical nerve, and to the complexus minor, extending to the occiput. *The inferior fascis* furnishes mostly superficial branches. 1. One turns forward and communicates with the accessory nerve. 2. Winds backward and ramifies superficially over the splenius. 3. Pierces the levator humeri, and expends itself in subcutaneous ramifications. 4. Creeps along the under surface of the levator humeri, sending off one or two subcutaneous filaments. 5. Is a filament of communication with the

Third Cervical Nerve.

This is likewise a nerve whose branches are numerous and intricate. *The superior fascis* is split at its exit into several large and some small branches. 1. Some short twigs to the spinalis colli. 2. A large branch to the splenius. 3. and 4. Long winding branches, which ramify upon the ligamentum subflavum and vanish in the substance of the complexus. 5. A single branch to the spinalis colli. *The inferior fascis* is composed of two principal branches. The inferior branch turns round the articulation formed between the third and fourth vertebræ, and spreads its ramifications upon the longus colli. The superior branch winds upward for a short way, and subdivides into three smaller ones, of which two run to the levator humeri, and the third pierces that muscle, and ends in subcutaneous ramifications: from one of the former branches a filament of communication runs to the

Fourth Cervical Nerve.

Its *superior fascis* turns round the vertebræ and separates into three or four large branches, which supply the contiguous parts of the spinalis colli, splenius, and complexus. *The inferior fascis,* the more considerable and important one, gives off, at its origin, some twigs to the longus colli: it then runs down a short distance and detaches—1. A large branch to the splenius. 2. A small one to the longus colli. 3. A long filament which passes backward, covered by the levator humeri, to assist in composing the phrenic nerve. 4. Several long terminating branches, which may be traced upon the levator humeri, over the point of the shoulder. This nerve communicates with the fifth cervical by a small circumflex filament, and sends a considerable branch backward which also joins it.

Fifth Cervical Nerve

Makes its appearance between the fifth and sixth vertebræ. Its *superior fascis* forms a set of deep muscular branches, mostly destined to the splenius. *The inferior fascis* comprehends three principal branches. 1. Runs to the point of the shoulder, where its ramifications are principally expended in the levator humeri: at its origin it sends a twig to the longus colli.

2. A large branch to the serratus magnus. 3. The most important of the three, takes a deep-seated course to the point of the shoulder: there it sends off—*a*. A filament to the phrenic nerve. *b*. One of communication to the sixth cervical nerve. *c*. One that descends obliquely outward to contribute to the formation of the humeral plexus.

Sixth Cervical Nerve,

At its exit, bifurcates. *The superior fascis,* comparatively small, turns round the articulation, runs upward, and penetrates the serratus magnus. *The inferior fascis,* remarkable for the number and large size of its branches, passes backward under the transverse process of the seventh vertebra. It furnishes—1. Twigs to the longus colli. 2. A long filament to the *posterior cervical ganglion.* 3. A filament to the phrenic nerve. 4. Large branches running to the formation of the humeral plexus.

Seventh Cervical Nerve.

The last of these nerves comes out between the last cervical vertebra and the first dorsal. Its *superior fascis,* very inconsiderable, consists of a small branch only which is expended in the serratus magnus. *The inferior fascis* comprises a large, flat nerve, directed backward to join the humeral plexus. In its way, it forms a broad union with the first of the dorsal nerves, and detaches a branch to the sympathetic nerve.

The Diaphragmatic, or Phrenic Nerve,

Principally formed by the union of branches from the fifth and sixth cervical nerves, and generally by the addition of a small filament from the fourth, takes a solitary course down the neck, along the inferior border of the scalenus, enters the thorax just above the root of the axillary artery, and traverses the side of the pericardium to reach the tendinous centre of the diaphragm, where it divides and spreads out into many divergent ramifications.

Dorsal Nerves.

Of these nerves there are eighteen pairs. In issuing from the spine they are directed obliquely backward. Like the cervical nerves, they are regularly numbered in succession; and present, at their exit, superior and inferior fasces; but the fasces are less in size, and evolve fewer ramifications. *The inferior branches* acquire the name of *intercostal nerves;* because they correspond with the intercostal blood-vessels, which they accompany along the shallow furrows in the posterior edges of the ribs, between the internal and external intercostal muscles, directing their course to the sternum.

The superior branches turn directly upward between the transverse processes, piercing the intercostal muscles and mounting upon the back, where they proceed obliquely upward, deeply buried in muscle, until at length they grow very small, and become superficial, and end in subcutaneous ramifications upon the faschia of the back.

The dorsal nerves grow smaller accordingly as they are given off more posteriorly. The anterior divisions of them furnish branches to the muscles of the dorso-scapular region; the middle and posterior, to the muscles of the dorsal region: the hinder nerves also send a few filaments to the loins.

THE INTERCOSTAL NERVES require that we enter further into particulars.

The first nerve is of large size, and its principal portion is destined to the humeral plexus. The proper intercostal nerve is but a slender branch. It is remarkable for its solitary course: the other intercostals, for the most part, accompany the intercostal vessels, whereas this maintains a middle course between the first and second ribs, and ramifies upon their lower extremities. It is also distinguishable from all others but the second, in not furnishing any cutaneous ramification.

The second nerve detaches, near its origin, a considerable branch, which describes an arch downward in its course over the belly of the longus colli, and afterwards joins the first nerve. Its intercostal branch, which is rather larger than the first intercostal nerve, runs for some distance along the muscular space, and then accompanies the intercostal blood-vessels, and, like the first, ends in ramifications near the sternum.

The third, fourth, fifth, sixth, and *seventh intercostal nerves,* furnish, each of them, a long cutaneous filament which ramifies among those muscles of the costal region exterior to the ribs; they then pursue their course downward, incline forward between the cartilages, and expend their ulterior ramifications among the muscles of the sternal region.

The remaining intercostal nerves, with the exception of the last, having reached the lower ends of the ribs, do not continue their course between the cartilages, but quit the intercostal spaces and traverse the under surfaces of the cartilages, to reach the muscular parietes of the abdomen, where we find them pursuing their way in parallel lines, nearly at equal distances from one another, between the transverse and internal oblique muscles, to the rectus, in the substance of which they branch out and are lost. From the thirteenth nerve, and from every one posterior to it, before they leave the intercostal spaces, issues a large cutaneous branch, which, deviating from the continuation of the trunk, takes an oblique direction backward, and ramifies extensively upon the aponeurosis of the external oblique muscle.

The eighteenth and last intercostal nerve forms an exception to this general description. It quits the last rib at its origin, and stretches obliquely backward, passing close under the extremity of the first lumbar transverse process. Soon after this it splits into two branches: the smaller one is directed backward across the abdomen, passing at first between the external and internal oblique muscles, but afterwards insinuating itself among the fibres of the former, and ending in subcutaneous ramifications; the larger one traverses the flank, and proceeds for a considerable way between the internal oblique and transverse muscles.

LUMBAR NERVES

Correspond in number to that of the lumbar vertebræ. They issue through the spinal foramina in the loins, and are, at their exit, distinguishable into superior and inferior divisions. *The superior fasces,* of minor importance, are reflected upward, and directed into the mass of muscle forming the loin; and, having distributed the majority of their branches therein, pierce the faschia lumborum, and terminate in subcutaneous filaments. The inferior divisions require to be distinctly considered.

The first nerve runs obliquely across the transverse process of the second vertebra, under the sacro-lumbalis, and at the end of the third transverse process divides into two branches. The inner one makes directly for the anterior spine of the hip-bone, over which it passes, and disperses its ulterior filaments in an arborescent manner upon the iliacus, covered by its faschia. The outer branch takes a sweep outward, between the external and internal oblique muscles, around the spine of the same bone, and extends along the anterior border of the tensor vaginæ nearly to the stifle, and there ends in subcutaneous ramifications upon the faschia lata. Its other branches are—1. To the last dorsal nerve. 2. To the sympathetic. 3. To the second lumbar nerve.

The second nerve, though generally double from its origin, is smaller than the first. It has communications with the first nerve and sympathetic, and sends back a small branch that contributes to the formation of the crural nerve. It also sends twigs to the psoæ. Its principal divisions are two. One is stretched along the iliacus outwardly, and continues its passage along the fore part of the haunch, where it becomes subcutaneous, and ramifies over the stifle. The other division crosses the ilio-lumbar artery, just below its origin, and takes nearly a similar course to the inward part of the haunch, where it disperses its ramifications upon the skin and faschia: in its way, it detaches a considerable branch—*the spermaticus externus,* which passes through the abdominal ring, and sends twigs, in the male, to the scrotum, and a filament along the chord to the testicle; in the female, filaments go from it to the uterus, udder, and external labia.

The third nerve is almost wholly consumed in forming the crural nerve. It sends a small branch to the sympathetic, another to the psoas, and a third backward to the obturator nerve.

The fourth nerve detaches a filament of communication to the sympathetic, and then joins the others in contributing to the production of the crural nerve; but, in addition, it sends a considerable branch to the obturator nerve.

The fifth nerve communicates with the sympathetic, and afterwards subdivides into three considerable branches: one assists in the formation of the crural; another joins the obturator; and a third splits and sends one portion to the gluteal, but a much larger one to the sciatic nerve.

SACRAL NERVES.

Of these nerves we reckon five pairs. The foremost nerves are of very large size; the last two are much diminished in volume: they all take an oblique direction backward, and traverse the lateral parietes of the pelvis.

To facilitate their description, we may consider these nerves also as consisting of superior and inferior fasces.

The superior fasces make their exit through distinct foramina upon the upper part of the sacrum, and are there buried under a thick mass of muscle: a few filaments from them pierce the faschia above and become subcutaneous, and ramify upon the outer part of the haunch.

The inferior fasces, remarkable for their large size, are of more importance. *The first nerve* largely contributes to the origin of the sciatic; but it also sends a considerable branch to the gluteal nerve, It communicates with the sympathetic and second lumbar nerve.

The second nerve communicates with the third and sympathetic, and afterwards sends off two large branches. One joins the sciatic; the other continues backward, and disappears among the coccygeal muscles.

The third nerve has similar connections, and likewise joins the sciatic; but the major part runs backward, along the side of the pelvis, and penetrates the muscles of the haunch.

The fourth nerve, similarly connected, is principally destined to the supply of the bladder and rectum, and muscles of the anal region.

The fifth nerve runs backward, and plunges into the heads of the coccygeal muscles.

COCCYGEAL NERVES.

Generally speaking, we find *four* pairs of them. Like the sacral, they issue from the spine by two sets of foramina, and are therefore best considered as divided into superior and inferior sets. The sympathetic not extending thus far, they have no connection with it. In other respects they do not importantly differ from the other spinal nerves.

The superior fasces pass out obliquely backward; communicate with the last of the sacral and with one another, distribute many muscular branches, and end in subcutaneous filaments. From the two or three last originates a considerable nervous chord, which penetrates the erector coccygis, and may be traced among its fibres to the extremity of the tail.

The inferior fasces likewise communicate with one another. The first nerve receives a branch from the last sacral, and detaches one to the perinæum. Posteriorly, they all end in one common nervous chord, somewhat larger than the one above, which runs between the depressor and curvator coccygis, branching out in its course, and ending in filamentous ramifications at the point of the dock.

NERVES OF THE FORE EXTREMITY.

With the exception of some cutaneous filaments ramifying over the point of the shoulder and extending thence to the arm, the fore extremity receives all its nerves (which are comparatively large and numerous, not to add complicated) from the *axillary plexus;* and this plexus is constituted, in a manner that has already been shown, by a small branch from the fifth, by the principal portions of the sixth and seventh cervical nerves, and by the main division of the first dorsal nerve. The plexus, thus formed, resolves itself into several large nervous trunks, generally about seven or eight; and these surround the axillary artery. They are as follow:

The external thoracic nerves, commonly six or seven in number, arise from the axillary plexus, and are dispersed upon the breast and side. Three or four of them run obliquely downward, to give branches to the pectoral muscles. The others take a backward course, and send branches to the serratus and latissimus dorsi. One branch is found turning round the posterior border of the triceps, where it becomes superficial and ramifies among the fibres of the panniculus, extending thence into the skin.

THE SCAPULAR NERVES may be distinguished into the anterior, the posterior, and the subscapular nerves.

The anterior scapular nerve is reflected upward and forward, in company with the artery of that name; winds round the anterior costa of the scapula, between the subscapularis and anteaspinatus, to which muscles it sends off branches in crossing the dorsum scapulæ, and stretches its ultimate filaments into the triceps.

The posterior scapular nerve, after detaching a branch to the subscapularis, dips between that muscle and the triceps. There the trunk splits into several branches which penetrate the triceps, teres minor, and shoulder-joint: one of them is continued upon the outside, round the cervix humeri, where it becomes subcutaneous, and ends in the insertion of the levator humeri.

The subscapular nerves, two, three, or four in number, issue from the top of the plexus, and ascend between the scapula and the ribs, and enter the substance of the subscapularis.

THE SPIRAL NERVE, the largest of the nervous trunks furnished by the axillary plexus, arises behind the humeral artery, and for a short distance accompanies the vessel. It then leaves the artery and turns round the back of the os humeri, between the bone and the large head of the triceps, and is to be found, covered by that muscle, coursing the outward surface of the body of the same bone. Next, it plunges deep among the heads of the extensors; afterwards, much diminished in size, it insidiously creeps round the neck of the radius, and penetrates the head of the flexor metacarpi externus, among the fibres of which its remaining ramifications are expended. Its branches are—1. Near its origin, three or four long branches are sent down to the triceps. 2. Lower down, a branch is separated which pierces that muscle and gains the front of the elbow-joint, where it escapes through the faschia and takes its course under the skin covering the arm, and ramifies upon the fore and outward part of the knee: this nerve may be distinguished as the *external cutaneous nerve.* 3. Several considerable branches that penetrate the heads of the extensor muscles.

THE RADIAL NERVE clings to the humeral artery, with which it descends to the inward side of the elbow-joint, and runs down behind the vessel, along the back of the radius, to the knee; there it passes under the posterior annular ligament, and continues its course with the artery, and, as soon as it has descended upon the leg, takes the name of the internal metacarpal nerve. Its branches are—1. Which comes off the trunk a little below its origin, from its size and importance is distinguished as the *musculo-cutaneous nerve.* After accompanying the trunk for a short way, it leaves the parent nerve and crosses obliquely behind the flexor brachii, passing between that muscle and the coraco-humeralis, to both of which it sends filaments; it then winds forward and reappears upon the upper and fore part of the arm, where it becomes subcutaneous, ramifying upon the faschia, and prolonging its ramifications over the knee upon the metacarpus. 2. A small slip detached opposite to the elbow-joint, distributed to the heads of the flexor muscles. 3. In its course down the arm, several small twigs to the flexor muscles. 4. Above the knee, a communicating slip separates, which obliquely crosses over the fleshy terminations of the flexors, and joins the ulnar nerve as it passes the joint.

The ulnar nerve, which, at its origin from the plexus, holds a middle situation between the radial and the nerve before described—the spinal—also accompanies for a short distance the humeral artery. In its course to the elbow it preserves the line of the os humeri; there it runs over the inner and back part of the joint, glides down the arm concealed by the posterior borders of the flexores metacarpi, inclines a little inward before the tendon of the flexor medius to reach the back of the knee, where it is found under the posterior annular ligament, within a dense faschial sheath, creeping along close to the inner edge of the trapezium. From this, it gains the border of the tendo perforans, and becomes the external metacarpal nerve. Its branches are—1. Soon after its origin, one that may be called the *internal cutaneous nerve,* which runs over the elbow-joint and ramifies in the loose cellular substance about the inward part of the olecranon. 2. Three or four considerable branches which penetrate the heads of the flexors, also destined to the joint. 3. A little above the knee comes off a branch which pierces the faschia and becomes subcutaneous. After having detached some twigs to the back part of the knee, this nerve runs along the outer and posterior part of the cannon to the fetlock, where it disperses its ramifications. 4. A short but considerable branch to the back of the knee, sending twigs into the joint. 5. A branch is sent off immediately below the knee, which turns suddenly forward and disperses its ramifications in front of the leg.

The metacarpal nerves, *internal* and *external,* continue down the leg along the borders of the flexor tendons, over the fetlock-joint, where they become the *plantar nerves;* these pursue their course, behind their corresponding blood-vessels, to the posterior part of the foot, which they penetrate to the inner sides of the lateral cartilages. About midway between the knee and fetlock, the internal nerve sends a branch obliquely over the flexor tendons, which joins the external nerve: with this exception, their branches and ultimate destination are the same on either side. Their branches are—1. Filaments dispersed upon the flexor tendons. 2. A large and important branch that comes off just above the fetlock-joint, and runs obliquely forward, and distributes its ramifications to the outward and fore part of the pasterns, and then ramifies upon the coronet.

The plantar nerve detaches—1. A branch opposite to the fetlock-joint, that runs, before the trunk, directly to the lateral cartilage, over which its divisions are dispersed. 2. A large branch from the posterior part of the trunk, just before it dips behind the cartilage, which passes backward, and sends its filaments into the fatty frog. 3. Behind the cartilage comes off a branch that winds forward through a foramen in the ala of the coffin-bone, to go to supply the laminæ. The trunk then enters the foramen in the posterior concavity of the coffin-bone, in company with the plantar artery, and there divides, and distributes its ultimate branches through the foramina around its edge to the sole.

NERVES OF THE HIND EXTREMITY.

The following nerves owe their formation to the concurrence and union of several of the lumbar and sacral nerves, in a way that has already been pointed out: nevertheless, in commencing the descriptions of them individually, I shall again briefly revert to the manner in which they are constituted.

The CRURAL NERVE is derived partly from the second, but principally from the third, fourth, and fifth lumbar nerves. It is concealed at its origin by the psoæ muscles; shortly afterwards, however, it makes its appearance under the last transverse process of the loins, which it crosses obliquely, and proceeds directly backward, in a line with the external iliac artery, to the outward side of, and rather higher than, the vessel, but not in contact with it. In crossing the tendinous and fleshy insertions of the psoas magnus and iliacus, it splits into several parts, and these plunge into the thigh between the rectus and vastus internus, distributing their branches laterally to them and to the vastus externus behind them. Its branches are—1. Which comes off at its root and runs still more obliquely outward than the trunk, and distributes its filaments to the iliacus, psoas magnus, and pectineus. 2. The most considerable and important branch takes its course along with the trunk, between it and the artery; but, instead of leaving the vessel, continues to accompany it for a short distance below the pubes; it then strikes forward upon the faschia lata, and divides into two cutaneous filaments: of which, one runs into the stifle and ends in ramifications upon the fore part of the thigh; the other is continued down, in company with the vena saphena, distributing twigs to the skin covering the inward and anterior part of the thigh and leg, where it often splits into two branches, and is traceable with the vein as low as the fetlock.

THE OBTURATOR NERVE, contributed to by the third, but principally formed by the fourth lumbar nerve, sweeps round the brim of the pelvis, first above, afterwards to the inner side of, the external iliac artery, and passes through the anterior nook of the foramen magnum ischii, detaching some twigs to the obturator muscles in its passage, and is subsequently found sunk in the haunch, behind the pectineus, but before the short and long heads of the triceps; to which muscles it gives branches, and afterwards creeps under the gracilis, upon whose inner surface it spreads and expends its ultimate filaments.

THE GLUTEAL NERVE receives a tributary filament from the last lumbar, but owes its formation principally to the first sacral nerve. It leaves the cavity of the pelvis through the foramen in the anterior part of the sacro-sciatic ligament, and winds round upon the dorsum ilii, in company with the gluteal artery, and is entirely expended in the substance of the gluteus maximus.

THE SCIATIC NERVE, the largest in the body, derived from the union of the last of the lumbar with the three anterior of the sacral nerves, immediately after its formation quits the cavity of the pelvis, through a hole in the anterior part of the sacro-sciatic ligament, proceeds backward in contact with that ligament, passes between the hip-joint and the tuberosity of the ischium, and plunges deep into the substance of the haunch. Here we find it split into three large branches—*the popliteal nerves*—which are lodged in an inter-muscular hollow, imbedded in adipose membrane, having the semi-tendinosus and semi-membranosus posteriorly, the biceps to the outward side, and the large head of the triceps to the inward side: in passing through the foramen it detaches three or four branches to the head of the biceps, about the same number to the semi-tendinosus, and two or three to the semi-membranosus. Of the three large nerves into which the trunk divides—*The first* and principal one takes an oblique course between the bellies of the gastrocnemii, leaves those muscles at the place where they become tendinous, and runs to the hock between their tendons and the muscles of the deep posterior crural region, clinging to the faschia enveloping the latter. At the hock it separates into two nerves—the *internal* and *external metatarsal nerves:* the former runs over the tendon of the flexor pedis, and upon the leg creeps along the inner and anterior border of the flexor tendons; the latter passes between the tendon and the base of the os calcis, and pursues a like course upon the outer side. Their subsequent course and ultimate distribution are the same as those of the plantar nerves of the fore extremity. Its branches are—1. A long branch which at first accompanies the popliteal trunks, then passes between the gastrocnemius externus and lower end of the semimembranosus, and makes its appearance upon the fashia covering the outer side of the thigh, where it sends off many cutaneous filaments, and ramifies over the outer part of the hock. 2. A long slender branch to the gastrocnemius internus. 3. Several filaments to the skin and faschia, above and about the hock.

The second popliteal nerve passes also between the bellies of the gastrocnemii, above the first, detaching twigs to them in its passage, and then expands into many branches, which penetrate the heads of the flexor muscles of the foot, and sends filaments into the stifle-joint.

The third popliteal nerve, leaving the others, winds round to the outer part of the thigh, between the gastrocnemius externus and the semi-membranosus; there it crosses the head of the peroneus, and then suddenly turns down, running between that muscle and the extensor pedis, along with the anterior tibial artery, and takes its course with it to the middle of the cannon, whence (instead of accompanying that vessel between the metatarsal bones) it pursues its way along the side of the large metatarsal bone, over the fetlock-joint, and terminates subcutaneously upon the side of the pastern. Its branches are—1. A small one to the semi-membranosus. 2. A filament, or two, to the gastrocnemius externus. 3. A large branch that runs along the peroneus, under the faschia, and ends superficially in front of the hock. 4. Branches to the flexor metatarsi and extensor pedis. 5. Various small subcutaneous filaments during the remainder of its course.

Sympathetic Nerve.

This nerve (designated *sympathetic,* from the universal influence which it possesses in the nervous system) is one no less remarkable for its vast and vital importance in the animal economy than for its extensive distribution all over the body, from the head to the tail; for its ganglia; its plexuses; the number and complication of its branches; and its frequent intercourse and connection with other nerves belonging to the head, neck, chest, abdomen, and pelvis. Indeed, late experimental researches lead us to consider it as a nervous system of itself, or at least one that renders the parts to which it furnishes nerves, *constitutional* organs less under the influence of the denominated the *lesser, secondary,* or *accessory splanchnic nerve,* whose destination is nearly similar to that of the former.

These three nerves, the two splanchnics and the sympathetic, make their entry into the abdomen along the under surface of the crus of the diaphragm. The splanchnics are then thus distributed :—The greater splanchnic turns downward, and contributes its branches to the formation of the semi-lunar ganglion; the lesser splanchnic likewise sends most of its branches to that ganglion, but it also transmits two or three long filaments backward to the renal plexus : and both the splanchnics detach communicating filaments to the sympathetic.

The semi-lunar ganglion, consequently, is constituted of branches from the left division of the par vagum, and of almost all those of the splanchnic divisions of the sympathetic. This ganglion partakes of the semi-lunar figure, lies close underneath the posterior aorta, at the root of the cæliac artery, and occupies the space between that vessel and the anterior mesenteric artery. It consists of a number of small ganglia, connected one to another, and is surrounded by a plexus of nervous filaments ; which little ganglia have been denominated the *cæliac.* From the irregular convex border of the semi-lunar ganglion, nervous filaments shoot in various directions, and these, from having been likened to the rays of the sun, have been denominated, altogether, *the solar plexus :* from which divergent filaments the several minor plexuses of the abdomen may be said to derive their formation, taking names according to the viscera they are particularly designed to furnish with nerves. The first to be noticed is

The splenic plexus—a network of small nerves surrounding the splenic artery. It sends some filaments to the pancreas, but the majority of its detachments run to the spleen.

The hepatic plexus consists of a similar nervous interlacement around the hepatic artery: it is very extensive, for it winds round the vessel from its origin to its termination in the porta of the liver. It transmits filaments—1. Along with the phrenic arteries to the diaphragm. 2. To the stomach. 3. To the pancreas. 4. It then divides into *right* and *left hepatic plexuses,* which cling to the arteries of the same names, and accompany them in their ramifications through the liver.

The anterior mesenteric plexus includes a vast assemblage of nervous filaments intricately wound round the trunks of the anterior mesenteric arteries, and furnishing numerous filaments that proceed along with these vessels, greatly exceeding them in number, to ramify within the substance of the small intestines, cæcum, and cæcal portion of the colon.

The aortic plexus is a name given to the frequent intercommunication of some fine filaments sent backward along the posterior aorta from the solar plexus, with the addition of two or three branches from the trunk of the sympathetic. Most of the filaments derived from it pass on to form—

The posteriar mesenteric plexus; one that is likewise reinforced by branches (comparatively large in size) from the sympathetic. It transmits nerves to that part of the colon left unsupplied by the anterior mesenteric plexus, and to the rectum: some few of them also ramify in the substance of the mesocolon, while others penetrate the lymphatic glands seated within the folds of that membrane.

The hypogastric plexus, situated still further backward than the posterior mesenteric plexus, consists of divers delicate nervous filaments ramifying upon the aorta, and spreading themselves, entangled in cellular substance, about its bifurcation. This plexus is also multiplied by branches coming from the sympathetic. The filaments departing from it run to the pelvic viscera and the organs of generation.

The renal plexus is a more important one: it is produced by the intercommunication of a few filaments from the lesser splanchnic nerve with the addition of numerous others from the solar plexus. It is found close to the aorta, immediately behind the anterior mesenteric plexus. It conceals the origins of the emulgent arteries, spreads around them in their passage, and sends filaments in company with their branches into the substance of the kidneys. It also furnishes with nerves the capsulæ renales, the renal glands, and the beginnings of the ureters.

The sympathetic nerve in the abdomen travels over the sides of the bodies of the lumbar vertebræ, below the articulations of the ribs, covered by the crura of the diaphragm, and thus pursues its course into the pelvis. Here likewise it forms ganglia, corresponding in number to that of the lumbar nerves; and from every ganglion issue two filaments, one of which runs to the correspondent lumbar nerve; the other crosses the aorta, and, by joining the aortic plexus, communicates with nerves coming from the sympathetic of the other side.

From the loins, the sympathetic descends into the pelvis, where it takes its course, laterally, along the body of the sacrum. Five sacral ganglia, corresponding to the five sacral nerves with which they communicate, are found here, and between them run in arches across the sacrum several intercommunicating filaments. In quitting this bone, the nerve grows so small, and becomes so firmly adherent to the ligamentous covering of the os coccygis, that I have not yet succeeded, to my mind, in ascertaining the precise manner in which it finishes its course: it is said, however, to do so by forming a union with its fellow.

⁂ I take this opportunity of acknowledging the services afforded me in the dissection of the nerves by Mr. Bean, V.S, who, I believe, is in practice at Durham. Unwearied assiduity and unusual zeal had qualified him in an especial manner for such an undertaking; and I hope that he is now enjoying that support which his professional acquirements will always render him deserving of.

SECTION X.

SENSITIVE SYSTEM.

INCLUDING THE NOSE; THE EYE; AND THE EAR.

OF THE NOSE.

The nose comprehends the apparatus of the organ of *smell*; a sense so acute and cognoscent in the horse-species, as greatly to make up for the deficiency of that of *touch*.

Division. The component parts of the nose are divisible into such as are *hard* in their nature, and such as are *soft*.

THE HARD PARTS comprise *the bones* and *the cartilages*.

THE SOFT PARTS are comprehended in *the membrane lining* the various nasal cavities and passages.

Cavities. The cavities of the nose consist of the *nasal fossæ* and the different *sinuses of the head.*

Nasal Fossæ.

The nasal fossæ are the two chambers or lateral cavities, whose external openings are *the nostrils*. Their *walls* or *external parietes* are almost entirely osseous; and to the OSSEOUS SYSTEM (page 45) the reader must turn for a description of the manner in which the fossæ are formed, and of the bones entering into their formation. But in addition to bone, they are *cartilaginous* in their constitution.

THE CARTILAGES OF THE NOSE are *five* in number:—of which one (the septum nasi) is situated *internally*; the other four (entering into the composition of the nostrils) *externally*.

THE SEPTUM NASI is the vertical cartilaginous partition interposed between the nasal fossæ. It exhibits four borders. The inferior one is received into the groove of the vomer; while the superior presents a lengthened channel between two elevated edges, into which is admitted the internal crest formed by the union of the nasal bones. Its posterior border is affixed to the ethmoidal plate: its anterior serves to sustain the cartilages forming the nostrils. Both its sides are completely covered by the Schneiderian membrane.

NOSTRILS.—Four in number:—two on each side, distinguished by the epithets *true* and *false*.

THE TRUE NOSTRILS are the large, ovoid, and ever-open orifices so conspicuous externally. They have for the base of their structure four pieces of fibro-cartilage, which are involved in doublings of the common integument. Each nostril is formed of two flexible *alæ* or wings:—a *superior* or internal one; and an *inferior* or external: the former is supported by a broad circular cartilaginous plate; the latter is crescentic in shape, and forms a flexure outward, within which is perceptible the orifice of the lachrymal duct. They are attached to, and supported by, the nasal peak and septum nasi.

THE FALSE NOSTRILS are two little pouches or cavities (having the semblance of *culs-de-sacs*), situated internally, above the true nostrils, into which an external opening is found within the commissure formed by the union of the two alæ. They are formed out of duplicatures of the skin, which is here thinner, and finer, and softer in its texture; and, except at their entrance, are without hair upon their surfaces. Their use is not known.

SCHNEIDERIAN MEMBRANE.—The cavity of the nose is not only divided into the two nasal fossæ, but each fossa is subdivided into the three *meatus* (for a description of which, vide page 45). Every part of these cavities and passages is covered by the *Schneiderian* or *pituitary membrane*. This is a membrane of the mucous class, distinguished for its thickness of substance, for its vascularity, and for its olfactory papillæ. It has two surfaces:—an exposed or secreting one: and an unexposed or adherent one. *The secreting surface* is smooth; and is rendered glib and shiny by the varnish it derives from the mucous secretion emitted by the numerous small rounded pores everywhere visible in the membrane, but more particularly upon the lower part of the septum, and upon the inferior turbinated bone. This surface exhibits a pale pink blush, the effect of the blood-vessels spread over it, which are here so superficial as to owe their principal defence to the mucous exudation: hence it is that the complexion of the membrane (varying with the influence of the atmosphere and other agents) is extremely fugitive and uncertain. *The adherent surface* of the membrane contracts a close and firm adherence to the parts it covers, through the insinuation of its fibres into them: indeed, to the bone it appears to supply the place of periosteum; to the cartilage, of perichondrium. The substance of the membrane exhibits a fibrous structure, interwoven with cellular tissue; and upon that—as a substratum—is spread a glandular and vascular apparatus, from which issues the mucous secretion; together with numerous *papillæ,* of small size, constituted of the terminations of those nerves from which the membrane derives ordinary sensation, as well as those that endow it with the peculiar sense of smelling. The Schneiderian membrane, inferiorly, within the nostrils, is continuous with the duplicatures of skin lining those parts; superiorly, with the membrane lining the pharynx; besides which, it is continued into the several sinuses of the head, through the openings leading from them into the nose, and likewise gives them a complete covering: it is to be observed, however, that in the sinuses the membrane is thinner, and assumes a paler and more delicate aspect; its natural secretion is also found more sparing. The membrane is abundantly supplied with blood-vessels, as well as nerves; and also possesses its share of absorbent vessels. Its arteries, which ramify and anastomose so as to form a spreading network upon the secreting surface, are derived superiorly from the *lateral nasal;* inferiorly, from the *facial* and *palato-maxillary.* Its nerves are furnished by the first and fifth pairs.

SINUSES.—These cavities are formed in the interior of several of the bones of the cranium and face: in fact, with the exception of the membrane lining them, they are entirely osseous in their composition. This will account for their description having been already given (at page 46), to which we must again refer.

DUCTS.—There are two ducts belonging to, or connected with, the nose. One is the *ductus ad nasum*—a tube partly osseous and partly membranous in its composition, commencing at the inner angle or corner of the eye, within the substance of the lachrymal bone, running within a canal continued from this bone through the superior maxillary bone, and terminating at the inner and inferior part of the nasal fossa, underneath the duplicature of the inferior ala, upon the surface of the common skin, about one fourth of an inch from its junction with the Schneiderian membrane, by an orifice large enough to admit a crow-quill. The other duct is the *ductis communis narium,* which pursues its course along underneath the vomer to the pharynx; after arising from two lateral branches springing from oblong apertures in the floor of the nostrils.

OF THE EYE.

The parts comprehended under this organ of sense are commonly divided into *those immediately concerned in the production* *of vision,* and *those that are but auxiliary to the function:* in other words, into the EYEBALL and its APPENDAGES.

Of the Appendages.

Regarded in a general view in relation to their several functions, the appendages will be found to answer the subsidiary purposes to the eye itself of *protection, motion,* and *abstersion.*

The appendages comprise—*the eyebrows; the eyelids; the eyelashes; the muscles of the eyelids; the tarsal cartilages; the meibomian glands; the tunica conjunctiva; the membrana nictitans; the lachrymal gland; the caruncula lachrymalis; the puncta lachrymalia; the lachrymal sac; the ductus ad nasum;* and *the muscles of the eyeball.*

Eyebrow.

The supercilium or eyebrow is a part which characteristically attracts attention in man, but one that is denied to animals.* It is that ornamental arched eminence, clothed with hair, upon the superciliary ridge of the frontal bone, which forms so striking a feature and marks such expression in the human countenance, while it serves as a shade to protect the eye from descending glares of light, and from foreign bodies coming in the same direction. Although *eyebrows* are not allowed to the horse by writers, the elevations formed by the orbital processes of the frontal bones have similar relation to the eyes to what the *same parts* have in man; and these eminences, in addition to their common pilous coverings, are furnished with many long hairs, which, though they are rather stragglingly planted, for the most part *slant outward* and are *disposed in arches:* call them, therefore, by what name we may, they are evidently designed to intercept vivid rays of light, and any foreign matters descending upon the eye.

Eyelids.

The palpebræ or eyelids are the moveable curtains in front of the eye occupying the space comprehended within the circular ridge of the orbit. There are two of them;—an *upper* and a *lower lid.* The upper being much the larger and more moveable one, will cover a proportionably broader segment of the eyeball. Both being capable of retraction and expansion, we find them in the former or ordinary state, particularly the upper, drawn into wrinkles, which run in curves, and have some effect in the expression of the eye; in general these wrinkles are more strongly marked in old horses. The lids are separated by a transverse aperture or slit, at the extremities of which they have angular junctions denominated the *canthi* or *angles of the eye:* the *superior* or *temporal angle* is sharp, is situated in respect to the other in the direction of an oblique line drawn upward and inclined outward, and has a loose and moveable attachment to the tarsal ligament; the *inferior angle* is extended and rounded off, and is firmly fixed to the tendon of the orbicularis. *The palpebral aperture* exposes more or less of the eye in different animals and individuals: in man and in the pig much of the white of the eye is seen; but in the horse and in quadrupeds in general the transparent part only is exposed, unless when the eye happens to be turned to one side. The extent of this opening will likewise account for the impression made upon us that one individual has a large or full eye, another a small or sunk eye; for I believe that the magnitude of the eyeball itself will be found to vary but inconsiderably, or at least not sufficiently to amount to this apparent diversity. The loose portion of integument entering into the composition of the upper lid is a prolongation from the skin covering the forehead; that of the lower lid is derived from the face. Many short horse-hairs, but not more than three or four long ones, are observable in the upper lid, growing in the same direction as those upon the orbital prominence above; but from the lower lid stand erect six or seven hairs of considerable length, without any regular arrangement, which appear to be stationed there as sentinels to give the alarm to the organ of approaching danger; for, if by any accident one of them happen to be touched by an insect or any foreign body, the lids are thrown, involuntarily, into a convulsive twinkle, with such alertness as almost for a certainty to shield the eyeball from impingement. The internal surfaces of the lids are shaped into uniform concaves, to adapt them to the globe of the eye, with which they are everywhere in close apposition. They are lined by the conjunctive membrane. The hems of the lids, the *ciliary borders* as they are called, are considerably firmer and something thicker than the other parts, but this augmentation of substance diminishes towards the temporal angle: they limit our view of the eyeball, across which the upper border swells into a curve, while the lower proceeds nearly in a straight line. Each of these borders has two facings or *margins: the anterior margin* is set with a row of horse-hairs, denominated *eyelashes; the posterior* is hairless and smooth, broadens as it approaches the inferior canthus, and slopes a little inward in such manner, that, when the lids are closed, a triangular-shaped conduit is formed by their approximation, by which the tears are conducted into the *puncta*. The *edge* of the lid, the boundary line between the two margins, presents a series of pinholes, which are the orifices of the *ciliary glands:* they give issue to a sebaceous secretion which serves to prevent adhesion of the lids during sleep, as well as to keep the tears from escaping as they run along the triangular canal.

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* No animals have eyebrows. In the human species it is an organ of expression; well known as such to painters, who by a little arrangement in the eyebrow can make great alteration in the expression of the countenance, which same alteration they cannot produce by the variation of any other feature.—*Abernethy's Lectures.*

Eyelashes.

The cilia or eyelashes are the long, fine-pointed horse-hairs growing from the anterior margins of the lids. They are generally black, unequal in their lengths, and are implanted in ranks, two, three, and four deep. They are much longer, and their ranks are more regular, in the upper than in the lower lid: in the former they grow thin towards the upper canthus, and ultimately become discontinued altogether; in the latter the same thing happens as they approach the lower canthus. It requires but little discrimination to perceive that this is the most advantageous arrangement they could possibly have in both of the lids: it being obvious, from the position of the head, that light coming from above must dart upon the temple, while that which is reflected from the ground will be directed to the nasal canthus; consequently, the cilia are suitably disposed to intercept rays in either direction.

Structure of the Eyelids.

The eyelids in composition are cuticular, muscular, cartilaginous, and membranous; also, it may be added, glandular, vascular, and nervous. These several parts and textures are most developed in the upper lid.

The skin, covering and in part composing the lids, is thin, fine, soft, and very extensible in its texture; it becomes more attenuated as it approaches the ciliary borders, around which, to a broader extent in the lower than in the upper lid, it is destitute of hair. This marginal portion (which is commonly black, though in some horses pied) is pierced by the eyelashes, perforated by the ciliary holes, and turns in to join the conjunctive membrane, from which it can only be distinguished along the line of union by their respective colours.

The orbicularis palpebrarum, consisting of a broad stratum of fleshy fibres encircling the lids, and lying immediately underneath the skin, has been already described (at page 86).

Underneath the muscle is found a dense, tough, *fibrous expansion;* and interposed between the two is a long, loose, cellular tissue, which admits of very free motion between them. This fibrous substance is the expanded tendon of the *levator palpebræ superioris*. It may be traced completely over the tarsal cartilages : indeed, we only lose sight of it when we come to the border of the lid.

Tarsal Cartilages.

The tarsi or *tarsal cartilages* are the substances imparting that firmness and elasticity to the borders of the lids which we have already had occasion to notice. There are two of them, a *superior* and an *inferior :* the superior tarsus is the broader and more convex cartilage; for, in fact, they correspond nearly in shape and size to their respective lids. They are convex outwardly; concave, in order to embrace the ball, inwardly. They possess thick and firm ciliary margins; but grow thin as they recede from the borders of the lids, and end in fibrous expansions, which, from connecting them to the rim of the orbit, have got the name of the *tarsal ligaments*. The tarsus is fibro-cartilaginous in texture; but it is so intimately united with the tendon of the levator and beset with the ducts of the ciliary glands, that it can scarcely be said to be demonstrable in a separate and perfect state : in short, the tarsi are the flexible shapes upon which the other soft parts are stretched and moulded, preserving by their elasticity the form of the lids, keeping them in constant apposition with the eyeball, and serving to approximate them when not counteracted by muscular force. The stiffening thus imparted to the lid also proves the means of preserving the arrangement of the eyelash; for, without it, the hairs would be apt to run across one another. At this stage of the dissection we gain a view of

The Ciliary or Meibomian Glands.

These are so many little white follicular bodies, whose canals are large enough to admit a pin, vertically ranged in parallel lines like the pipes of an organ along the borders of the lids, within grooves made for their reception in the concave part of the tarsal cartilages. They are distinctly visible, when the lids are everted, through the thin lining membrane. They vary somewhat in caliber, but more in length; being longer in the upper than in the lower lid. Viewed through a microscope each row (upper and under) is found to consist of a congeries of very small spheroid bodies, every one of which is considered to be a distinct gland, and to possess an excretory duct. They secrete an unctuous matter—a suety sort of oil, which may be squeezed out from the mouth of their ducts, *the ciliary orifices,* in taper portions resembling small white worms. This secretion serves to prevent the gumming or agglutination of the lids together by the mucilaginous matter contained in the tears.

Cellular Tissue. The several textures we have been examining, including the *lining membrane* (yet to be described), are all connected together by a fine cellular tissue, destitute of fat; adipose substance here would not only have proved burdensome and inconvenient to motion, but by accumulation must inevitably have permanently closed up the eyelids; an effect that does occasionally happen from serous effusion, to which they are from their loose contexture particularly liable.

Tunica Conjunctiva.

The tunica conjunctiva is the membrane lining the lids, and from them reflected upon the eyeball—hence the derivation of the epithet *conjunctiva*: it has been styled also the *tunica adnata*, from a notion that it arises from, or grows to, the globe of the eye. To convey a familiar notion of its extent and reflections, it may be remarked, that if I introduce a probe or my finger between the lid and the eyeball, and attempt to push it to the back of the orbit, I find that I am suddenly arrested, and that I cannot effect my purpose, try what point I may, in consequence of meeting with a duplicature of conjunctiva: nay, more, I find I am unable even to *touch* any part but what is covered by this membrane. For, after it has given an entire lining to both the lids, even to their edges, where it is pierced by the ducts of the Meibomian glands, and after it has given coverings to the membrana nictitans, caruncula lachrymalis, and puncta lachrymalia, it leaves the lids and becomes reflected upon the globe, to the anterior hemisphere of which it likewise gives a complete covering; so that it is the angle of reflection of this membrane that forms the boundary between the closed and open cavities of the orbit—between the tangible and intangible parts of the globe, and that which prevents the probe or finger from reaching the bottom of the eye. Being the common investing and connecting substance of such moveable parts as these, we find the membrane running into loose folds in passing from one part to another, and these folds furnished with abundance of cellular tissue. In tracing its connections, we may begin along the line of the cilia, where it forms a union with the common skin; in passing backward it adheres closely to the tarsi, and afterwards has a loose connection with the tarsal ligaments; it gives the membrana nictitans a close, tense covering, but is thrown into folds around its base; lastly, it adheres but loosely to the opaque cornea, but is intimately and inseparably united with the transparent part:

indeed, so perfectly is the membrane incorporated with the latter, that the existence of such a covering has been doubted; the continuation, however, has obtained, of late years, the passport of our best human anatomists, which, with the corroboration of some remarkable circumstances connected both with health and disease, appear to have set the much-agitated question at rest. The conjunctiva is not thrown into wrinkles (the same as the skin is) when the lids are opened: the elasticity of its cellular connections in general, particularly the one it has with the adipose matter at the bottom of the orbit—which from being stretched will recede again—being such as to prevent any corrugation. The conjunctiva presents two ample surfaces: *the adherent one* is rough, lax in texture, and flocculent; *the inner surface* is smooth, glossy, and humid with secretion. In texture, it is no more than a finer sort of cellular membrane condensed so as to be rendered firm and resisting, in whose substance are distributed numerous blood-vessels, that give it a carnation hue. There are some striking varieties, however, in its organization, notwithstanding it is everywhere one and the same continuous membrane: *e. g. the conjunctiva palpebralis* possesses numerous blood-vessels, from which, as we know, it appears commonly red; *the conjunctiva scleroticæ* is comparatively thick and pulpy in texture, only showing a straggling red vessel or two, and, from the nature of the part it covers, ordinarily appears immaculately white; whereas, *the conjunctiva corneæ* is particularly thin and dense, and is transparent, and in a perfectly sound state has no appearance whatever of vascularity: indeed, as was observed before, vessels were some years ago denied to it altogether, and their existence probably would be disputed yet, did not inflammation of the part occasionally afford us ocular demonstration of them.

Organization of the Eyelids. The eyelids receive their vessels from the orbito-frontal, facial, and temporal arteries. Their veins terminate in the corresponding venous trunks. They derive their nerves from the fifth pair, and are very sensitive and irritable parts.

Use of the Eyelids. Comparing the eye to a window, the lids may be regarded as the shutters; their uses being to exclude light and to protect the organ from all violence or accident. Light being its natural excitant, exclusion puts the organ into a state of repose, and enables it to recruit those energies which intense or long-continued vision may have weakened or exhausted. During sleep, the lids are closed for this purpose: not, however, that this is absolutely necessary; for let the nervous excitability be withheld or suspended, and the organ will be equally in a state of repose, as is the case with those individuals who sleep with their eyes open. Even the act of winking has a refreshing effect, from intercepting the light even but for an instant.

Membrana Nictitans.

THE MEMBRANA NICTITANS (by farriers called *the haw*) is a concavo-convex cartilaginous body, lodged behind the inferior canthus, between the eyeball and side of the orbit. In a perfectly healthy condition of these parts only the cuticular margin of this substance is naturally visible, and that preserves the line of the transparent cornea: but in a morbid or preternatural state of sensibility it is protruded forward, and encroaches more or less upon the transparent part of the eye. In a detached state, it approaches in figure to an extended triangle, of which the short side is turned forwards, the lengthened angle backwards. The anterior part is thin, very elastic, and is bounded by a crescentic edge, terminated by two salient angles, by which it is shaped to the inward third of the circumference of the cornea; it increases in substance, but grows narrow posteriorly, and there ends in a thick, obtuse, conical point, which is sunk into the adipose substance at the bottom of the orbit: thus it covers the inner and inferior sides of the globe—about one third of its entire superficies. Inwardly, it is evenly concave, to adapt itself to the globe; outwardly, it is unevenly convex, and clothed with adeps. With the exception of the posterior end, this body is enveloped in conjunctiva, which, though it adheres closely to the thin portion, so loosely invests the thick part, that very free and extensive motion is admitted. The crescentic margin is edged with cuticle, commonly black, sometimes pied; and this is the only part visible externally. Though it has got the name of a *membrana,* it has a thin piece of *cartilage* for its base, to which it owes its shape: this cartilage is thin and pliant, becomes thicker and more resisting posteriorly, and is interposed between two rough brownish substances of a *ligamentous* nature, the outer of which is double the thickness of the inner.

Use. Writers on comparative anatomy treat of this body as a *third eyelid.* In birds it certainly answers this purpose in the ordinary way, and in some quadrupeds too; but it appears to have been given also for a purpose which the lids alone could not accomplish, or at least not perform with the same ease and effect. If one makes a feint to strike the eye of a horse, one perceives that the convulsive twinkle of the lids is accompanied by the momentary sliding of the membrana nictitans over the eyeball, the same as a man would oppose his arm (or a shield if he had one) to ward off the blow: in this case it affords greater protection to the organ than what the lids offer. But its chief operation appears to be one for which the lids are by no means well adapted. If a foreign body happens to lodge in the eye of a man, the lids frequently rather tend to retain than to dislodge it; and, were it not for his hands, it would occasionally remain there and create dreadful irritation: so it would be with a horse, were he not provided with a membrana nictitans, which here serves him in the place of hands in performing an office to which the lids in a general way are of themselves inadequate. Why was the monkey not furnished with a membrana nictitans? Because he can make use of his fore paws after the manner of hands. The eye of a man therefore, as well as that of a monkey, is, *abstractedly considered,* an imperfect organ compared with the eye of a horse. What supervenes upon the admission of any insect or foreign substance into the eye (a rare occurrence among horses) is this,—the convulsive twinkle consequent upon the accident commonly carries the foreign body underneath the lid, where it soon creates irritation and pain; tears are then shed in profusion, and the membrana nictitans during the time is repeatedly slid across the eye; in one of these efforts, the irritating substance is dislodged from its place, and in the next, probably withdrawn upon the convex part of the membrane, from which it becomes subsequently washed off by the tears.—But (since this part has no muscle whatever in its composition, nor any attached to it) how is it put into motion? In this manner—The space at the bottom of the orbit unoccupied by the globe is completely filled with adeps; the globe consequently cannot be retracted without displacing some of this fat—that being liquid in the living subject, and on that account incompressible; and as the globe, when it is retracted, is drawn with an inclination inward, it is the fat next the nose, or that in which the membrana is cushioned, that must give way. It is quite evident what the result of this must be. The fat is forced against the membrana, and that being moveable becomes projected (guided by the eyelids and confined by the conjunctiva) over the transparent cornea; which it more effectually covers, from the circumstance of the globe being at the same instant turned inward. The retracting muscles relaxing, the adeps, from its own inherent elasticity, recedes back into its place, drawing the membrana nictitans along with it.

The Lachrymal Gland.

To obtain a full view of this part *in situ,* the orbital arch must be removed. Underneath this process of bone we find the gland, covered by the common aponeurotic lining of the orbit, supported by the eyeball, cushioned upon the levator palpebræ, and enveloped in fat and cellular membrane, by which it is confined in its situation. It is a pale, yellowish, delicate mass, of an irregular figure, moderately convex superiorly, in accommodation to the bone, inclining to the concave inferiorly, to adapt it to the globe, of whose upper and outer surface it occupies the summit. Its thickest and broadest part is turned forward: it grows thin and narrow behind. It is a gland of the conglomerate class, being constituted of many lobules, resembling externally those of the salivary glands, connected together by a delicate and easily lacerable cellular tissue. These lobules are themselves composed of granules, which receive the terminating ramifications of the supplying arteries. From the granules spring the radicles of the excretory ducts, and they, by their inter-union with one another, form a set of tubes that open upon the surface of the conjunctiva lining the upper lid, not far from the superior angle, by seven distinctly visible orifices, large enough to admit an eye-probe, whose margins are marked by slight eminences upon the smooth plane of the membrane. The office of this gland is to secrete the tears; and they are conveyed and poured by its ducts upon the surface of the conjunctiva, where they become diffused, partly by their own weight and partly by the motion of the lids, over the transparent part of the eye. The tears consist of a watery fluid, possessing a brackish flavour, from some saline impregnations they contain, and from the same cause having slightly irritating properties; so that, when long or often discharged upon any undefended part, they are very apt to occasion excoriation.

Caruncula Lachrymalis.

The lachrymal caruncle is a little black or pied tubercle, whose magnitude varies somewhat in different horses, lodged within the inferior canthus, in the vacancy between the eyelids and the eyeball. Only that part of it is black or pied, however, which is visible without disturbing the lids; and this is owing to a covering it receives from the skin, which turns in for that purpose at the canthus; for its base is clothed by conjunctiva, the membrane being continuous with the cuticular covering. From its cuticular surface grow several very fine, short hairs. In the human subject, the caruncle is said to be *glandular* in its composition, being constituted, it is asserted, of a structure which may be resolved into mucous follicles: be this the fact or not, in the horse it is found to yield a mucous matter by expression after death, and it is not uncommon, during life, to find a little mucus collected within the canthus. It appears to serve the mechanical purpose of directing the tears into the puncta lachrymalia as they flow against it along the triangular canal.*

Lachrymal Puncta and Conduits.

THE LACHRYMAL PUNCTA are two small, circular holes, large enough to admit the end of a common silver probe, more distinct in the living than in the dead subject, piercing the inward margins of the two lids near the root of the caruncle. The superior punctum is ordinarily smaller than the inferior, and the latter is nearer to the caruncle. They are the openings of two little canals, named—

The lachrymal conduits, which are formed within the substance of the lids. The superior conduit is somewhat longer than the inferior.

These canals are both lined with conjunctiva, and the membrane assumes a finer texture at the entrance of the puncta. They take an oblique direction inward to terminate in the lachrymal sac: the superior one slanting downward, the inferior likewise inclining a little downward, but at the same time bending forward.

Lachrymal Sac.

THE LACHRYMAL SAC is a small membranous bag lodged within the funnel-shaped bony hollow that leads into the canal in the lachrymal bone, behind and rather below the little eminence upon the orbital ridge of that bone, which forms a very convenient guide to find it. Our English veterinarians have denied the existence of a sac: the best argument I can offer of its presence is *dissection*—the same that has convinced myself. The front of the sac is crossed by the fibres of the orbicularis, which operate in discharging its contents; it has also a connection with the tendon of that muscle. The posterior part of the sac adheres firmly to the lachrymal bone. It is composed of a dense, white, fibrous membrane, and this is furnished with a lining from the conjunctiva. The sac corresponds nearly in figure to the funnel-shaped hollow in which it lies: it is broad and capacious above, where it is perforated by the lachrymal conduits; but contracted below, where it is joined to the ductus ad nasum. The internal surface is uneven, and is lubricated by a mucous secretion. This sac is the reservoir into which the tears flow from the lachrymal conduits; and from which they are pressed, in the action of winking, into the ductus ad nasum. Gravitation also, in the ordinary position of ihe head, may assist their defluxion.

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* The caruncle is a little bit of fat rising up to fill an apparent vacancy. It was thought to be an organ of secretion; but we have now reason to believe it is merely mechanical—merely placed there to prevent the tears from going beyond the puncta. In some animals—I allude to *the horse*—it is covered by cuticle, and therefore it cannot be a secretory organ.—*Abernethy's 'Lectures.'*

Ductus ad Nasum.

THE DUCTUS AD NASUM is a long membranous canal, beginning from the contracted bottom of the lachrymal sac, running within the groove through the lachrymal bone; then along a canal in the superior maxillary bone, between it and the anterior turbinated bone, to terminate at the inner and inferior part of the nostril, upon the cuticular surface there, by an oblique oval orifice, which, from being constantly open, conspicuously strikes our view whenever we dilate the nostril. The precaution of its termination upon the *cuticular* surface was evidently taken to prevent the tears from trickling upon and irritating the membrane of the nose. In the first part of its course the duct diminishes a little in its caliber; from about its middle, however, it begins to enlarge again, and soon after acquires its former diameter. After having emerged from its bony passages, the duct makes several flexures, which, though inconsiderable, are sufficient to render the introduction of a probe through it at this part an affair of some difficulty. The membrane composing the duct appears to be a continuation of that which lines the sac: in its passage through the bones it is strengthened by a fibrous sheath. Its internal surface is shielded from the salineness of the tears by a mucous secretion. Its office is that of conveying away the tears collected within the sac, and of discharging them at the external nostrils.

Course of the Tears.—The tears, as they issue from the ducts of the lachrymal gland, are dispersed, by the operation of winking, over the front of the eye, for the purpose of preserving the transparent part of it humid and bright; and as they make their way to the bottom of the eye by gravitation, they naturally run along the triangular canal to the inner canthus, and become directed by the caruncula into the puncta, which, it is thought, imbibe them by *some peculiar vital action*, and not by any supposed capillary attraction*. When the tears overflow their proper channels, and trickle down the side of the face, the eye is said to be *watery*: this is commonly the condition of the organ on the approach of ophthalmia; it arises also in states of common mechanical or chemical irritation; and in the human subject, weeping is induced by excessive pain, and by certain emotions of the mind, particularly grief. Augmented secretion of tears may be the effect of inflammatory action in the gland itself; but it is more frequently, perhaps, the result of sympathy.

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* Whether do the puncta transmit the tears into that which leads to the lachrymal bag, in consequence of the fluid being impelled by force, or whether they have the power of absorbing the tears? We have reason to believe that the orbicularis does, *jointly* with other powers, impel the tears onward. A person having a redundancy of tears, shuts his eyes, and gently impresses the fluid with that muscle, in order to get rid of them. But yet there is reason to believe that there is an absorbing power. Dr. Fullerton was convinced that they (the puncta) had this power, and I think it reasonable myself.—*Abernethy's 'Lectures.'*

The remaining *muscle of the eyelids*—the levator palpebræ superioris internus—and also the

Muscles of the Eyeball.

Having been already described (at page 87), we pass on to the eye itself; finishing the description of the *Appendages* with a few

Concluding Observations.

Contents of the Orbit.—In addition to the contents of the orbit already spoken of, viz. the lachrymal gland, the levator palpebræ superioris, and the seven muscles belonging to the eyeball, there are (besides the globe of the eye itself) some vessels and several important nerves met with therein. There is the *optic nerve,* sheathed in dura mater, in the middle, entering at the foramen opticum, and penetrating the back of the globe. The nerve of the *third pair,* supplying three of the recti, the inferior oblique, and the levator palpebræ, besides contributing to the formation of the lenticular ganglion. The nerve of the *fourth pair,* running to the trochlearis. The nerve of the *sixth pair,* to the rectus externus. And the *ophthalmic artery,* whose ramifications are distributed to the globe and the various parts connected with it; and also the *ophthalmic vein,* which returns the blood into the cavernous sinus.

These several parts are cushioned and packed in an abundance of soft adeps, which serves to connect them together, and at the same time accurately fills up the interspaces. Being in a state of semi-fluidity during life, this substance readily accommodates itself to the various movements of the globe, which ordinarily it bolsters forward in front of the orbit; although it is every now and then forced to one side, and then drives before it the membrana nictitans. That this is one of its principal purposes is shown by there being comparatively much less of it in man. In cases of extreme emaciation, part of this fat becomes absorbed, producing that appearance called *sunk-eyed.*

Ocular Case.—The orbit is lined with a dense, firm, fibrous ocular sheath or case, having the appearance of dura mater, of which it is said to be a continuation. It possesses fibrous attachments to the bony inequalities and foramina at the bottom of the orbit, and by several threads is fastened to the back or rough part of the zygomatic arch. It is thickest and offers most resistance at the outer and upper parts of the cavity, where bony parietes are wanting. It serves to hold the contained parts together, and to protect them from external injury; and it likewise offers resistance to the impulse of the adeps whenever the eyeball is retracted.

Of the Eyeball.

The ball, globe, bulb, or apple of the eye (so variously denominated from its spherical form) may be regarded as an optical instrument of complex but singularly beautiful construction, into which the rays of light are received, and by which they are in their passage in such manner refracted and inflected as to be collected into focal points, and thereby to represent a correct image in miniature of the object from which they are radiating.

Defence, relative Position, and Direction.—In order that we may perfectly understand the position of the eyeball in the head, the manner in which it is sustained in that position, and the various motions it is capable of, and thereby form correct ideas of the axis and range of vision, it is necessary for us to renew our acquaintance with the orbits. The orbit is an imperfect socket formed by unequal pieces of bone coming from the frontal, malar, lachrymal, temporal, ethmoidal, and sphenoidal bones, in the following manner and proportions:—Of the external ridge: the supero-anterior part, about two fifths of the whole circumference, is formed by the orbital process of the frontal bone: the infero-anterior part, about one fifth, by the lachrymal bone; and the remaining two fifths by the malar and temporal bones, in the ratio of three to one. Internally, the floor is constituted of the orbital plates of the lachrymal and malar bones; the side by that of the frontal, and by the os planum; the back parts by the ethmoidal and sphenoidal bones. The socket is of an irregular figure: looking into it in front, it has the appearance of being of a conoid or pyramidal form, but, on close examination, we find that the roof and one side are deficient—that the eyeball is guarded in those places only by bony arches, which, though they are firmly stayed and well placed to ward off attacks in the most perilous directions, seem to leave the organ exposed in others. This, however, is far from being the case. In the recent subject, not only a considerable part of the vacuity behind is occupied by the condyle of the inferior maxilla, but the remainder of the space, posterior to the orbital sheath, is filled with adeps: and this serves as a bulwark to the globe behind, while it freely admits of the motions of the jaw. But what principally demands our attention here, is the sheath lining the orbit. We have formerly examined this, and found it to possess considerable density, firmness, and resistance and to be thickest at the external and superior parts; and we now perceive that it was made so because there it has to supply the place of bone. The socket formed by the sheath is described by some as conical, by others as pyramidal; perhaps it bears the nearest approach to the latter form, though, like other anatomical comparisons to geometrical figures, it will be found not to possess mathematical precision: for the basis of the pyramid, instead of being equidistant at every point from the apex, is obliquely truncated in a direction outward and downward; to which may be added, there is a prominence of the boundary edge next the nose that contributes with this truncation to give the eye a sunken appearance on that side, while the outer part of the globe projects beyond the socket. The orbital ridge has a quadrilateral figure: the external side is the longest, the inferior one the shortest, the vertical to the transverse diameter being in the ratio of seven to six: the line of the internal side is interrupted by a notch. The axis of the orbit directs a horizontal line more outward than forward, more forward than downward: this line intersects another horizontal line drawn directly forward at an angle of about 70°, and one drawn directly outward at about 20°: the inclination downward, however, will of course vary with the position of the head. The axis of the eyeball is not exactly that of the orbit, though *it* likewise takes a direction more outward than forward; for in the ordinary position of the head, it is perfectly horizontal, and in consequence of the prominence of the eye next the temple, inclines more forward than the *orbital* axis, probably by 10°: the motions of the eye will, in course, vary its axis considerably, and especially in the lateral direction. In fact, the eyes, placed as they are in the head, command nearly a whole sphere of vision: the horse consequently is amply provided with visual means for seeking food and avoiding danger.

Situation and Connection.—The eyeball is placed within the anterior or more capacious part of the orbit, nearer to the frontal than the temporal side, with a degree of prominence peculiar to the individual, and within certain limits variable at his will. In front, the ball is suspended by the eyelids; laterally and posteriorly, it is slung by its seven muscles, and posteriorly it is also retained by the optic nerve: which muscles and nerve, together with its blood-vessels, are, as we have seen, enveloped in fat; and this fat forms a bolster for the globe (as has also been pointed out), maintaining it in a due state of advancement, and materially assisting in preserving its proper position, and giving steadiness to its movements.

Magnitude, Figure, and Diameter.—The magnitude of the globe varies something in different individuals. Its figure is a compound of two spheres of different diameters, united in front by an elliptical line. The small sphere, or rather hemisphere, projects in front from the large one, and is transparent; the large sphere, the less imperfect one, is flattened posteriorly and prominent around its sides, but is opaque: the former, from its apparent resemblance to horn, has been named *the cornea,* or, to distinguish it from the latter (which is sometimes called *the cornea opaca*), *the cornea lucida* vel *transparens.* The diameter of the globe, according to Girard, exceeds its axis by about a line and a half (trois millimétres): this is *the reverse of the relative dimensions of the human eye,* of which the axis exceeds the diameter by nearly a line.

Constituent Parts.—The visual organ is composed—1*st,* of certain *membranous parts,* mostly opaque, called *coats,* investing and protecting the contents of the globe; 2*dly,* of a series of *diaphanous parts,* or *refracting agents;* 3*dly,* of a *nervous lining,* which receives a representation of the object seen, and transmits the impression along the optic nerve to the sensorium.

THE COATS OR MEMBRANES

Are, the *sclerotic, choroid, retina, cornea,* and *iris.* The first three of these membranes forms the opaque case containing the transparent parts, and are, properly speaking, the *coats* of the eye, being concentrically arranged one within the other, like the layers of an onion. The cornea is the sight of the eye, the watch-glass, as it were, fitted into this case; and the iris is the coloured partition internally between the light and dark compartments of the organ, with a hole through its centre by which they communicate.

Sclerotic Coat.

The TUNICA SCLEROTICA (so named from its *hardness* or *firmness*) composes the white part of the globe, extending from the insertion of the optic nerve to the cornea, and forming about four fifths of the entire superficies. Posteriorly, it receives the insertion of the fleshy fibres of the retractor: in front, it is strengthened by the implantation of the tendons of the four recti, which have been (erroneously) supposed to spread over the part covered by conjunctiva, producing its shiny whiteness, whence the imaginary expansion has been named *the tunica albuginea;* but, in point of fact, no such expansion exists, the remarkable whiteness of the part being caused by the transparent glossiness of the conjunctiva itself. In other places the surface of the sclerotica is padded with fat. Its union with the transparent part, or *cornea*, is so neat and perfect that one has been deemed to be a *continuation* of thc other: the sclerotica manifestly differs, however, from the cornea, not only in being opaque, but in its texture and organization, and also in its diseases. Moreover, either maceration or putrefaction disengages one from the other, and then it is demonstrable that the surrounding margin of the elliptical opening of the sclerotica is bevelled off, for the purpose of overlapping and nicely fitting the edge of the cornea, which is also sloped off, but in the contrary direction. The sclerotica is thinner upon its nasal than its temporal side, though it terminates in front in a thickened border all round; but it is thickest at its posterior part, near the centre of which is a small circular aperture for the admission of the optic nerve: this opening is situated towards the inner and inferior part of the globe, and appears, when examined internally, as a white cribriform spot. The internal concave surface of the sclerotica is in intimate contact with the tunica choroides, from which it commonly receives a dusky stain, the natural effect of transudation after death: these coats are weakly connected together by a very delicate cellular tissue, likewise by blood-vessels and nerves which find their way in great numbers to the choroid coat through pinholes in the sclerotica, most numerous round about the entrance of the optic nerve, and in the vicinity of the corneal border in front. The sclerotica possesses this peculiarity over the other ocular textures—that it retains its figure in the detached state equally the same that it does when distended and connected with other parts, and that it will regain its shape after indentation or distortion, immediately the pressure (should that have been the cause) is removed; even small excised portions manifest the same retentive properties: so far, however, is this from being the case with the other component parts of the eyeball, that, we shall find, there is but one of them but what is directly or indirectly dependent upon the sclerotica for the preservation of its form, and that one even (the crystalline lens) is unable to recover itself after its shape has once been destroyed. Some anatomists consider this tunic to be an expansion—either a laminated or an entire one—of the sheath of the optic nerve: whether one or other or neither be the case, we certainly find their union to be intimate, and continuity of fibre to be the uniting medium. The sclerotic fibres, which are dense, firm, and elastic, and remarkable for their whiteness, are of the same nature apparently as those that compose ligaments and tendons. They take every variety of direction, and are so strongly interwoven and matted together, that no force the fingers can exert will lacerate it: indeed, they are found to decussate so generally throughout the tunic, that the opinion of its being divisible into layers seems to be resisted by anatomical evidence. The principal use of the sclerotica is, to give configuration, support, and protection to the abstractedly formless delicate parts encased within it. It also affords attachment to the muscles moving the globe.

Cornea.

The CORNEA (also called the *transparent cornea*) is the part completing the sphere of the eyeball in front, filling up the elliptical vacuity left by the sclerotica, thereby forming rather more than one fifth of the whole superficies. In quadrupeds (not overlooking that notable exception, the hog,) this is the only externally *visible* part of the eye; they have not, therefore, according to the common meaning of the term, any *white* to their eyes; at least none is apparent but on such occasions as when the animal, without turning is head, looks behind him, a glance that generally betokens slyness, if not viciousness: and this, I presume, is the origin of the vulgar assignation of vice to a horse who is in the habit of showing the white of his eye. The convexity of the cornea, which varies somewhat in different individuals, is greater than that of the sclerotica; it being, as was said before, the segment of a smaller sphere let into the segment of a larger one. Its figure (taking the circumferent outline of the cornea) is horizontically elliptical: it is not a perfect ellipsis, however, for the part turned inwards is bounded by an arc of larger sweep than that turned outwards: a remark that will serve us, so long as we remember that the optic nerve pierces the inner and inferior part of the globe, to distinguish a right eyeball from a left, in the detached state. The vertical diameter of the cornea bears the same relative ratio to its longitudinal that five does to eight. Its margin is cut aslant to fit that of the sclerotica, by which it is overlapped; in this manner, the surfaces of apposition are considerably broadened, and their union so much the more strengthened: indeed, their union is so firm, that as much resistance is opposed to their mechanical separation as to the laceration of either of their textures. Its convex surface is covered by conjunctiva, continued over it from the sclerotica, upon which its limits are marked by a black elliptical line relieved by a dusky shade: this part of the membrane, however is so condensed and attenuated, that it becomes perfectly diaphanous, which circumstance has given rise to doubt, and even denial, of its presence here; the fact, however, is nowadays admitted to receive indubitable evidence from long-protracted maceration. At first view we might suspect that the cornea itself, being so pellucid a part, was thin and delicate in its texture: but, in point of fact, it is allied in density, firmness, and resistance, even to the sclerotica; for neither one texture nor the other are we able to rend with our hands, even with the aid of the forceps. If an incision be made directly across the substance of the cornea, lamina after lamina may be stripped off; and while we are doing this, we cannot but notice that the surface is continually freshly bedewed with a limpid serous fluid oozing from the cellular interstices. This watery exudation, some imagine, is pent up in cells during life, and its escape and diffusion after death is the cause, they conceive, of the filmy obscurity of the cornea, which so speedily follows the extinction of life. If the cornea is macerated, it swells, turns opaque, and becomes soft and flabby; and in this condition it proves very readily separable into its component laminæ, in consequence of their cellular adhesions, which in the recent eye are dense and compact, being now lax and filled with fluid: indeed, the laminæ may be felt sliding one over another, by squeezing and rubbing them between the fingers: for all this, however, we cannot correctly determine their number, though we can discover that the anterior layer is evidently continued from the conjunctiva scleroticæ. When closely examined in this softened condition, the laminæ show signs of a fibrous texture; and the density and toughness of the cornea favour this idea, as also does the circumstance of its blood-vessels being both small and scarce. In the healthy state the vessels are too minute to admit red blood, though red ones are seen commonly enough under inflammation. Nerves have not been traced into its substance, nor do its laminæ appear to be sensible, unless it be the anterior one, which has probably nearly the same feeling as other parts of the conjunctiva: this (coupled with the vascularity) is a strong fact to show their identity. Since, then, this is a part that possesses such firmness of texture and mechanical resistance, we must consider that it was made so tough to complete the eye-case or defence in front; at the same time, from being transparent, it is perfectly permeable to light, and, as such, is also operative in the production of vision.

Iris.

THE IRIS (so denominated from the brilliancy of its aspect and variety of its tints) is that part from the appearance of which is vulgarly assigned the *colour* of the eye. In order to examine this body we must excise the cornea, behind which it is perpendicularly extended, after the manner of an internal eyelid, for the purpose of regulating the quantity of light going to the bottom of the eye. Its boundary edge being fixed within the periphery just behind the cornea, they both necessarily exhibit the same figure in outline; but, the cornea being concave and the iris flat, an interval is left between them, deepest in the middle, and this is called the *anterior chamber*, to distinguish it from a corresponding space behind the iris, denominated the *posterior chamber*. The iris exhibits a perforation, horizontally elliptical, through its middle, which forms the *pupil*, or what is vulgarly called *the sight of the eye*: the aperture is rather nearer to the inner than the outer, to the upper than lower side of the globe, and this in course it attended with a correlative variation in the breadth of the iris at these places. The diameter of the pupil will vary—and so indeed will its figure occasionally—according to the condition of the organ and the quantity of light to which it is exposed. The periphery of the pupil, both above and below, is more or less intruded upon by several little, black, pendulous bodies, which are the *corpora nigra*.

Surfaces. We distinguish in the iris two flat *surfaces*, and two elliptical *margins*. The *anterior surface*, the veritable *iris*, is noted for its brilliancy, and for its colour, which varies in different individuals. It is a remarkable fact, that this variety of hue in the iris corresponds with the colour of the hair; bay and chestnut horses have hazel eyes; brown horses have brownish eyes; and very dark brown or black horses, eyes of a still darker dusky-brown shade. This curious relation is still more observable in human beings; the diversity of colours and hues in their irides being infinitely greater than anything we behold among any one species of animals. Cream-coloured and milk-white horses have wall-eyes, and Albinos have red eyes; in both which instances the iris is said to be destitute of any colouring matter whatever. Both eyes are commonly alike in hue and shade; though now and then it happens that one is a light, its fellow a dark eye. Upon the anterior surface of the iris are visible two broad elliptical belts, the inner of which may be distinguished from the outer by being a little darker coloured; and upon the latter are discernible several *plicæ*, of which two are more elevated and conspicuous than the rest: the inner of these two plicæ forms the boundary line of the belts, and casts a shade upon the inner belt, imparting to it the effect of distance when viewed in the living eye.—*The posterior surface* of the iris is covered with a thick stratum of black mucous matter derived from the pigment, which, from impregnating it with the colour of a grape, has begot for it the name of *uvea;* and it would appear that the colour of the iris (the nature and production of which yet remain a mystery) is essentially dependent upon the uvea: for if the pigment be washed off, the iris will be rendered colourless. In wall-eyes, in which the uvea is wanting, the iris is white; so it is in Albinos, in whose eyes there is the same deficiency. This surface has likewise a division into two parts by a prominent elliptical fold in the middle: the larger one exhibits numerous convergent striæ which run in radii from the outer margin, where they look almost like continuations of the ciliary processes, and terminate in this prominent fold; the inner and lesser division is a plane oval surface, apparently without striæ, perforated in the centre by the pupil.

Margins. The greater or *ciliary margin* of the iris is embraced by the ciliary circle, and has a broad attachment to the choroid coat besides, through the continuation of the pigmentum nigrum. *The lesser* or *pupillary margin,* rendered black and prominent by an edging from the uvea, and hanging loose and floating in the aqueous humour, constitutes the boundary line of the pupil, and gives attachment to the corpora nigra.

The pupil, then, is nothing more than a hole in the iris, oblong or elliptical in the same direction as the cornea is, whose diameter varies with the intensity of the light to which the eye is exposed. There are animals, however, in which the pupil does not ordinarily correspond in shape with the cornea, in consequence of its altering its figure as well as its magnitude under such circumstances: *e.g.* in the cat, the cornea is circular, but the pupil during the daylight is elliptical in the vertical direction, though at night it becomes circular; and, indeed, the pupil of the horse, widely dilated from the effects of amaurosis or the influence of belladonna, likewise assumes the circular figure.

Structure. All that we know about the structure of the iris, is, that it is apparently a fibrous membrane, divisible into two layers, provided abundantly with blood-vessels and nerves, and thickly coated behind with uvea: the division of it cannot be carried through the pupillary margin, there its layers becoming inseparable. Its fibres are believed by some to be *muscular,* the quick and free motions of the part forming the principal grounds of their argument; for the fibres (even by their own admission) are two minute to admit of anatomical demonstration. Professor Coleman found them well marked in the eye of a greyhound that had been long inured to cunning coursing in a rabbit warren. Not only do these fibres elude all anatomical test of their nature, they are insensible to the common mechanical and chemical excitants of other muscles, and even to galvanism.—The arteries of the iris come from the *long ciliary,* and are arranged so as to form two *circuli arterosi* upon its anterior surface, corresponding to the two prominent plicæ thereon: from these, minute branches are detached, which are so numerous, that they of themselves appear to constitute the basis or essential part of its texture. *The ciliary* nerves lavish their branches upon the iris; but, owing to their minuteness, defy all attempts to make out their distribution.

Motion. The motions of the iris consist in contraction and dilatation, and the dimensions of the pupil are conversely regulated thereby: when the iris becomes contracted the pupil becomes dilated, and *vice versa;* the pupil, however, is never shut so completely as to exclude light altogether. These motions are involuntary—excited by the presence of light—and, *cæteris paribus,* are regulated by the quantity admitted, or the suddenness with which it is admitted, into the eye. This action, however, is not the effect of direct stimulus, but proves to be a secondary or sympathetic result, since light has no visible influence upon the iris itself—the impression is made upon the retina: in gutta serena (paralysis of the optic nerve), for example, the pupil becomes dilated and the iris remains motionless; and when the pupil is closed so that light cannot get to the bottom of the eye, the iris becomes fixed. Furthermore, the motions of the iris are influenced by the magnitude and distance of the object of vision: when the eye is intently viewing a near object, or one very small, the pupil becomes contracted; but if the object be removed to a distance, or it have a wide surface, the pupil will become dilated. During sleep the pupil is contracted. After death it remains in that state (either contracted or dilated) in which it happened to be at the instant of the last expiration, and cannot by any means we may employ be re-excited to action. The efficient cause of these movements remains undeveloped.

Corpora Nigra.

I have given this name to the little globular, black bodies found attached around the pupillary margin of the iris; and I have taken the liberty to do so, because I am not aware that any appellation has been assigned them by the veterinarians of this country. Girard, speaking of them, says, "que l'ouverture pupillaire offre *communément* quelques tubercles noirs, sortes de prolongemens frangés, replies en dehors, et nommés *fungus;*" but the term *fungus* sounds to our ears so much like disease, that I consider this a sufficient reason for not adopting it. By this laconic description of Girard's (for this is all he says about them) it would appear that they are not *unexceptionably present:* I have not myself remarked their deficiency unless where the pigment was wanting. There are commonly three of them, about the magnitude of pepper-corns, ranged *en masse* along the upper margin of the pupil, something nearer to the outer than the inner corner; and the largest is placed outwardmost—unless we reckon a very small one indeed, which is generally found beside it. Along the lower edge there are likewise three, sometimes four of them: but these are comparatively inconsiderable, not being larger than pins' heads. The *corpora nigra superiora* hang more or less over the pupillary opening in front: *the corpora inferiora* project just enough to interrupt the regularity of the pupillary line. I am inclined to regard these bodies as productions of the black pigment: they have similar fringed or velvety surfaces, and appear to be resolvable into the same mucous substance, and to be continued from the uvea—to be, in fact, *uveal excrescences.* Professor Coleman has seen them as large as the largest garden peas, without their seeming to interfere at all with vision.

Choroid Coat.

THE TUNICA CHOROIDES is the black, soft, delicate texture immediately covered by the sclerotica. It extends from around the termination of the optic nerve, by which it is perforated, in intimate contact with the internal surface of the sclerotica, as far forward as the edge of the cornea, where it ends in the ciliary circle: it being connected to the sclerotica by a very fine cellular web, by intercurrent blood-vessels, and by the ciliary nerves.

Ciliary Circle. If that part of the sclerotica in union with the cornea be removed, we shall expose, immediately behind the vanishing edge of the latter, a whitish cellular belt about two lines in breadth: this is named the *orbicularis ciliaris, ciliary circle,* or *ciliary ligament.* It forms the medium of union or line of demarcation between the choroides and iris; it is also the place where the sclerotica has the firmest connection with the choroides, and through that connection likewise an intermediate one with the iris. The basis of the ciliary circle is nothing but condensed cellular membrane; but the ciliary vessels and nerves in their course pervade it, forming a sort of vascular and nervous plexus: a circumstance that has given rise to other names for it. This part may be stripped off altogether with the forceps; and in doing so it will be found to adhere with most tenacity to the choroides. Fontana has described in the human eye a triangular canal in the cellular tissue between the sclerotica and this circle; but, for my own part, I cannot find any such cavity in the eye of the horse.

Structure. The inner surface of the choroides is accurately applied in every point to the internal tunic—the retina; though so closely applied, however, they nowhere adhere, either by vascular or cellular connection. Externally, the choroides presents everywhere a black surface; internally, only the anterior parts are black: the posterior concave part, about ouc half of the entire internal superficies, being of a brilliant variegated green tint. The black part is called the *nigrum pigmentum*: the green, the *tapetum lucidum*. The basis of the structure of the choroides consists in vascularity: arteries and veins in countless numbers enter into its composition, dispersed through an intertexture of fine cellular web. Though this fact has been ascertained, however, the arrangement of the vessels is a question that does not seem to this day to have been satisfactorily determined. It appears certain that there are two strata or sets of vessels; but, some say an *external* one of veins, which they call the *venæ vorticosæ*, and an *internal* one of arteries, to which has been given the name of *tunica Ruyschiana*; while others place the veins upon the *inside*.—"Les artères," says Girard, "distribuées à la surface *externe* forment une couche première, unie à une lame *intérieure*, dans laquelle se rendent les veines." It is, perhaps, sufficient for us to know, that this tunic is (with least difficulty in the situation of the tapetum) separable into two layers; that these layers consist almost entirely of blood-vessels, which cross and intercross one another so as to form a vascular network very difficult if not impossible to unravel; and that its arteries come from the *ciliary*, and its veins pour their blood into the *ophthalmic vein*. In order to examine the structure of the choroides it should be freed from the colouring matter adhering to it; and this cannot be done without suffering it to remain some days in water, which is very apt to impair its texture.

Pigment. This adventitious substance is spread over both of the choroid surfaces; but the inner layer is thicker and more consistent and determinable in its limits and disposition than the outer. The outer, the entirely black one—the veritable *nigrum pigmentum*—begins just behind the ciliary circle, and appears to be uniformly continued over the whole of the posterior hemisphere; the inner one, partly black and partly green, lines the dark chamber, fills up the interstices between the ciliary processes, and coats the posterior surface of the iris. The coloured part, called the *tapetum* or carpet, or from its brightness the *tapetum* LUCIDUM, is not found in the eyes either of men, birds, or fishes, and in quadrupeds it is seen of different colours: in the horse, it is pea-green; in the cat, it is yellow; in the stag, blue. In all, however, its relative situation is the same: it makes a circular sweep to a certain extent around the entrance of the optic nerve; in the horse, it spreads wider superiorly than inferiorly, occupying the posterior half of the dark chamber—that part which is within the axis of vision. In a perfectly fresh eye, the tapetum is bright, and its limits are distinctly marked; indeed, with pains, it may be stripped cleanly off the sclerotica, and even without staining the fingers in so doing; but putrefaction destroys its verdure and consistency, and converts the entire pigment into a thin, sooty, semi-fluid matter, readily diffusible in water, and which leaves a dusky stain upon the sclerotica and other parts in contact with it. The pigmentum and tapetum (apparently the same substance, differing only in colour) are supposed to be a peculiar secretion from the vessels of the choroides—a secretion of a mucous nature—only that it is contained within a very fine, soft, and delicate cellular tissue by which it is held together. Mr. Hunter compared it to the rete mucosum: and there would appear not only to be a similarity in composition, but also some mysterious relationship existing between them in regard to their formation; for, in Albinos, in purely white and cream-coloured horses, in white rabbits, ferrets, &c., in whose eyes the pigment is deficient, the rete mucosum is also wanting: this accounts for the delicate whiteness of their skins, and for the redness of their eyes, in which the blood (circulating in the vessels of the choroid) is seen through the pupil, unobscured by colouring matter.

Ciliary Processes. Leaving the ciliary circle, the choroides makes a sudden inflection inward behind the iris, and then turns intensely black. This inflection considerably contracting the space the tunic was formerly spread over, there results a superabundance of substance, which we find to be disposed of in puckers or plaits, arranged in parallel lines, like radii, around the circumference of the crystalline lens: regarding the doubling and plaits together as a whole, the part is named the *corpus ciliare*; but the plaits by themselves are called the *processus ciliares*. These processes repose, posteriorly, upon the soft bed of the vitreous humour, whereupon they make counter-impressions, *the membranula corona ciliaris* being alone interposed. The corpus ciliare is coated with pigment of the deepest dye—the interstices of the processes in particular are thickly bespread with it: this explains the remarkable blackness of this part, and accounts for *the radiated circle of black striæ* marked upon the surface of the membranula ciliaris, after the processes have been stripped off. In order to examine the structure and connections of the corpus ciliare, the pigment should be washed off. It will then be found to be continuous at the ciliary circle with the choroid, to possess the same vascular basis as that tunic, and, in fact, in no wise to differ from the choroid but in its disposition and arrangement. The internal part of the choroides near the angle of inflection presents to minute inspection (or through a magnifying glass) numerous delicate and faintly-marked stripes, arranged in parallel radii, which are the *ciliary striæ;* and every two or more of these striæ unite afterwards to form a single plait or ciliary process, that runs direct to the crystalline lens, growing broader as it proceeds, adhering in its way to the membranula ciliaris (which is behind it), and terminating with an angular point at the capsule of the lens, with which, though in contact, it has no connection whatever. The best view we can have of these processes is obtained by making a perpendicular section of the eye and looking at them through the remaining portion of vitreous humour: a broad, black, well-defined line will then be seen, showing their union with the choroides; and in consequence of their posterior edges having a greyish cast, we are enabled to distinguish their interstices filled with black pigment. We can also distinguish that they vary in length, but not perceptibly in breadth.

The retina (so called from its supposed reticulated texture) is the third or innermost tunic. The optic nerve having reached the inner and inferior part of the globe, pierces the sclerotic and choroid coats, and in its passage through them grows somewhat contracted in its diameter: having arrived at the internal part, the nerve swells into a little white eminent papilla (appearing as a white spot in the living eye), from whose circumference issues, in white radiating lines, a medullary pulp which spreads over the entire surface of the dark chamber. It is sustained in this state of globular expansion by the vitreous humour, and thus becomes accurately applied to the choroides externally, but without contracting any adhesions whatever until it has reached the corpus ciliare. In an eye perfectly recent and unprepared in any way for the examination, the retina appears to terminate on a sudden, by a defined edge, at the black circle upon the ciliary body, by adhesion there to the tunica vitrea: it is asserted, however, by some anatomists, that it does not end but only grows much thinner here, afterwards extending almost imperceptibly between the ciliary processes and tunica vitrea, and proceeding to the capsule of the lens; and this part, they say, in consequence of being much compressed, puts on the appearance of nervous striæ; whereby, they add, its connection with the iris becomes established. During life, the retina is transparent—the choroides shines through it and gives colour to the pupil; but speedily after death it loses its pellucidity, and exhibits a dead or opaque whiteness: immersion in spirits of wine produces the opacity at once, at the same time giving to the membrane a degree of firmness.—*In composition,* it appears at first view merely to be an expanded mass of nervous pulp; but, by scraping the surface of it as it floats in water, it becomes resolvable into a pulpy or medullary part (which is seen dispersed in the fluid) and an extremely delicate membrane, whose texture has been found to be almost entirely vascular; the latter forming the basis or vascular network upon which the former is spread, and by which it is nourished and supported. This membrane is intimately united with the border of the opening that gives passage to the optic nerve. It receives its vessels from the *central artery of the retina*—a vessel that takes its course through the axis of the nerve.

OF THE HUMOURS.

These are three in number, viz., the *aqueous, crystalline,* and *vitreous;* and they occupy in succession the spaces in the anterior, middle, and posterior parts of the globe.

Aqueous Humour.

THE AQUEOUS HUMOUR escapes as soon as the cornea is punctured, and the cornea itself falls afterwards into wrinkles, showing that the convexity and tension of the one is owing to the presence and pressure of the other. It fills the interval between the cornea and crystalline lens, insulating the iris by which the whole space is divided into two cavities, named the *anterior* and *posterior chambers:* these chambers consequently communicate through the pupil; but they are very unequal in their dimensions, the posterior being nothing more than a very narrow chasm between the uvea and the lens, surrounded by the ciliary processes, whose points may be said to project into it. The aqueous humour is a bright limpid fluid, and in its properties bears a great resemblance to the vitreous, in the condition in which the latter drops from its cellular case: they are both compounded of albumen, gelatine, and muriate of soda, suspended in a watery menstruum. This humour (as well as the others) has a capsule of its own; at least, we infer so from analogy, or rather from the separability of a thin transparent lamina from the concavity of the cornea, not possessing the fibrous character of the other corneal laminæ, and which some have been able, they say, to trace upon the iris; though no one, I believe, has seen it enter the pupil: this membrane is supposed to secrete the humour; and, if we may judge from the rapidity with which the fluid is reproduced after it has been let out, its secretion is by no means either a difficult or an expensive process.

Crystalline Lens.

THE CRYSTALLINE LENS, though a solid body, is always considered as one of the *humours*. It is named *crystalline* from its resemblance to crystal, and *lens* from its shape. It is lodged between the aqueous and vitreous humours, the latter presenting in front a hollow bed for its reception; and it is surrounded by the ciliary processes, and parted from the iris by the posterior chamber. The lens is inclosed within a capsule of its own, by whose attachment to the tunica vitrea it is retained in its place, with the assistance of the membranula corona ciliaris. This capsule, the *tunica crystallina* of some, is denser, firmer, and more resisting than the tunica vitrea: it cannot be shown to have any adhesion to the lens itself, there being between them an aqueous moisture, which some regard merely as a *post-mortem* exudation, while others consider it as necessary during life to prevent adhesion of the contiguous surfaces, and call it the *aqua* vel *liquor Morgagni,* from its discoverer. The anterior part of the capsule is thicker, stronger, and more elastic than the posterior part; though the latter is something strengthened by the membranula ciliaris, and is closely, but not inseparably, united by a fine cellular web to (and consequently cannot, as some have supposed, be *continuous in substance with*) the tunica vitrea. Successful injections show the vascularity of the capsule; and the liquor Morgagni is supposed to be a secretion from its vessels, which themselves are derived from the central artery of the retina.

The lens in figure approaches more or less to a sphere: it is not uniformly spherical, but is composed of the segments of two unequal spheres, the posterior of which has more convexity than the anterior. Though perfectly transparent, it has this peculiarity in its composition—that it is soft externally, but gradually increases in firmness and density of substance from the superficial to the central parts, which latter becomes its *nucleus*. It appears to be placed, as it were, in a state of insulation within the capsule; for we cannot detect any cellular, vascular, or other direct connection between one and the other; and we constantly find both their surfaces moist with the liquor Morgagni, rendering them so slippery that whenever the capsule is wounded the lens readily makes its escape.—The nature and composition of the lens is a subject still open to inquiry. As in other doubtful and obscure cases, where anatomical tests forsake us, hypothesis is ready to supply their place, and, as in the present instance, now and then furnishes us with some ingenious and plausible conjectures. Dr. Young* thought that at one time he saw in the lens of a bullock's eye muscular fibres with intersecting tendons, to which he ascribed the power of augmenting its sphericity: indeed, Mr. Hunter had a notion that it possessed a power of varying its figure, and had made some allusions to a fibrous structure. These suppositions, however, have arisen from examinations of the lens in an opaque and altered condition: so long as it remains pellucid, though its substance does come away in spherical laminæ, there appear no grounds for ascribing a fibrous composition to it. Notwithstanding the physiological ingenuity, therefore, of these hypotheses, all that we are absolutely warranted in offering upon the subject of its composition is rather the result of chemical inquiry than any anatomical knowledge we possess of its organization. In the living animal, it is as transparent as the clearest crystal: after death it gradually loses its pellucidity, and more rapidly when immersed in water, by which it becomes converted into an opaque pulpy mass. Even if it is simply squeezed between the fingers, it turns opaque: a change rationally explained by saying, that we have destroyed its organization and extravasated its fluids. Acids and alcohol take the same effect that boiling water does upon it: they convert it into an opaque, white, and more solidified body, such as we see it in the head of a boiled fish. It is found to be chemically composed of albumen, gelatine, and water; and this seems to be the sum and substance of our present knowledge of its conformation. Neither blood-vessels nor nerves have ever been traced into it; nor are we certain that it is organized at all, unless we receive as proofs the ordinarily assigned tests of organization—the phenomena of growth and morbid changes.

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* Young, 'On Natural Philosophy.'

Vitreous Humour.

THE VITREOUS HUMOUR fills the posterior concavity of the globe—the dark chamber—occupying nearly four fifths of its whole interior. It is of the consistence of thin jelly, and from its pellucidity and glassy appearance has got its name. It is moulded to the form of the cavity containing it, and lies in contact everywhere with the retina, though there is no connection whatever between them. Beyond the boundary line of the retina it is covered by the corpus ciliare; and in front is shaped into the form of a hollow bed for the reception of the lens. Let this tremulous mass be pricked or otherwise wounded, and a limpid fluid drops from it, very like water, leaving behind a thick and gelatinous part, which at length becomes resolved into a membranous substance: this membranous residue is said to be disposed in small cells, varying in figure and size, and is called the *tunica vitrea* vel *hyaloidea*. Opposite to the corpus ciliare, this membrane is double: one part of it lines the hollow containing the lens; the other advances under the ciliary processes, for whose reception it is arranged into an equal number of radiated longitudinal folds, with depressions between them, which proceed to the border of the lens and adhere to the anterior circumference of its capsule. The portion of black pigment between the ciliary processes and these plicæ adheres to both: so that when the processes are stripped off, the plicæ are seen marked with a regular series of black striæ forming a radiated circle around the lens, which appearance has obtained the name for this folded portion of membrane of *membranula corona ciliaris*. This being the arrangement of the divisions of the hyaloid membrane, it follows that there must necessarily exist a triangular interval or canal around the capsule of the lens, which forms the base of it, having indentations in its front side: this is the *canal of Petit—canalis Petitianus*. This canal possesses the breadth of the corpus ciliare, behind which it is readily inflatible. It has no communication with any other part.

The fluid that escapes from the punctured vitreous mass, though of greater specific gravity, is much the same in appearance as the aqueous humour, from which, I believe, it only differs in the proportion, not in the number or nature, of its ingredients—viz. albumen, gelatine, common salt, and water.

The arteria centralis retinæ takes its course through the middle of the vitreous humour to the capsule of the lens: but for all this, anatomists have not succeeded in detecting any signs of vascularity or organization in this extremely delicate tremulous mass.

OF THE EAR.

THE ORGAN OF HEARING is constituted of divers parts, which have been arranged in two classes—the *external* and the *internal ear*.

The External Ear

Comprises the *Concha* and the *Meatus Auditorius Externus*.

*Concha.**

THE CONCHA, OR CONCH, is the term we use to denote the *whole* of that part of the organ which is exposed to external view. This consists of a flexible, trumpet-shaped, moveable structure, erected on either side of the summit of the head, for the purpose of collecting the vibrations of sound. Superiorly, the concha (which is ordinarily about six inches in length), grows contracted, and terminates in a point: inferiorly, it presents a broad, firm, circular base or root, so connected with the cranium upon which it rests, as to admit of some considerable extent of sliding motion. Antero-externally, appears the aperture or *external orifice* of the concha, ovoid in its outline, and of large dimensions, extending from the point down to within an inch of the base: it is broader above than below, and is terminated inferiorly by a rounded angle. Internally, the concha exhibits a capacious cavity, broadly exposed by the external orifice; but ending below, at the back part, in a sort of chamber or *cul-de-sac,* in front of which is the funnel-like entrance to the meatus auditorius. The sides of the conchal cavity are marked by several longitudinal grooves or furrows, separated by irregular salient ridges; and the whole is so thickly clothed with long downy hair that the cavity in some horses seems to be almost choked up by them.

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* In general form and external appearance the horse's ear bears no sort of comparison with the ear of a man. The external ear of the latter, altogether, has got the appellation of *pinna*; and on examining the surface of a well-formed human ear, we perceive five eminences, the *helix*, *antihelix*, *tragus*, *anti-*

Composition. The concha is composed of three *cartilages,* connected and attached by *ligaments* and *muscles,* and enveloped within an *external* and an *internal covering of common integument.*

THE CARTILAGES OF THE EAR, fibrous in their structure, are the *conchal,* the *annular,* and the *scutiform.*

THE CONCHAL CARTILAGE (so denominated from its giving shape to the concha) is the largest of the three, constituting the entire upper or trumpet-shaped part of the ear. In its detached state it represents a hollow cylinder very obliquely detruncated along its outer side, in which defective part is formed the external orifice. Its superior end or *apex* runs into a point: the *base* or inferior part bulges posteriorly, forming the chamber aforementioned; while anteriorly it is elongated into a bifurcated process of a semicircular form, which assists in the formation of the meatus auditorius. All the muscles but two, moving the external ear, are connected with this cartilage.* By them it is attached to the cranium, and also, as well as by ligamentous expansion, to the cartilage next to be considered.

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tragus, and *lobula;* and three cavities, that of the *helix, fossa navicularis,* and *concha.*

On the present occasion I have (after the manner of the French Anatomists) adopted the term *concha* as an appellation for the *whole* external ear: its literal signification (a *shell*) bearing out very well this extended application of it. The general cavity, or interior of the external ear, I call the *conchal cavity;* and the cartilage, which more particularly gives this shell-like or trumpet-form to the external ear, the *conchal cartilage.*

* Vide p. 84, "Auricular Region."

THE ANNULAR CARTILAGE, ring-like in its shape, surrounds the auditory process of the temporal bone, in which situation it is embraced by the lower end of the conchal cartilage, the two being connected by ligamentous substance. It forms the entrance or beginning of the meatus auditorius externus.—Its use appears to be, to admit of the motions of the external ear, and, at the same time, preserve the meatus from sustaining obstruction or interruption in its canal in consequence of such movements, whereby sound might be checked or arrested in its way to the interior.

THE SCUTIFORM, OR TRIANGULAR CARTILAGE (wrongly called *triangular*, however, since its form bears a nearer approach to an *oval*, flattened), is situated at the inner and fore part of the base of the conchal cartilage, reposing upon the temporal muscle. It gives attachment to several of the muscles moving the ear.

THE SKIN covering the ear, although continuous with the other common integument of the body, exhibits within the cavity of the concha a comparatively thin and delicate texture. It becomes very thin and dry; and adheres to the cartilage by a cellular tissue, dense and compact, and destitute of adipose substance. After having lined the conchal cavity, it ends in a sort of blind pouch over the membrane of the tympanum, to which it contributes an outward layer. Underneath the skin we find numerous follicles, from which oozes a peculiar greasy matter, for the purpose of keeping the parts soft and pliant. Below these follicles there is a second set of glands—the *glandulæ ceruminosæ;* whose ducts open between the roots of the hairs, and issue a sticky bitter matter, which, acquiring consistence from evaporation, constitutes the *cerumen* or wax of the ear. This secretion protects the bottom of the ear from the insinuation of insects, dust, &c. Sometimes it collects and forms concretions, obstructing the passage into the interior.

Organization. The arteries supplying the external ear are derived from the anterior and posterior auricular branches of the external carotid. Its veins return their blood into the jugular. Its nerves come from the portio dura of the seventh pair.

Meatus Auditorius Externus.

The external auditory passage is the tubular canal leading from the cavity of the concha to the membrane of the tympanum. Its commencement is dilated after the form of a funnel, from which the canal grows contracted, and at the farther end is elongated in the direction of the membrane of the tympanum. In composition, it is partly osseous and partly cartilaginous: the auditory process of the petrous portion of the temporal bone constituting the inner, the annular cartilage, the outer part. It is lined by an extension of the skin from the concha, and is plentifully furnished with sebaceous glands.*

The Internal Ear.

This comprehends two parts—the *Tympanum* and the *Labyrinth.*

Tympanum.

The tympanum consists of an irregular cavity, situated within the petrous portion of the temporal bone, having the meatus auditorius externus on its outer side, the labyrinth on its inner. The cavity is lined by a very delicate mucous membrane, though it contains no fluid; and exhibits several *foramina* or apertures. At one part it has a communication, through the Eustachian tube, with the external air; but the entrance into it through the meatus auditorius is closed by the *membrana tympani.* This semi-transparent membrane is stretched tightly across the termination of the meatus; not, however, after the manner of the parchment of a drum, but funnel-like, a shape into which it is drawn from the attachment to its centre of a lengthened process belonging to one of the little bones contained within the cavity. Two layers enter into its composition—an outer of skin, an inner of lining membrane; which last exhibits so high a state of vascularity as to have been assimilated to the iris.†

Fenestræ. The side of the cavity facing the meatus externus exhibits a very irregular aspect, and is perforated by two apertures—the *fenestra ovalis* and the *fenestra rotunda.* Between these two perforations is an osseous eminence called the *tubercle.*

THE FENESTRA OVALIS (also known as the *foramen ovale*) is an aperture bearing an approach to the fissure of an oval, looking from the cavity of the tympanum into the labyrinth.

THE FENESTRA ROTUNDA (also called the *foramen rotundum*) is likewise an ovoid opening, situated by the side of the tubercle, and communicating (not with the labyrinth, as in the case of the former opening, but) with the scalæ of the cochlea.

Bones. Arranged along the interval between, and connected with, the membranes closing the external meatus and the oval fenestra are four little bones (*ossicula*), by whose intervention vibrations of sound agitating the membrana tympani are transmitted to the membrane opposite—that closing the fenestra ovalis: for these bones are connected to each other by ligaments, and are so disposed in relation to one another as to offer the greatest mechanical advantages in this chain of communication for the purpose of augmenting the intensity of the vibration. The names of the ossicula are, *malleus, incus, os orbiculare,* and *stapes.*

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* In the fœtus a thick whitish substance is secreted by these glands, which answers the purpose of defending the parts against any acrimony in the liquor amnii. After birth, this secretion is discharged along with the subsequent issue of waxy matter.

† In the fœtus, the membrana tympani (and, indeed, the tympanum altogether) is very superficially placed; for that which forms the osseous part of the meatus externus in the adult is a mere bony ring at this period, across which the membrane is extended. This is beautifully illustrated in the cranium of a fœtal puppy now before the writer.

THE MALLEUS (so called on account of its similitude to a *hammer* or *mallet*) is the one most outwardly situated. Its long process, *manubrium* or handle, is attached to the central part of the membrana tympani, which is drawn inward by it into the shape of a funnel. The head of the malleus stands out from its body in an oblique direction, very similar to that of the os femoris; the handle forming an angle with the head and neck, and tapering to its termination against the membrane. From the upper part of the handle, immediately below the neck, issues an acute tapering process; and this is received into a depression in the bone (in which it rests) in the side of the cavity. This process forms the centre of motion of the malleus, and as such it is worthy of remark here, that it originates near its head and at a distance from the extremity of the handle; a point of considerable import in the physiology of hearing.

THE INCUS, though it has received its name from its fancied resemblance to a blacksmith's anvil, bears a much nearer approach in figure to a molar tooth. Answering to the tooth, too, it has a depression upon its surface, adapted to receive the head of the malleus. Like the malleus, it possesses two processes—a superior and short one turned backwards to be let into a depression in the wall of the tympanum; a longer one projected downwards into the cavity, whose extremity is curved a little, and whose point is attached to the os orbiculare.

THE OS ORBICULARE is not only the smallest of the *ossicula,* but it is the smallest bone in the whole body. Soemmering disbelieves in the existence of such a bone; but it may, with a little care, be found and demonstrated, although it hardly exceeds in magnitude a grain of sand. It forms the medium of junction and communication between the incus and stapes: through it, the joint existing between the two obtains additional freedom and facility of motion.

THE STAPES (or stirrup-bone) seems to be the most aptly named of them all; since it really possesses much of the form and character of the common iron stirrup. Its base (which is not an exact oval, one side being somewhat flattened) rests against the membrane filling up the fenestra ovalis, to which in figure it precisely corresponds. By a small head at the other extremity it articulates with the os orbiculare.

Muscles. The mechanism of the internal ear is such as to require in the cavity of the tympanum the presence of four small muscles;* and these operate on the malleus and stapes. They are the—

LAXATOR TYMPANI. A very minute muscle, arising from the outside wall, close to the attachment of the membrana tympani, and inserted into the handle of the malleus, near its root.

M. EXTERNUS MALLEI vel M. Processus Minoris, is by some denied altogether—at least, to be of the nature of muscle. It arises from the upper part of the tympanum, and is attached by a small tendon to the shorter process of the malleus.

TENSOR TYMPANI arises from the side of the Eustachian tube, and is inserted into the handle of the malleus, upon its upper side.

STAPEDIUS. In the horse this muscle is developed in a remarkable degree. It takes its rise from a little eminence within the tympanum called the *pyramid*, and is fixed to the head of the stapes.†

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* Sound is the effect of impression upon the portio mollis of the seventh pair of nerves—the true *auditory* nerve. This impression is produced by vibrations of the air upon the membrana tympani, communicated therefrom by the osseous chain extended between them to the membrane of the fenestra ovalis, and thence to the expanded auditory nerve. Now, these vibrations being once excited, do not immediately cease, but continue succeeding one another in great rapidity; as, in common speaking, every syllable articulated produces a separate and distinct impulse or vibrating motion upon the ear. Consequently, to prevent confusion of sound, or rather confused audition, some contrivance was found necessary to put a stop to one vibration before another was communicated. This explains, in general terms, the use of the muscles of the tympanum.

† It may not, perhaps, be considered altogether out of place to make a remark or two here on the motions of the bones of the ear, and on the mechanical advantages derived from their arrangement and relative position. The manubrium of the malleus is, as we have seen, extended downward to be attached to the tympanum, whose every vibration, in course, affects it. The other slender process, issuing from the neck of the bone and abutting against the wall of the tympanum, being much nearer the point at which the impression is received than the one where the power resides, becomes the centre of motion—the *fulcrum;* so that the bone is set into action upon the principle of the lever. The moving power is applied to the manubrium, the process from the neck becomes the fulcrum, and the head of the bone is the part on which the effect is to be produced; it being a law in mechanics, that in proportion as the distance of the power from the fulcrum or prop exceeds that of the weight or resistance to be overcome, so will prove the mechanical advantage. In the example before us, this distance is *twice* as great; and, consequently, vibra-

Eustachian Tube. The cavity of the tympanum holds a communication with the external air through a canal named, after its discoverer (Eustachius), the EUSTACHIAN TUBE. This tube communicates with the cavity of the tympanum by what (in the dried bone) appears to be nothing more than a fissure, from which, having passed through the petrous portion of the temporal bone, it becomes cartilaginous in its composition, and proceeds for some distance gradually expanding in caliber, until ultimately it opens into the *guttural sac,* formed at the back of the fauces. One side of the tube is clothed by the levator palati and stylo-pharyngeus muscles.*

Labyrinth.

The labyrinth, in which are deposited the organs more immediately concerned in the function of hearing, is an exceedingly irregular cavity, comprising the *vestibule, semicircular canals,* and *cochlea.*

The cavity of the tympanum we found contained *air,* having a communication with the atmosphere without; but within the

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tions communicated by the membrana tympani to the extremity of the manubrium of the malleus, will be transmitted by the head of that bone to the incus with twofold intensity.

Again, we perceive the same principle brought into operation in the motions of the incus. One of the processes of this bone is received into a depression in the wall of the tympanum in such a manner that the centre of motion proves to be in the direction of a line drawn through the middle of the body of the bone; so that the extremity of the other—its *long* process (to which the orbicular bone is attached)—performs a greater sphere of motion than the part receiving the impression from the head of the malleus: the consequence of which is, that but a trifling degree of motion given to the body of the incus must become very much more perceptible from augmentation before it reaches the orbicular bone.

The os obiculare appears to have been interposed in the manner it is, in order that an accurate perpendicular impulse might be communicated to the stapes: had this bone not been where it is, the vibration from the long process of the incus must have been transmitted to the stapes in an *oblique* direction, the result of which would have been confusedness and indistinctness in audition.

The stapes, resting as it does flat against the membrane closing the fenestra ovalis, and receiving these full and distinct impulses, imparts the benefit of them to the membrane, and thus the sensation becomes most impressive and perfect.

* The design of the Eustachian tube appears to be to admit of a free circulation of air in and out of the cavity of the tympanum. Air, from being retained within the cavity, must necessarily become heated and rarefied, a condition in which it is less suitable to transmit sounds with full intensity; and therefore a renewal of it takes place through the Eustachian tube.

labyrinth we find a quantity of *aqueous fluid,* bedewing the expansion of the auditory nerve.*

VESTIBULE.—This is a small roundish cavity, hardly so much as a quarter of an inch in diameter, situated between the cochlea and the semicircular canals; to the outer side of it is the tympanum, with which it communicates through the fenestra ovalis. In its roof we find five openings, leading into the semicircular canals; besides which we notice two particular pits or *foveæ,* containing membranous sacs, *the sacculi vestibuli,* filled with fluid, and furnished with expansions of nerve. Anatomists have been misled, by their examinations of these depressions in the dried bone, in supposing that they reverberated the sound: this shows the danger of forming conclusions from such artificial inquiries.

Semicircular Canals.

These canals are *three* in number, placed side by side, behind the vestibule, opposite to the cochlea; but they are entered by *five* openings through the upper part of the vestibule. They are distinguished as the *superior* or *vertical canal,* the *posterior* or *oblique,* and the *exterior* or *horizontal.* The superior and exterior canals possess one opening common to both, and one peculiar to each, besides; while the posterior canal opens into the vestibule by two distinct orifices; thus making altogether *five* apertures. The separate orifice of the superior eanal opens nearly perpendicularly upon the fenestra ovalis.

From the sacculi vestibuli branches of nerves are sent into the semicircular canals, in which they float loose and unattached in the fluid surrounding them. It was once supposed that the auditory nerve was spread over the periosteum by which the labyrinth is lined; but later researches, however, have shown that it is within the sacculi it expands, which do not even come in contact with the periosteum, but are simply connected to it by a pellucid, cellular, mucous-like matter.

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* This cavity is provided with a watery (in place of an aeriform) fluid, for three sufficient reasons. In the first place, water adds to the intensity of a vibration in a very much greater degree than air. Formerly it was imagined that sound could not be conducted through so dense a medium as water; but the Abbé Nollet overturned this hypothesis by direct and simple experiment. Every schoolboy knows that two stones struck together under water emit a sound, so far greater than the one created in air, as to be in a degree insupportable to the hearer. Consequently, by the water in the labyrinth the impression made upon the auditory nerve is so much the more intense.

A second reason why the labyrinth should contain water (and not air), is, that sound is so much more quickly propagated by one medium than the other. Through air it vibrates at the rate of 1132 feet in a second; through water, at the rate of 4000 feet in that time. Thus the auditory impression is more suddenly and perfectly disseminated over a cavity filled with water than it would be through one that contained air.

A third reason for placing water here, consists in its not being nearly so expansible a fluid as air, and consequently not subject to that rarefaction and increase of volume that air is; and which might be attended with serious consequences in a cavity so confined as the labyrinth is.

The semi-circular canals are formed out of a peculiarly hard, brittle bone; and their diameter is so small as scarcely to admit of the introduction of the head of a common pin.

Cochlea.

This is the last division of the labyrinth, and by far the most complex one. It receives its name from its resemblance to the convolutions of the shell of the snail. Possessing a spiral or pyramidal form, it has (by no means inaptly) been compared to a spiral staircase, running round a column placed in the centre. It is situated below the vestibule; its base resting against the meatus auditorius internus; its apex extending to the Eustachian tube. At its base it describes a large circle which winds upward, gradually decreasing towards the apex, forming altogether about two turns and a half. If we make a vertical section of the cochlea, it presents the appearance of being divided into three cavities or separate compartments: this, however, is not the case in its integral state, since the spiral turnings of the tube run from one into the other.

Lamina Spiralis—Scalæ Cochleæ. There exists a structure inside the cochlea, giving peculiar complexity to it, denominated the *lamina spiralis.* It consists in a partition or plate set edgeways, partly osseous and partly membranous, running through the spiral tube of the cochlea, and dividing it into two separate gyrations, called the *scalæ cochleæ,* which at the apex run into each other and communicate. At the base, the external gyration communicates, through the fenestra rotunda, with the cavity of the tympanum; the internal gyration ends in the vestibule.

Modiolus. This is the central column or pillar around which the scalæ perform their gyrations. It consists of a soft spongy structure, being pierced on every side like a colander, for the transmission of nervous filaments to the lamina spiralis.

Infundibulum. Towards the apex of the cochlea the modiolus opens, the aperture bearing some resemblance to a funnel, being full and expanded upwards: this aperture is what is called *the infundibulum.*

Meatus Auditorius Internus. This is a small and entirely bony canal, piercing the petrous portion of the temporal bone, and running from the interior of the cavity of the cranium to abut against the vestibule and cochlea, for the conduct of the seventh pair of nerves. At its termination it is closed by a cribriform osseous plate, which is not flat, but bulges a little, through whose perforations are transmitted the fasciculi of the portio mollis. The principal part of this plate is set opposite to the cochlea, but a portion extends across to the vestibule; so that nervous filaments gain admission into both cavities.

SECTION XI.

TEGUMENTAL* SYSTEM.

COMPRISING THE SKIN, HAIR, CELLULAR MEMBRANE, AND FAT.

OF THE SKIN.

The ancient anatomists placed the skin, cellular membrane, and panniculus carnosus, in the same class or set of parts, denominating them the *common integuments:* the epithet "common" merely serving to denote their presence and uniformity over the body *generally*. And, indeed, at the present day, the appellation of "common integuments" is still in use; though its meaning is now limited to the skin alone.

Composition. The skin is composed of three parts, differing in appearance, texture, and organization from each other: viz., the *cutis, cuticle,* and *rete mucosum.*

Cutis.

The *cutis* or *dermis,* sometimes designated the *cutis vera* or true skin, from its being the most substantial of the constituents of the skin, is that part which the tanner converts into leather: it lies underneath, and may be said to be (in the full sense of the word) the support of the other two.

Attachment. The cutis is attached to the subjacent parts by cellular membrane, in some places so tensely that little or no motion is admitted of; in others so loosely that it admits of being thrown into folds: about the forehead, upon the back, around the dock, and upon the pasterns, it is so braced that we can hardly pinch up a portion between the finger and thumb; but upon the side of the face and neck, upon the ribs, along the flanks, and upon the arms and thighs, it will easily admit of duplication. Indeed, between the fore legs we find several natural semi-circular doublings of it, in order that the action of the fore extremity may not be constrained; and along the posterior part of the belly and flanks are other folds, not so numerous, but of larger size, giving freedom of motion to the hind parts: in fact, wherever the panniculus runs, the skin is loose, or that muscle could not have imparted to it the power of corrugation.

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* I was for some time at a loss for an appropriate title for this system of parts. The one I have adopted (synonymous with the epithets "investing," "enveloping," "covering" is the most expressive—of any one I could select —of the *general* physiological character of the contained parts.

Density. There is considerable variation in the density or thickness of the skin, not only where it covers different parts in the same individual, but in horses of various breeds. What a contrast there is, for instance, between the skin of the cart-horse and that of the racer! And there appears to be, in this respect, some connection between the cutis and the hair; for the skin, as well as the coat, of a black horse are coarser and thicker than those of a horse of the same breed of another colour; and it is rather uncommon to see a black racer, whereas the colour is predominant among our large heavy cart-horses. The skin is thinnest and softest in those parts which are either thinly clad with hair, or are quite hairless:—such are the lips, the nose, the interior of the ears, the borders of the eyelids, the inward part of the thighs, and the generative organs.

Colour. The cutis itself is white; its apparent colour it derives from the rete mucosum, of which we have evidence in those horses in whom that membrane is also colourless; such are the milk-white and cream-coloured racers; in pieballs, the skin appears white also in places where the hair is white. But in order to show that the cutis itself has no connection in colour with the hair, it will be found that, whether it be taken from a bay, a chestnut, or a black horse, when deprived of its fellow constituents, it will in every instance exhibit the same pale white aspect.

Structure. The cutis is of a fibrous texture, tough but supple, elastic, very vascular, and highly sensitive. Its fibres, which take every direction, are so intimately interwoven and knitted together, that it is a texture possessing considerable strength; a fact we have abundant proofs of both in and out of the body: and that these fibres are elastic is plainly shown by the skin returning to its former dimensions after having been stretched or wrinkled, and in places where muscular fibre can have no action upon it; in fact, by this property it is, chiefly, that the skin so nicely adapts itself, both as a partial and general covering, to different parts of the body under the variations of bulk and shape to which they are, from change of position and condition, constantly liable. From what I have been able to learn in my examinations of the cutis, I should say that its structure was substantially the same as that of the human skin. It appears to consist of a dense substratum of cellular tissue, with which are interwoven fibres of a ligamentous nature, in such a manner that innumerable *areolæ*, like the meshes of a net, are formed in it: these areolæ open, through correspondent pores in the cuticle, upon the external surface, and are for the purpose of transmitting thither blood-vessels and absorbents, of giving passage to the hairs, and of lodging the various emunctories and secretory organs of the skin.

Organization. Few organs exhibit more vascularity than the cutis: scarcely can a pin be introduced into any part of it without drawing blood; but its vessels are small; indeed, generally speaking, so minute that they do not carry red blood. On close inspection of it, after the cuticle and hair have been removed (by maceration or putrefaction), multitudes of little rounded eminences may be seen upon its external surface, with depressions between them: these are readily reddened by injection with size and vermilion, and are ultimately resolvable into vessels, nerves, and cellular substance. In allusion to their shape they may be called *papillæ;* but they certainly do not deserve the name of papillæ *nervosæ;* they may be regarded as excretories of the perspirable matter, and as points endowed with great sensibility; but I do not myself view them in the light of veritable *organs of touch.* I know it is common, among professional men, to say, that "the *lips* of the horse are his *organ of feeling,* performing a like function to the *fingers* of a man;" but I feel inclined to think that this assertion is not well founded: the lips most unquestionably have a more delicate sense of feeling than most other parts; but may not this be accounted for by their hairless and thin and fine integument? Of objects in general, the horse takes cognisance by inhalation; and it is yet doubtful, in my mind, whether he can really be said to be in possession of any veritable *organ of touch:* if he is, a peculiar nervous structure similar to what endows our fingers, or something like it, ought to exist about the muzzle; and such, I apprehend, has only yet been *verbally* shown to us. The sole of the foot is plenteously supplied with nerves—no part more so; but no horseman will contend that the animal can feel more through the hoof than the obvious properties of the surface upon which he treads.

The skin also abounds in absorbents. In places where it is *thin,* the superficial lymphatics, which are supposed to take their origin from its areolæ, are comparatively large, and their trunks, in the subcutaneous tissue, are readily found and injected; thus we learn why the eruptions of farcy mostly make their appearance upon the *inside* of the thigh and arm, and about the breast, lips, and sheath; and why, when medicine is administered by inunction, these are the parts chosen for perfrication.

Pores. Of the infinity of pores the skin exhibits upon its surface, probably the greater number transmit hairs. But there are crowds of others, smaller and consequently less distinctly seen, which are denominated the *perspiratory pores,* from their being known to emit an imperceptible *halitus* or vapour, distinguished as the *insensible* perspiration; that which is *sensible* being the ordinary *sweat.* And it is the condensation and collection of this exhalation, in the form of drops of sweat upon parts that have little or no hair, that serve to mark the situation of these pores; though they may also be rendered visible by putrefaction or maceration. Again, there is another set of pores of larger size, more discernible in some places than in others, which are the mouths of follicles;—the nose exhibits them of large size for the secretion of mucus; the auditory passages are furnished with many of them—*the glandulæ ceruminosæ*—from which issue a waxy matter; and those parts of the skin subject to friction are, in particular, beset with them: in fact, the unctuous matter furnished by them preserves the skin soft and supple, and in some places keeps up a constant greasiness of surface.

The skin at the bend of the knee and hock has a secretion of this nature, which, from irritation, now and then becomes augmented, and from want of cleanliness grows inspissated, and collects about the parts, and, if the incrustation be not disturbed, will generate a foul ichorous sore: lameness, of course, must result from this, as soon as stiffness or pain is felt in flexing the limb. When the bend of the knee is its seat, grooms call it the *mallenders;* but, should the front of the hock become thus affected, it is the *sallenders.* Almost all our treatises on farriery contain some *specific* recipe for it. Nothing more is required to be done, however, than to cleanse the part from the scurf or scab that may infest it, by soaking it in hot water; and afterwards correct any morbid disposition the skin may have contracted to emit matter, differing in quantity or quality from its natural secretion, by anointing the parts daily with some astringent ointment—such as will, at the same time, render the skin soft and supple.

Heel. The skin of the heel of the horse, imitating the structure of the axilla of the human subject, possesses very many of these glandular pores; through which oozes an unctuous secretion, having a peculiar odour, and this it is that gives the well-known softness, suppleness, and greasy feel to the part. An unusual flow of this matter, somewhat altered in its nature is what gives rise to grease.

Regeneration. The cutis is but slowly regenerated, appearing to be so at no little expense to the animal economy; at least Nature never fails to make the old go as far as possible by extension, before the formation of new is commenced: in the cicatrization of a large wound, for example, the old skin first contracts from all sides to its utmost, in order to leave as little space as possible to be covered by new. And not only is it with difficulty reproduced, but its living powers are weaker when formed than the old; for, though it appears to be very vascular at first, its vessels, after a time, either shrink in caliber, or some of them become obliterated: hence it is that horses who have once had exulcerated backs from saddle-galls or fistulæ are always more disposed to subsequent injury in those places which are commonly marked with patches of white hair. With regard to the actual formation of cutis, it has been said, that "nothing but skin can produce skin." I am much mistaken, however, if I have not seen, in the human subject as well as in horses, cutis forming upon the granulations, in the very *middle* of a sore; which, by fresh depositions upon every side, has met and coalesced with that growing from the old, and thus considerably shortened the term of cicatrization.

Cuticle.

THE CUTICLE, epidermis, or scarf-skin, is a thin, tough, inorganic membrane, serving as an envelope to the true skin. In the living animal it may be demonstrated by the application of a blister: serum is effused from the exhalents of the cutis, and the cuticle becomes elevated by it into little hemispherical bladders, *vesicles* or *blisters*, through the transparent *cuticular* sides of which the straw colour of the fluid is made perfectly evident. Boiling water will destroy its adhesion to the cutis, both in the living and the dead subject: in the latter they may also be separated by putrefaction, or by long maceration.

Composition. The cuticle appears to be composed of very attenuated flexible scales, so disposed as to bear an analogy to the scales of fish, which, in fact, are nothing more than their cuticular coverings: this squamous structure is best seen by viewing through a magnifying glass a piece of cuticle that has been recently peeled off a putrid surface; it is likewise demonstrable in some stages of mange, in which it becomes hard and dry, turns white, and desquamates in successive laminæ.

Colour. The colour of the cuticle is the same in all horses, be they black or grey, chestnut or bay: although the surface of the skin appears (when the hair is shorn off) to correspond in hue with the colour of the hair, the infiltration of serum from a blister underneath the cuticle shows that this appearance is deceptive.

Extent. In most parts of the body the cuticle is thickly clad with hair; but there are places (which were pointed out before) where we find it nearly or quite bare. Every part of the cutis is covered by cuticle; and it not only insinuates itself into perspiratory pores and follicular passages, but lines to a considerable extent some of the outlets of the body. Cuticle passes into the mouth and pharynx, and therein becomes continuous with the membrane covering those parts; it likewise may be traced into the anus, and, indeed, some have imagined, through the entire alimentary canal. The nature of the parts, however, by no means bears such a character: although we must acknowledge, that, so indetectible is the line of termination or separation, we are unable to say precisely where the skin ends and the membrane begins. It may, demonstrably, be traced into the meatus auditorius externus. Bichat, indeed, is of opinion that not only the cuticle, but the cutis also, lines these cavities in man. "All authors," says he, "have admitted an epidermis upon mucous membranes. But it would appear that most of them believed that only this part of the skin entered the cavities and lined them. Haller, in particular, is of this way of thinking. But a slight inspection will suffice to remark, that here, as upon the true skin, it forms but a superficial covering to the papillary surface and to the corion. Boiling water, which detaches it from the palate, tongue, and pharynx even, exposes to naked view the *two other strata* of skin."*

Pores. The cuticle is everywhere pierced with holes, corresponding in size, situation, and number, to those of the cutis. First, there are the pores for the hairs; secondly, the perspiratory or exhalent pores; thirdly, the absorbent or inhalent pores; and, fourthly, pores of a larger size, through which unctuous secretions, in various parts, are emitted.

Production. At one time it was believed that the cuticle was formed out of the crystallization of a fluid effused from the surface of the cutis: but the simple fact of the fœtus in utero (wherein it is surrounded by liquid) having a cuticle, is a refutation of this opinion. That it is, however, a deposition or *secretion* from the cutis, the same as the hoof is from the sensitive parts of the foot, seems not to admit of a doubt; and yet in what manner the process of production is carried on, no one has yet been able to discover. For every practical purpose, probably it is enough for us to know, that, if from any cause the cutis vera be denuded, the cuticle will be speedily reproduced; from which we may conclude that its formation is a process neither difficult nor expensive to the animal economy. It is destitute both of nerves and vessels.*

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* 'Anatomie Générale,' tom. iv, p. 469.

Sensibility. Being semi-transparent, colour, as has been observed, is imparted to it by the subjacent skin; and by parity of reasoning we must account for its assumed sensibility: for, in reality, the sensitiveness it appears to possess is solely attributable to its intimate connection with the highly sensitive cutis underneath : the animal feels through it and the hair somewhat in the manner which we do through a thin furred glove. Those parts therefore where the cuticle is thinnest, are, *cæteris paribus*, the most susceptible of impressions: the lips and nose of the horse instance this ; and, in us, the extremities of the fingers, in which the *proper* sense of feeling is known to reside. That the cuticle itself has no sensation whatever, the simple cutting of a corn in man is a sufficient attestation of. Herein may be said, therefore, to consist the chief *use* of the cuticle—to protect the cutis from immediate contact with foreign bodies or agents, and to moderate its extreme sensibility.

Density. The cuticle does not vary a great deal in thickness in the horse; but in the human subject, in the palms and soles, its substance far exceeds that of any other part: indeed, in the latter, it is very apt to grow *morbidly* thick in places, the effect of external pressure, and this is the nature of what is called a *corn*—a very different disease from what has been absurdly so named in the horse's foot. The only approach to a corn that we meet with, are those horny or cuticular exuberances growing upon the inner parts of the arms; these, however, cannot be viewed as morbid excrescences, since they are unexceptionably present in horses, as well as in asses and mules.

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* "It has no perceivable circulation. The exhalents and absorbents that traverse it, do not belong to it. No morbid appearance that argues organic sensibility happens in it. It does not inflame; it is passive in all cutaneous affections, and never participates of them, notwithstanding its continuity. Corns (in the H. S.) and other excrescences from it, are inert, dry like it, and without vascularity: they are only painful in consequence of the pressure they give to the nerves underneath, and not of themselves. No pain is ever felt in the cuticle; it is worn by friction, like other inorganic bodies, and, like them, is afterwards reproduced."

"From all this, its life is extremely obscure; I doubt even that it really has life. I feel inclined to consider it as a semi-organic body, nay, even inorganic, that nature has interposed between foreign agents and the truly organized cutis, as a medium of intercourse and gradation."—BICHAT; '*Anatomie Générale*,' tom. iv.

Rete Mucosum.

The *rete vel corpus mucosum* consists of a fine, delicate, laminated tissue, interposed between the cuticle and cutis, and serving as their connecting medium; so that the two parts I have been describing are, in fact, nowhere in contact with each other. It is to this substance that the skin owes its colour; in proof of which, as was observed but now, if either the cutis or cuticle of a *black* horse be examined in its detached state, it will be found to be, in itself, colourless. Again, the cutis vera of the Negro is as white as that of the European; the only difference in their skins consisting in the colour of the rete mucosum, which in the latter is black.

Composition. This part is with difficulty demonstrable in a separate state from the others. We may detach it by putrefaction from the cuticle, but we succeed only with great pains in stripping it from the cutis, and this is best attempted by maceration in hot water: the skin of a black horse, and a part bare of hair, should be selected for the purpose. It is (as its name implies) a viscous mucilaginous matter, clothing the delicate vessels and nerves of the cutis in their way to the surface, and appearing to afford them some protection from outward impressions, and to assist in preserving their integrity of structure. It has been compared to the pigment of the eye; and, as far as their general *appearance* is the ground of analogy, certainly not without reason.

Colour. In most animals there appears to be a general relation in colour between the skin, the hair, and the eyes. In black horses we invariably find the skin black, and the eyes dark-coloured; on the contrary, in the milk-white and cream-coloured breeds, the skin is white or colourless, and the eyes red or ferrity. In brown, bay, and chestnut horses, the rete mucosum participates of the colour of the coat; in pieballs, skewballs, &c. it varies its hue in places with the change in colour of the hair. The Negro has black hair and black eyes; the Mulatto, black hair and dark eyes; the Albino (in whom by some this substance is thought to be wanting) light hair and red eyes.

Regeneration. This part, when destroyed, as it occasionally is by abrasion or ulceration, appears to be with difficulty regenerated: some say that it never is. We know that after broken knees, white hairs are frequently seen upon new skin; but, in the course of time (unless the part go bare), it generally becomes covered by hair of an uniform colour with the coat: this inclines me to think that the rete mucosum is reproduced. Again, new skin in the Negro is at first red—from its blood: still, in the course of time the cicatrix assumes a dark hue, and I believe, in almost every instance, ultimately acquires a black tinge.

Of the Hair.

The hair is the covering Nature has provided for the skin of animals to protect it from cold, heat, and external injury: it is to be regarded as their *clothes*, being in general suited both in quantity and quality to the temperature of the climate they inhabit. The cutaneous surface in man, being for the most part but thinly furnished with hair, possesses a degree of sensibility, and of relation to surrounding agents, which that of a quadruped is excluded from; and in this respect, says Bichat, whose sentiments these are, life is less active in the latter. In animals, the functions of reproduction and digestion constitute the principal if not the only sources of pleasure.*

Quality. The horse is clad with hair of two kinds or qualities: the one is that fine soft material which clothes the body generally, and which we expressively distinguish by the term *coat;* the other, vulgarly known as *horse-hair,* is of a coarser and stronger nature, is confined to particular parts, and appears to have been added rather for the purposes of ornament and defence than those of vesture and interception. The mane, for instance, forms a shield to the neck in combat, and for this reason is more luxuriant in the male than in the female: it is likewise (as well as the foretop, which is a continuation of it) an ornament.† The tail is not only a handsome appendage, but it in some measure supplies the deficiency of hands, in switching off insects and other irritants within its reach. The tufts of hair sprouting from the fetlocks, defend those parts from contusion when forcibly depressed in action, and serve, at the same time, as a protection to the heels. The long bristly hairs standing erect from the muzzle and eyelids, are so many tangents of communication with the delicate organs of feeling into which they are implanted.

Thickness. The coat itself is not of an uniform thickness or consistence in all parts. Upon the sides, the back, loins, and quarters, and upon the shoulders and arms, it is thick and abundant; but upon the inner parts of the thighs, and under the arms, it is thin and scanty. Upon the genitals, udder, and anus, around the lips, and at the entrance of the auditory canal, it is so soft and fine, that it assumes the nature of down. It is longest and most luxuriant about the throttle, and within the ears; it is coarsest and most capable of resistance upon the legs. Rarely, and only in certain climates, are seen horses whose skins are hairless; at least, they have no other pilous covering than a light down, and that only perceptible on close inspection.* Dogs of this description are not so uncommon.

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* 'Anatomie Générale,' tom. iv, p. 496.

† A singular variety in the production of mane presents itself in a bay gelding, belonging to the Artillery. Out of the *back*, posterior to the part covered by the saddle, is growing, for the space of three inches, a row of horse-hairs, precisely similar in colour and quality to the mane (to wit, *black*), several of which exceed four inches in length.

Direction. The hair, generally speaking, takes an oblique direction, either backwards, or downwards, from a medium line that would cut the body into equal halves: in parts possessed of much motion—as the throttle, axilla, flank, and bend of the knee and hock—it is rough, elevated, and irregular in its course. Now and then we meet with a horse in whom the coat is everywhere frizzled or curled.

Structure. Whatever may be the apparent nature of the hair in various animals, it does not seem materially to differ in the most remarkable circumstances connected with its structure. A hair may be said to be composed of three parts; the *bulb*, the *root*, and the *stem*. The bulb consists of a transparent membranous canal, of a cylindrical figure, perforated at either extremity, that has its origin in the adipose and cellular tissue underneath the skin, is received into one of the areolæ or large pores of the cutis, and terminates under the cuticle. The aperture through the base is filled by a little conical papilla, from its softness, denominated the *pulp* of the hair, from which issues the root, or the tender unhardened part of the stem, shooting up through the bulb: which appearances have led anatomists to regard the stem as a secretion from the pulp. In the whiskers and bristles of large animals, nerves as well as blood-vessels have been traced into the bulb: to the latter we may assign the production of an unctuous matter that anoints the stem, and gives that sleekness and glossiness to the coat so remarkable in the Arabian horse and his race; a deficiency of which appears to be the prevailing cause of the dry and stubborn coat of a horse out of health, or of one that has suffered from exposure to cold. The stem, as soon as it has emerged from the bulb, is said to receive, in piercing the epidermis, a coating from it; but, if it does so, friction soon destroys it, for I have never been able myself to obtain any distinct demonstration of such a tunic. Bichat, indeed, denies its existence altogether. Those who have subjected large quantities of hair to chemical analysis have found its composition to be very similar to that of horn or cuticle; but it has been a matter of dispute whether the stem is formed of a single case, or whether it consists of filaments including two or more canals in their interstices: from the observations of those who have most extensively and minutely inquired into this part of comparative anatomy, it would appear that bristles, and what is called horse-hair, are filamentous, but that the finer hairs are simply tubular. From the summit of the pulp proceeds an elongation of soft matter into the cavity of the stem, which, from its outward resemblance to it, by many is regarded as a process or continuation of the pulp itself; but Bichat avers, that it is a distinct substance, and, though he acknowledges his ignorance of the true organization of it, maintains that it is a vital part, and that it is the seat of the *colouring* principle of the hair. For my own part, whatever may be the nature of this particular substance, I am inclined to agree with the learned writer of the article "Hair," in Rees's Cyclopædia, "that the colouring matter pervades the horny tube of the hair, to which it communicates an uniform stain or dye, in the same manner as the substance of a horn or hoof is coloured."

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* Mr. Sewell, in the course of his visit to the continental Veterinary Schools, met with, at that of Berlin, a preparation of "the stuffed skin of an African horse, *which had not the slightest appearance of a single hair upon it.*" "It is of a dun colour, and is no doubt a particular genus," he adds.—In consequence of the skin being in a dried state, I suspect that the down upon it had become imperceptible; for I apprehend that the surface of it was not perfectly *bare* during life.—*Mr. Sewell's 'Report.'*

Identity. All hair has a common similarity in its structure and mode of growth; whether it assume the nature of human hair, that of the coat or mane of the horse, the wool of the sheep, the fur of the rabbit, the bristles of the hog, or the spines of the hedgehog: its particular varieties in every one of these animals being owing simply to the quality and disposition of the fibres of its cuticular case. The coat varies in quality, colour, and length, in horses of various breeds: the Arabian, the racer of this country, is characterised by his smooth, silken, and glossy coat; the cart-horse, the Shetland pony, and the northern horses in general, are contradistinguished by the greater length and consequent roughness, the coarseness, and stubbornness of their hair.

Colour. With regard to colour, I have already had occasion to remark, that there is some connection between that of the skin, the hair, and the eyes: black horses have black skins and dark eyes: milk-white and cream coloured horses, light skins and wall eyes. The three primitive colours, those of which all the other appear to be either shades or combinations are *white*, *red*, and *black*. According to Richerand, the lighter the shade the finer the hair; as a proof of which, he says, there are fewest black hairs in a square inch of skin, more chestnut, and most light coloured. This assertion, our own observation appears to confirm: since it is comparatively rare to meet with a black thorough-bred horse, though it is a very prevalent colour among cart-horses; and the glossy silken coat for which the former is so much admired is in none more conspicuous than in those that are light-coloured.

Shedding. Most animals, I believe, at certain seasons of the year, lose one pilous covering, to have it renewed, or replaced by another. The pulpy substance at the root of the hair shrinks and dries up, the stem, consequently no longer supplied with nourishment, losing its support, decays and falls off; at the same time, a new pulp appears by the side of the old one, which, during the absorption of the latter, grows and gives root to a new hair: so that the pulp and stem only, and not the bulb, undergo the process of regeneration. The coat of the horse is shed twice during the year—in spring and autumn: a phenomenon exhibited with great regularity so long as the animal remains in his native fields; but as soon as he is domesticated, this process is influenced by many circumstances connected with his stable management; though by none more, perhaps, than the *temperature* of the stable. That which comes under the denomination of *horse-hair*—the main and tail, and the long hairs about the fetlocks, muzzle, eyelids, &c., is never shed; hence it grows to an extreme length. One of the most striking phenomena in the natural history of quadrupeds is, that in deer, not only the hair but the horns are deciduous. In the spring, the antlers of the stag, but lately so strong and formidable, become soft, and are cast off altogether, leaving him in a comparatively defenceless state: in the course of the ensuing summer, however, new horns spring up in their places, which, before the commencement of autumn, crown the animal again with his noble weapons, and give him his wonted majestic mien, preparatory to the season of copulation, which is now at hand. And now, his horns being fully regenerate and fit for the purposes of combat, with ungovernable sensuality he wanders forth in search of the female, whose possession should another dispute with him, he will by terrible conflicts strive to obtain and secure.

Reproduction. The hair is speedily reproduced upon any denuded part, so that we are not afraid of the skin remaining bald so long as the *cutis* (and consequently the bulbs of the hair) remain uninjured: indeed, hair will be regenerated even after it has been plucked out by the roots. In the case of broken knee, when it happens that the contusion is attended with destruction or disorganization of the cutis, a scar or bald place must result;

should a few white hairs make their appearance, we may conclude they are the offspring of the injured (not totally destroyed) pulps.

Of Cellular Membrane.

Cellular membrane is the material employed in uniting, covering, and defending parts; as well being of itself, under various modifications, a very general component substance. The *membranes* (both serous and mucous) are resolvable entirely into cellular membrane. *Periosteum* appears to be nothing more than a modification of it under a condensed form; and from the periosteum (and not from the muscles, as was formerly supposed) are derived the *tendons*. Another derivation from this same source are the *capsules of joints*: they only differ in being thicker in substance, and in as far as they are added to and strengthened by surrounding parts. The *faschiæ* are composed exclusively of cellular membrane; and from them appears to be derived the cellular substance we find in the composition of the muscles. *Bursæ mucosæ* are likewise cellular membrane: indeed, they are much the same as the capsules of joints, containing a similar fluid. Even the *animal matter of bones* themselves appears to be mainly, if not entirely, cellular membrane. So that cellular membrane may truly be said to be a general component, as well as the universal connecting medium, of the different structures of the body.

Kinds. There is said to be two "kinds" of cellular membrane in the body: one denominated *reticular;* the other *adipose.* By the "reticular" is meant the *true* cellular membrane, that which is properly so called; by the "adipose," the membrane which contains the fat.

Comparative Quantity. Cellular membrane exists in greatest abundance immediately underneath the skin, binding it down loosely in some places, in others tightly to the subjacent parts. On the ribs, and more especially about the breast, it is abundant and loose in its texture; but upon the belly, and about the head, it is dense, and so short that we can scarcely pinch up the skin, or insert a rowel, though we effect either with the utmost facility in the chest, or underneath the jaw. Although the quantity of this substance depends in some measure on the condition of the animal, it is always plentiful in parts possessed of much motion: hence we find it long and loose in the scrotum (wherein it invests the testicles), on the inside of the elbow and thigh, and underneath the jaw.

Texture. Cellular membrane is made up of fibres, interwoven and disposed in such a manner as to form innumerable cells or small cavities: and this it was that first gave rise to the name of *cellular* membrane. These cells have a free communication with each other; a fact demonstrated by occurrences of the most common and familiar kind: who has ever seen the carcass of a calf inflated by a butcher, in order to give the veal a fatter and whiter aspect, will need no farther proof. There are many phenomena, however, connected with disease, that verify the same thing: in *emphysema* (which is a swelling of the skin in consequence of the admission of air through a wound communicating with the cells of this membrane), the air very commonly diffuses itself over the whole body; and a wound in the chest, or one at the point of the elbow, is the most likely of any to be followed by such consequences. Again in *anasarca* (which is an effusion of water into this substance), or in *ecchymosis* (an extravasation of blood into it), the fluids invariably, after a time, occupy the most depending parts: hence the tumefaction of the legs, breast, belly, and sheath, in the first of these diseases, beyond that of any other parts.

Exhalation. Into the cells of this membrane, during life, is poured forth a serous fluid, in the form of vapour, by the exhalent extremities of the arteries; from the exhalation of which that peculiar odour so constantly perceived in flaying an animal recently dead is emitted.

Modification. In addition to the modified forms of this membrane already noticed, one yet remains to be mentioned. In most structures it is opaque, but there is one part where its texture is so very fine and delicate, that it is perfectly transparent: it is the *tunica vitrea* in the eye, through which the rays of light pass without the slightest interception.

Elasticity. The cells of this membrane possess a degree of elasticity. If, for instance, we include a portion of skin between our finger and thumb, it will suddenly recoil on being liberated, and recover its original situation; a circumstance in part attributable to the elastic property of the subjacent cellular membrane.

Organization. The cellular membrane is not very vascular: the blood-vessels found ramifying within it being chiefly distributed to other and neighbouring parts; so that whenever violent inflammation is excited in it, sloughs of it not uncommonly take place. This happens when we introduce any caustic under the skin; the core which comes out being chiefly dead cellular membrane. Absorbents would seem to exist in great numbers in it; for if we but extravasate quicksilver under the skin, in some parts of the body, it will find its way through the cells of the cellular membrane into many of these vessels.

Although a part not apparently excitable, in a healthy condition, by either mechanical or chemical stimuli, and although no nerves are traceable into it, yet does it appear to possess some degree of sensibility, which becomes more manifest under disease; since the simple introduction of a probe into the cavity of an abscess evidently occasions pain.

Of Fat.

Adeps or fat is a concrete oily matter deposited in various parts of the body, apparently more for physical purposes than any important end it can answer in the animal economy. It is contained in a cellular membrane, which only differs from the ordinary kind (the one just described) in its cells being so many little circumscribed or independent cavities (*culs-de-sac*), by which sage contrivance the fat (which in the living body is a liquid) is prevented from gravitating and collecting about any particular parts. It is this membrane that constitutes the residue (or *skin*, as it is called) after the fat is melted down by the tallow-chandler.

Fat exhibits differences not only in different animals, but in different parts of the same species. In some parts of the body it is white; in others it has a yellowish cast. In general it possesses but little taste or smell: both, however, grow stronger as the animal advances in years. In the living body it exists in the liquid form, and in carnivorous animals it retains much of its oily nature after death: but in graminivorous beasts it concretes, on exposure to air, into the white solid substance best known by the name of fat. About the kidneys, particularly in fat animals, adeps is always found deposited in abundance; assuming here a whiter aspect and a firmer consistence than in other places, for which reason it is commonly called *suet*. In many parts of the body there is little or no fat; and when we come to reflect on the nature of their functions, we shall discover that its presence must have proved inconvenient to them: the eyelids, for instance, had they been loaded with fat, could not have moved as they now do: nor could the penis, so constructed, have answered the purposes for which it was designed. Young animals have more fat than old, and have it deposited more upon the superficial parts of their body; in fact, the young of many of the higher animals are enveloped in fat: of this, remarkable examples are found in the infant, the puppy and the kitten. But it is not so with the foal, the calf, and some few others, which immediately after birth have the power of following their dams, in search after food: fat to them would have proved burdensome, without answering the same useful purposes for which

Nature seems to have given it to the young of most other animals. We frequently see very fat young horses; indeed, most of the horses three and four years old, purchased of dealers, or of the breeders, have considerable depositions of fat between the skin and abdominal muscles; or, to express ourselves in the jockey's phrase, are "fat upon the rib." The prodigious bulk that beasts, fed for the purpose, will attain, is almost incredible: a prize ox has weighed two hundred stone;* and a prize sheep, forty stone.* In the human subject, also, we have had astonishing instances of corpulence: Lambert weighed fifty-two stone.† In respect of the latter, it has been remarked, that fat people do not, in general, live to a great age.

Production. As the cells of the cellular membrane are filled with serous exhalation, so in like manner do we conceive those of the adipose to be with fat: we have no anatomical proof of the existence of any distinct gland for the purpose, but we suppose it to be a secretion from the arterial ramifications distributed over the interior of the cells.

Deposition. In almost all animals that are healthy, copious food of a nutritive kind, combined with little labour will increase the deposition of fat; but in the human subject, and, indeed, in many quadrupeds, the animal spirits appear to have a very considerable influence over this secretion. We see numberless examples of people, who appear to enjoy the best bodily health, and yet are constantly meagre, though their food and habits of life tend to an opposite state; and we may occasionally observe horses and dogs, particularly circumstanced, in which, from their natural leanness, or *poorness upon the rib,* something of a mental nature would appear to be operating; indeed, it is a well-known truth, that if you separate a horse of an irritable disposition from others with whom he is accustomed to be stalled, he will fall away in condition, in consequence of .(to use the vulgar expression) *fretting from being alone;* and so much does this act of segregation affect some, that I have known them even refuse their food. Those horses are commonly the fattest that are fed on easily digestible food—such as bruised or scalded corn, roots of a nutritive kind, chopped hay, &c., and that have little or no exercise: a fact well appreciated by the horse-dealer, whose horses are *fine* and *fit for sale,* but incapable of fatigue.

Absorption. Constitutional diseases, generally speaking, extenuate the body, and more particularly such as are of the acute or painful description; hence, the irritation caused by a simple puncture in the foot, will, if it be of long duration, induce a state of emaciation: under which circumstances, the absorbents are supposed to act with more than ordinary effect, and to take up the adeps from the interior of its cells.

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* A stone is 8 lb.

† Horseman's weight, 14 lb. to the stone.

SECTION XII.

PLANTAR SYSTEM.

COMPRISING THE FOUR FEET.

OF THE FOOT.

THE foot is the part upon which the animal stands; with which he treads the ground; and by which his body is supported. Of his whole structure it constitutes the basis.

Number. Animals exhibit differences in the number of their feet, and accordingly have been distributed into classes, consisting of *bipeds, quadrupeds,* and *multipedes.* Bipeds include men and birds. Quadrupeds comprehend most of the land animals. Multipedes embrace insects. The *reptile genus,* such as serpents, &c., being without feet.

Toes or Claws. Another classification of animals has been formed from the number of toes or claws their feet are cleft or divided into. Those possessing but one toe, and consequently an undivided foot, come into the class of *monodactyles, solipedes,* or *solidungulous animals;* they are the horse, the ass, and the mule. The *didactyles,* or two-toed class, embrace the ruminants—oxen, sheep, and goats. The *tetradactyles,* or four-toed, include the dog, the cat, and the hog.

Division. Founded upon the obvious and important differences existing between the external and internal composition of the foot, a division has been made of its parts into those that are *sensible* or *sensitive,* and those that are *insensible* or *insensitive.* A more suitable phraseology would have been found in the terms *organic* and *inorganic;* since of the parts they are meant to distinguish, one possesses neither nerves, nor blood-vessels, nor absorbent vessels; while the others are furnished with all these attributes of organization.

The external parts of the foot consist entirely of horn, and from such composition have, collectively, got the name of *hoof.*

The internal parts consist of bones, ligaments, and tendons, besides structures *peculiar* to the foot.

OF THE EXTERNAL PARTS.

The Hoof.

The hoof is the horny case or covering Nature has provided for the protection of the sensitive parts of the foot. It may be said of itself to constitute such a shoe or defence, as enables the animal in his wild state to travel about in quest of food, not only without injury to the structures underneath it, but with a degree of elasticity that preserves his whole frame from concussion. Were one forced into any comparison of the sort, it must be admitted that the hoofs of animals bear some anatomical affinity to the human nails, or claws of other animals; though they are vastly superior in physiological importance to any such appendages as these.

Form. Sainbel viewed the foot as "the segment of an oval, opened at the back, and nearly round in front." To a common observer, the hoof exhibits a conoid form; the part resting upon the ground being the basis; the vacuity above, the obtruncated apex. Mr. Bracy Clark asserts that this view is incorrect, and that the general figure of the hoof is a *cylinder*, very obliquely truncated upon its ground surface. This he demonstrates in two ways; either by rolling up a piece of paper into the shape of a cylinder, and afterwards cutting one of its ends in a very slanting direction; or by taking a carpenter's square, and placing one limb beneath the foot across the quarters, then sloping the other backward, against the side of the quarters, parallel to the front, when the edge of the iron will be found parallel to the wall of the hoof. This corrected view of its figure will serve to account for the general equiformity manifest in the hoof, and also for the undeviating correspondence found to exist between its slope or slant, as well in front as behind, which in an ordinary or healthy foot may be estimated at an angle of 45°. Around the coronet, where the hoof unites with the skin, the cylinder is cut directly across its perpendicular—at right angles with it: it is the oblique truncation of its ground-surface that occasions the slant, which latter we may consequently increase at pleasure by any means that augment the former, viz. by lowering the heels; by cutting away a prominent frog; or by putting on thin-heeled shoes. At the same time that we increase the slant of the hoof, we increase the obliquity of the pasterns, and likewise proportionately augment the ground-surface of the hoof, from heel to toe, the breadth remaining unaltered; and in the same ratio, consequently, extend the surface of tread.*

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* For further elucidation on the cylindrical form of the foot, consult Mr. Bracy Clark's works on the Foot of the Horse.

Spread. By the *spread*, is meant the inclination the hoof manifests when left unshod, around the toe and sides, to bulge, or protrude at bottom, whereby its ground-surface becomes augmented, particularly around the outer quarter. To a certain extent this is worthy of observation; although, in my opinion, it is to be regarded rather as an effect of *pressure* than one of abstract growth. The surface of inclination upon which the horn is produced has no such spread, nor can the hoof itself be said, *from growth alone*, to have any such *natural* tendency; but, as it continues to grow and shoot beyond the inner foot that produced it, and to which it was so intimately united, it yields to the pressure of the animal's weight, and bulges or spreads out, and more at the outer side than the inner, in consequence of the pressure tending more in that direction. If we examine a number of hoofs of neglected growth, and consequent exuberance and deformity, of various descriptions, we may discover that, in them all, the spread seems to have been the first or *incipient* deviation from that line of growth viewed as consistent with the health and well-doing of the foot. It is only in the unshod hoof that any spread is found: as soon as the ground-surface comes to be confined by a shoe, pressure can no longer exert its influence to produce such consequences.

Mr. Goodwin aptly observes, that "to take the form of the hoof correctly, we must strip it of its exuberant or superfluous parts, the same as one would pare the superabundant growth off our own nails. The neglect of this necessary preparative has led to considerable difference of opinion about the natural, healthy, or true form of the ground-surface of the foot. Mr. Bracy Clark, I conceive, has inclined to the side of error in this particular; though, in the substitution of the cylindrical for the conical figure of the entire hoof, he has certainly the advantage of other writers. His natural foot (*Plate* 1) is one with *great spread* to it, much of which the smith would find it necessary to deprive it of, *even on the first shoeing;* and the protuberance of the outer quarter (which Mr. C. points out as an attribute of health) being *wholly owing to the spread*, will, of course, disappear with the annihilation of the spread."*

Although Mr. Goodwin has not here explained what he conceives to be the origin or cause of the spread, it is evident we both concur in viewing it rather as a *deviation* from health or nature than a circumstance worthy of the consideration it has been accounted of by Mr. Clark.

Colour. Hoofs are black or white, or some intermediate shade, or they may exhibit a black and white striped or marbly aspect. It is an old observation, and one that passes current among us at the present day, that black or dark-shaded hoofs possess greater strength and durability, and indicate less proneness in the feet to disease, than such as are composed of white or striped horn. The rationale of which appears to be, that white horn (the same as white hair) is the product of parts weaker by nature than such as produce dark or black horn, and, being weaker, consequently are more liable to disease, less able to resist those impressions that tend to disorder. White hoofs are more porous than black ones, and consequently absorb moisture and lose it again by evaporation with more facility: a fact that may probably aid us in accounting for the failures attributed to them.

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* Goodwin's 'New System of Shoeing,' edit. second, p. 33.

Magnitude. It requires no veterinary skill to discover any very material disproportion in the magnitude of the foot: it will strike us at once as being *large* or *small,* in comparison to the limb or the size of the animal. A foot of any description that is out of proportion is to the horse possessing it more or less objectionable: but for all that, these out-of-proportion feet, abstractedly considered, have their advantages as well as their disadvantages. Sainbel tells us, that a large wide hoof, by extending the surface of tread, "will increase the stability and firmness of the fabric;" but then, he adds, "this partial advantage grows into an evil when it becomes applied to a body capable of translation, and considered in a state of actual motion; because, then, the mass and weight of the foot overburthen the muscles of the extremity." And because, I would add, the surfaces of contact being greater, the attraction of cohesion becomes greater, and so much the more muscular force is required to raise the foot (particularly in moist ground) from the earth. Besides which, a large foot is apt to become objectionable from its striking, during action, the opposite leg. On the other hand, it is contended, that a large foot will not sink so deep into soft ground as a small one, and consequently will not demand so great an effort of strength to draw it out. This is an argument, however, that can only hold good under the supposition, that in both cases the muscular strength is equal, which we know but rarely to happen; in general, broad or flat-footed horses possessing superior strength; small narrow-footed ones, superior speed. There cannot be a doubt about a large foot being unfavourable for speed; a small one for stability: neither one nor the other can be indiscriminately found fault with; both within certain limits possess their respective advantages; though to turn out as such, they each of them require to be combined with suitable conformation and action.

Large bulky hoofs are found to be mechanically weaker than others, in consequence of being composed of a thin, soft, porous description of horn. Sainbel ascribes all this to "a relaxation of the fibres composing the hoof: in which case, the diameters of the vessels are increased, the porosities are multiplied, and the fluids abound in them in too great quantities; consequently this kind of foot is soft, tender, and sensible." Small feet, on the contrary, in general possess a close woven horn, thick in substance, and consequently prove strong: they are rather oval than circular in figure, with great depth of substance, and are found to be of a durable nature. "In feet of this description," says Sainbel, "from the too close union and too close tension of their fibres, the vessels destined to conduct the nutritious fluid are contracted and obliterated; whence proceeds that dryness of the part which renders the horn brittle and liable to split."*

Division. To the common observer the hoof appears to consist of one entire or indivisible case; but the anatomist finds, by subjecting it to maceration, or coction, or even to putrefaction, that it resolves itself into three separate pieces: still, so long as the hoof maintains its integrity, such is the force of cohesion existing between these three parts, that we as easily rend it in any other place as dissever one of its jointures. These constituent parts are the *wall*, the *sole*, and the *frog*.

The Wall.

The wall or crust is the part of the hoof which is visible while the foot stands upon the ground. It forms a circular boundary wall or fence inclosing the internal structures. On taking up the foot, we find the wall prominent all round beyond the other parts, making the first impression upon the ground, and evidently taking the largest share of bearing. It is the part to which the shoe is nailed. It is, in fact, the most important division of the hoof; appearing to form (in the words of Mr. Clark) "the basis or first principle in the mechanism of the hoof, the other parts being all subordinate to this."

Situation and Relations. The wall takes its beginning at the coronet, from the terminating circular border of the skin, with which it is intimately united; their line of union being concealed by a row of overhanging hairs. From the coronet the wall descends in an oblique direction to the bottom of the foot, where it embraces the sole, and terminates in a circular projecting border. The anterior and lateral parts of the hoof are formed entirely by the wall; but at the posterior part, instead of the heels of the wall being continued one into the other so as to complete the circle, they become inflected, first downward, afterwards forward and inward, and are elongated in the latter direction until they reach the centre of the bottom of the foot, where they terminate: these inflections or processes of the wall constitute the *bars*. Altogether, the wall may be said to form about two thirds of the entire hoof.

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* Sainbel's 'Lectures on the Elements of Farriery.'

Connection. Superiorly, around the coronet, the wall is united with the skin; inferiorly, within its circumferent border, with the sole; posteriorly, between its heels, with the heels of the frog; inferiorly, between the bars, with the sides of the frog; and internally, with the sensitive laminæ. Let us now consider the wall in its detached or separate state.

Figure. That of a hollow cylinder, having the side presented to the ground cut much aslant, and whose circle exhibits a *hiatus* or deficiency behind, from the lateral boundaries of which issue two narrow processes or appendages. Taking a lateral view, the wall assumes a conical shape, being broad and deep in front, and gradually narrowing as it stretches backward.

Division. For facility of reference, and in aid of our descriptions, we distinguish in the wall, First, the *toe;* secondly, the *quarters;* thirdly, the *heels;* fourthly, the *superior* or *coronary border;* fifthly, the *inferior* or *solar border;* sixthly, the *laminæ* or *lamellæ;* lastly, the *bars* or *appendages.*

THE TOE forms the bow or front of the hoof, and comprehends about two thirds of the superficies of the wall. It is the deepest, broadest, and thickest part of the wall; for reasons that will appear hereafter. It exhibits a degree of slant about equal, naturally, to an angle of forty-five degrees: though there are variations from this which (as was explained before) will be found, in a measure, to be dependent upon the oblique truncation of the cylinder. When we come to understand the physiology of this part, however, a more operative and efficient cause for this variation will be found in the weight the wall has to sustain, and in its own mechanical strength or force of resistance: on which principle it is that light horses, thorough-breds, and poneys, as well as mules and asses, have *upright* or *strong feet* (i. e.) walls but moderately sloped: whereas heavy horses, cart-horses, and coach-horses, have commonly *flat* or *weak feet* (i. e.), walls that slant immoderately. And (as was before observed) upon the degree of obliquity of the wall must very much depend that of the pasterns. In estimating the slant or slope of the wall, it is proper to distinguish between that which is consequent on the detruncation of the hoof, and such as is the effect of a burthen under which the wall succumbs. The depth of horn in front of the toe, measuring from the termination of the skin to the most prominent point below (and supposing the hoof to be cut and ready to receive the shoe), may be rated at about three and a half inches. The bow or degree of convexity of the toe in front must depend upon its obliquity as well as upon the circularity of the foot. The thickness of the horn composing the toe may be estimated at three eighths of an inch, or from that to half an inch, and this substance is the same from immediately beneath the coronary circle to the junction of the wall with the sole; at which part there is an accession of horny matter to block up the interstices between the laminæ, and also to fill the angular vacuity that would otherwise exist here between the wall and sole. In the forefeet, the toe is thicker in substance than either the quarters or heels: but (we have it from Sainbel) "in the hind, on the contrary, the heels and quarters are generally thicker than the toe."

THE QUARTERS are the portions of the wall intermediate between the toe and the heels. They are commonly described as standing *upright*, and, according to a carpenter's square set against the wall, so they appear to do; this is not, however, the view the anatomist ought to take of their position: to him the oblique course of their component fibres, together with the slant of their laminæ, demonstrate that they slope in the same manner and degree as the toe does. The quarters do not run in straight lines from before backward, but by their prominence describe gentle curves, the outer making a wider sweep than the inner. This gives the hoof altogether a sort of *twisted* appearance, and makes the inner part of the toe look more projecting than the outer: a deviation that seems principally to have originated in the *spread*, and one, methinks, that has had more attention given it than any consequences attachable to it render it deserving of. The quarters range in depth from two to three inches; and measure in thickness from one fourth to three eighths of an inch.

THE HEELS are the two protuberant portions of the wall by which it is terminated posteriorly. They are the shallowest, and thinnest, and (*in connection*) only flexible parts of the wall. Though their surfaces recede from the perpendicular, they maintain the same slope as the toe and quarters. At their angles of inflection, from which are continued the bars, they form (in conjunction with the heels of the sole) pouches or sockets into which are received the heels of the sensitive foot. In depth they range from one and a half to two inches. In substance they do not exceed a quarter of an inch, the outer heel being rather thicker than the inner.

THE SUPERIOR or CORONARY BORDER, is the circular, attenuated, concavo-convex part entering into the composition of the coronet. Its extent is marked exteriorly by the whitish aspect it exhibits, and also by some partial separation and eversion of the outer flakes of horn around its junction with the wall below. Externally, it assumes the same character as the wall below it; but its internal surface is altogether different. Instead of possessing laminæ, the surface is smooth and uniformly excavated, being moulded to the form of the sensitive coronet, and everywhere presenting numerous pores for the purpose of receiving the secreting *villi*. Superiorly, the coronary border presents two edges, having a groove between them for the reception of the terminating border of the cutis. It is this groove that marks the reception of the coronary border into two parts: the internal edge belonging to the inner part, which is the beginning of the wall itself; the external edge to the white band by which the other is embraced, and to which Mr. Clark has in particular drawn our attention, under the appellation of *Coronary Frog-band*. This covers the proper or veritable coronary border of the hoof; having, through its fibres, which are very fine, a sort of dove-tailed connection with it. As it recedes backward, it grows broader to that degree, that its breadth at length becomes doubled; being about half an inch broad in front, and one inch behind. It is thickest around its middle parts; its inferior edge, like the superior, becoming attenuated, until it grows so fine as to end in imperceptible union with the substance of the wall, giving it its beautifully polished surface: from the heat, however, to which the hoof is artificially exposed, the thin part below the coronet often grows arid, splits from the crust, and becomes everted: turning at the same time, in consequence of dryness, of a whitish complexion. Posteriorly, we find it continued round the heels of the wall and frog, and from thence across the back of the cleft, forming altogether a complete circle, and everywhere showing itself to be the *medium of connection* between the skin and the hoof. It has been already stated that the cutis terminates in a circular border, let into a groove around the summit of the wall: the cuticle, however, does not end here —it is continued down; in fact, we trace it to the horny band we have been describing, the one being continuous in substance with the other. Indeed, the only detectible differences in them are, that one is thicker than the other, and grows hard, and dry, and white, from the effects of heat upon it from without, and the want of moisture from within. This cuticular origin and assimilation may be demonstrated in the putrefied foot; or, better still, in the foot of the fœtus. The band is broader at the heels than elsewhere, in consequence of the greater breadth of exposed cutis at those parts. In its texture it is fibrous, and its fibres pursue the same direction as those of the wall, from which they differ only in being of a finer texture. Mr. Bracy Clark appears to enter-tain some singular notions in regard to the structure, but more particularly the *uses* of this part; which in the respect I bear for their author, I shall consider when the time may arrive for me to treat of the physiology of the foot.

THE INFERIOR or SOLAR BORDER offers but little worthy of observation. It constitutes the ground or wearing surface of the wall, and is the part to which we nail the shoe. It grows thicker and more exuberant around the toe than in other places, and from its projecting beyond the sole, presents a convenient and suitable hold for the nails of the shoe. Around the anterior and lateral parts, it embraces the sole; behind, it joins the bars, which two points of union form two principal bearing places for the shoe. The inferior border possesses a larger circumference than the superior, in consequence of the oblique detruncation of the hoof.

This is a part that requires paring down every time the horse is shod. Such is its exuberating nature, that (like the human nail), were it not continually kept worn down, or broken or cut off, it would elongate very considerably, and gradually turn up, exhibiting forms not only of the most unsightly but even grotesque description, and proving incommodious to a degree to be almost entirely destructive of progression.

THE LAMINÆ (better named *lamellæ*) consist of numerous narrow thin plates or processes, arranged with the nicest order and mathematical precision upon the internal surface of the wall. They extend, in uniform parallels, in a perpendicular direction from the lower edge of the superior border down to the line of junction of the wall with the sole; and are so thickly set, that no part of the superficies remains unoccupied by them. They are likewise continued upon the surfaces of the *bars*. In the recent subject they are found soft, yielding, and elastic; but from exposure they become dry and rigid.

Every lamella exhibits two *edges* and two *surfaces*. By one edge it grows to the wall; the other, which is somewhat attenuated, hangs loose and floating within the cavity of the hoof. The surfaces, which are two lateral, are smooth, and, considering the magnitude of the lamella itself, of enormous extent; so much so that it might be said almost to be constituted entirely of superficies. And this leads us to the contemplation of the great and magnificent design which Nature evidently had in view in their formation, viz., the production of ample surface within a small space, an end that has been obtained through the means of multiplication. Mr. Bracy Clark procured from the late Thos. Evans, LL.D., mathematical teacher of Christ's Hospital, a calculation of what their united superficies amounted to; and it appeared to afford an increase of actual surface more than the simple internal area of the hoof would give of about twelve times, or about 212 square inches, or nearly one square foot and a half.

The lamellæ exhibit no differences but in their dimensions. In length they correspond to the respective depths of the wall; being longest, and likewise broadest, around the toe, and gradually decreasing towards the hinder parts.

In composition, they are horny. Viewed through a microscope, Mr. Clark discovered in their substance two planes of fibres, "the one running in parallel lines to the axis of the hoof, the other obliquely intersecting these." When stretched, they exhibit signs of elasticity; but this appears greater in the transverse than in the perpendicular direction.

By means of its lamellæ, the wall presents a superficies of extraordinary amplitude for the attachment of the coffin-bone. A structure consisting of similarly formed lamellæ envelopes the bone, but these are dovetailed in such a manner with the horny lamellæ, as to complete a union which, for concentrated strength, combining elasticity, may vie with any piece of animal mechanism at present known to us.

THE BARS are processes of the wall, inflected from its heels obliquely across the bottom of the foot. For a long time, by farriers, they were confounded with the substance of the sole, an error that owed its origin and perpetuation to the malpractice they exercised in paring the foot—in cutting both bars and sole down, without any distinction, to a common level. In the natural healthy foot the bars appear, externally, as elongated sharpened prominences, extending from the bases of the heels into the centre of the foot, between the sole and the frog: posteriorly, they are continuous in substance with the wall, with which they form acute angles; anteriorly, they stretch as far as the point of the frog, constituting two *inner* walls or lateral fences between that body and the sole. Sainbel conceives, from their position, that they offer resistance to the contraction of the heels. Their internal surfaces exhibit rows of lamellæ, continued from those lining the wall, but which are here *short*, and in their direction *transverse*, two circumstances referable to the narrowness and inflection of the bar: towards the extremity of the bar they gradually grow shorter, and less distinctly marked, until we at length lose all vestige of any more of them. While the prominence of the bars is such as to give them a secondary bearing upon the ground, their sharpened forms will sink them more or less deeply into every impressible surface.

The Sole.

The sole is the arched plate entering into the formation (as its name implies) of the bottom of the hoof: or, to adopt Sainbel's definition, "it is that part which covers the whole inferior surface of the foot, excepting the frog." It is a very just practical observation of Mr. Coleman's, that although a knowledge of every part of the foot is indispensably necessary to render us scientific overseers of the farrier's art, no individual part requires such undivided attention, as regards shoeing, as the *sole*, since the success of this mechanical operation mainly depends on the paring and defence of this arched horny plate.

Situation and Connection. It fills up the interspaces between the outer and inner walls (or bars) of the crust. I differ in opinion from those who describe it to surround the toe of the frog. I hold its circumferent support and connection to be the wall of the hoof, to which it is firmly cemented by an interstitial horny matter, filling the crevices between the laminæ.

Figure. The circumferent outline of the sole measures about two thirds of a circle, the remaining third being omitted to form a triangular-shaped *hiatus* or opening for the reception of the frog and bars. This circular form, however, is by no means true, or even invariably the same, in its dimensions. Generally, the longitudinal exceeds the transverse diameter. Its greatest diameter is shown by a line extended from either heel across its middle to the opposite point of the toe.

Arch. Commonly, the sole presents an arch of more or less concavity inferiorly, and convexity superiorly. But it is not a regular or uniform arch, being one that rather waves or undulates, so as to bear a comparison, made of it by Mr. Clark, "to the mouth of a bell extremely extended or flattened." Like that of the bell, the arch is highest in the middle, from which it slopes, laterally, down to a flat, subsequently to rise again around its border, in order to present a dilated surface for attachment towards the wall. There is, however, vast variety in the degree of arc of the sole: in some feet it is of surprising depth; in others, the arch is converted into a flattened surface; and yet both seem to perform equally well. In the hind feet the sole is generally more arched than in the fore, and approaches in figure nearer to the oval than the circle.

Division. In the sole we distinguish an *anterior part* or *toe;* a *middle* or *central part;* two *points* or *heels;* and two *surfaces.* These divisions are not very well defined: but they prove serviceable in aid of our descriptions.—THE TOE of the sole is the part encircled by the toe of the wall, against which it abuts, and to which it is intimately united by horny matter, the two together forming a stout bulwark of defence to those parts of the internal foot included between them.—THE POINTS OR HEELS are the two posterior salient angles received into the angular intervals between the outer and inner walls or bars. Although, naturally, the least exposed, these are the parts most subject to injury or pressure from the shoe, being the seat of that disease mistakenly called *corn.*—THE MIDDLE OR CENTRE of the sole is the portion more immediately surrounding the fore parts of the frog, and would (were the sole a regular arch) be the most elevated part; but, in general, we find the sole flattened hereabouts: the highest parts of the arch being the angles alongside of the bars; the lowermost, those around the toe.

Surfaces. Of the surfaces, the superior (as was mentioned before) is unevenly convex; the inferior, correspondingly concave. The former is everywhere pitted, particularly about the heels, with numerous circular pores, running in an oblique direction, the marks of which remain evident upon the inferior surface likewise. These pores are the impressions made in the soft horn by the *villi* of the sensitive sole, from whose orifices the horny matter is produced. They also form the bond of union between the horny and the sensitive soles: which is of a nature so strong and resisting, that it requires the whole strength of a man's arm to effect their separation—an operation of a cruel description that was wont to be practised in times past, under the fallacious notion that "drawing the sole" was extirpating the malady.

Thickness. The natural thickness of the sole may be estimated at about one sixth of an inch. There will be found, however, variations from this standard in different horses; and it will also very much depend on the part selected for measurement. The portion of the sole most elevated from the ground—that which forms a union with the bars—is nearly double the thickness of the central or circumferent parts; and next to this, in substance, comes the heel. I do not find that the sole "grows thinner from the circumference to the centre," as has been stated by an author of celebrity.

The Frog.

The frog is the prominent, triangular, spongy body, occupying the chasm left by the inflection of the bars.

Situation and Connection. The frog is fitted into the interval between the bars; the three, altogether, filling up the vacuity in the sole, and thereby completing the circle, and establishing the solidungulous character of the foot. The frog extends forward, towards the toe, about two thirds of the longitudinal diameter of the ground-surface of the hoof, terminating a little beyond the central point (or what would be the central point) of the sole—or rather shooting directly through it, so as to annihilate the spot. Posteriorly, it is embraced by the heels of the wall; laterally, it possesses firm and solid junctions with the bars, and through their medium with the sole: and these unions are effected not by simple apposition and cohesion of surface, but by a *lamellated structure*, apparent on the sides both of the frog and bars, by which the parts are reciprocally dovetailed into each other. Lamellæ are discoverable upon its sides, even all round the toe of the frog; and this is a circumstance that confirms me in my belief that the bars reach thus far.

Figure. The frog may be called pyramidal, or cuneiform, or triangular in figure; its outline forming the geometrical figure denominated an isosceles triangle. I know of no comparison so familiarly apt as that of resembling it to a ploughshare: not only do they both correspond, as near as such comparisons can be expected to do, in outline and make, but they likewise exhibit a singular coincidence in function; the frog, like the ploughshare, being intended by its point to plough or divide the surface of the earth, and in that manner serve as a stay or stop to the foot.

Division. We distinguish in the frog two *surfaces*, an *inferior* and a *superior*; two *sides*; a *point* or *toe*; and two *bulbs* or *heels*.

SURFACES.—Both surfaces of the frog manifest striking irregularities, and these are respectively reversed, making one surface the exact counterpart of the other. In other respects, the only difference they exhibit, is, that the superior exceeds the inferior both in length and breadth.

THE INFERIOR SURFACE presents to our view a remarkable cavity, broad, deep, and triangular in its shape, bounded on the sides by two sloping prominences, which divaricate from the convexity forming the toe of the frog, and terminate, after a short divergent course, at the heels. This cavity or hollow is denominated

The Cleft of the Frog: with seeming reference to the relationship existing, through its presence, between the horse's foot and the cloven one of the ox, deer, sheep, &c. In consequence of its sides sloping inward, the cleft at bottom gapes wide open; but along the top is roofed by a simple linear mark running from before backward. The horn is kept continually soft and pliant within the cleft by a peculiar secretion from the sensitive parts it covers, the odour of which is notorious.

The solid wedge-like portion of horn in front of the cleft, extending from it to the point of the toe, has been observed by Mr. Clark to exhibit, in the natural foot at its full growth, "a considerable bulbous enlargement," which, by way of distinction, he calls the *cushion of the frog*. On making a perpendicular section of the foot, Mr. C. finds this part is situated "nearly opposite or under the navicular bone." And it would appear (according to this author) that this "rotundity, or swell of the frog," is never reproduced after it has once been annihilated by the knife of the smith.

THE SUPERIOR SURFACE OF THE FROG, everywhere continuous, uniform, and porous, being the counterpart in form of the inferior, presents us with nothing but reverses: where the one is hollow or depressed the other rises into swells and eminences, and *vice versa*. This accounts for our finding the part opposite to the cleft elevated into a conspicuous eminence, bounded on its sides by two deep channels, and a hollow of broader but shallower dimensions in the front. To this central conical elevation Mr. Clark has given the name of *frog-stay*, from some novel notions he entertains of its physiology. Such a bold promontory of horn rising in the middle of broad and deep channels is well calculated to form that dovetailed sort of connection with the sensitive foot, which greatly augments their surfaces of apposition, and establishes their union beyond all risk or possibility of dislocation. It is a part which (as far as my observations on it have extended) grows and becomes developed together with other parts of the foot; and one that is apt to vary in its relative volume in different feet. In front of the frog-stay, the lateral borders, bounding the hollow in the middle, describe a waving line, which, near half-way to the point of the toe, exhibits a dip or depression: this marks the impression of the navicular bone, and is the part immediately opposite to the "cushion of the frog,"—a coincidence important to be borne in mind, as tending to throw some light on the nature of this new-christened structure.*

THE SIDES are the parts by which the frog establishes its union with the borders of the triangular vacuity in the hoof into which it is admitted. Along their superior borders they are transversely lamellated, or rather indentated, in order that they may be fitted to the internal surfaces of the bars, which exhibit a similar structure.

The Commissures are the two deep triangular-shaped hollows between the bars and the sides of the frog. In being only the *superior* borders of these parts that are engaged in their union;

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* In fact, the cushion of the frog appears to be nothing more than a bulge of the part produced by the superincumbent pressure of the navicular bone.

their broad unattached parts, below, form the boundary walls of the commissures. Looking into the interior of the hoof, we discover that the commissures, internally, are converted into rounded promontories, similar in appearance and texture to the one in the middle—the frog-stay—on the sides of which they are rising. In the natural state, the commissures must unavoidably get plugged with dirt, or whatever the animal may happen to tread upon; a circumstance from which some far-fetched notions have been extracted concerning their use.

THE TOE or POINT OF THE FROG, is the anterior, undivided, elongated portion; that which forms the apex of the pyramid or wedge—the acute or extended angle of the triangle—the only part displaying that prominent or rounded form that would warrant us in using the epithet "conical" to the frog. It possesses solidity of substance, firmness of texture, and luxuriance of growth in an eminent degree; facts well known to the farrier, who, in paring the foot, seldom fails to make more free with this than any other part of the frog.

THE HEELS or *bulbs* of the frog are the posterior protuberant parts embraced by the heels of the wall, and separated from each other by the cleft, forming, together, the base of the wedge or triangle. They present greater depth of substance than the toe, but are of a softer, more spongy texture, and are less resisting and stable, in consequence of being deprived of mutual support by the division of the cleft. Anteriorly, the heels unite with the lateral prominences bounding the cleft; inferiorly, they present two surfaces of tread to the ground, evidently designed to take a share in the bearing of the foot; posteriorly and superiorly, they exhibit a bulbous fulness, in consequence of receiving at this part a supplementary covering from a production which has been (in the description of the wall) adverted to, under the appellation given it by Mr. Clark, of

Coronary Frog-band. It was there stated, that the coronary groove (the groove or canal in the coronary border of the cutis) broadened considerably as it descended to and turned round upon the heels; in like manner does the horny band produced by it broaden, and not only grow broader but thicker in substance, and consequently in the same degree augments the substance of the heels, occasioning that swell of them which has suggested the appellation of "bulb." The horny band itself is everywhere lamellated upon its internal surface; but these broadened parts of it display lamellæ of a much bolder character, and consequently render their union with the heels so much the more intimate and enduring. The inferior edge of the band is denticulated, and the denticulations become so interlaced with the lamellated fibres of the wall, that their union is rendered, in the ordinary state of the hoof altogether imperceptible. For drawing our attention to this part we are indebted to Mr. Clark; and insomuch as he considers it to be a production of the cutis (not having any connection with the glandular circle that secretes the wall), and to serve the purpose of "uniting the sensible parts with the insensible," I agree with him. I find something very similar to this growing upon the human nail, issuing from the superior edge of the terminating border of the cutis, and continued from the cuticle, which proceeds for some way upon the nail, uniting it more closely and firmly with the cutis, and protecting the latter from external injury. This production is no more the beginning of the nail itself than is the so-called *frog-band* the commencement of the wall: they are both distinct parts, though but supplementary ones, and seem to be of a nature partaking both of horn and cuticle. It has no more important relation to the frog, in my opinion, than it has to the wall: it serves the same purpose to both,—that of strapping up the heels of the frog, and binding them in closer and more intimate connection with the neighbouring parts. Were I asked what other use it appeared to have, I should say, that it was formed to *cover and protect from injury the new-formed horn* of the hoof, guarding it in its passage downward, until it has acquired substance and hardness sufficient to resist external impressions of itself.

Development of the Hoof.

During the early months of fœtality, no horn or hoof is to be found. The foot is covered with a substance, white, firm, and elastic, resembling cartilage in its appearance, but proving more of the nature of cuticle on examination, which supplies the place of hoof. At the coronet this substance takes its origin from the cutis, being found to be continuous with the cuticle; but that which covers the bottom of the foot is a production from the sensitive sole and frog. Altogether, it possesses the general form and appearance of the hoof, differing however in these particulars—that the substitute for the wall is comparatively thin in its substance: while that which grows from the bottom of the foot is enormously thick, and, instead of being shaped into sole and frog, exuberates to a degree to constitute club-footedness. About the same period at which the pastern and coffin-bones take on ossification, horn makes its appearance underneath this cuticular wall, in the form of plates descending from the coronet, exhibiting with peculiar distinctness the lamellated structure. The horny wall becomes considerably advanced before we perceive any change in the bottom of the foot. At length, horn is detected forming underneath the cuticular substance, which, increasing in thickness, gradually represents sole and frog. Not, however, in an undeveloped state; for even at birth, these parts are yet concealed by the exuberant cuticular covering, now become loose in its texture, and shaggy and ragged, in consequence of not receiving any further supply from the parts that produced it, and of being near its decadence; for it not long after falls off, disclosing sole and frog, both ready formed.

Structure of the Hoof.

Horn is found to differ in its texture or quality, not only in the many animals in which it is met with, but in different parts, and even in the same part of the body of the same animal. That which composes the hoof of the horse is a remarkable example of this. How different is the horn of the frog from the horn of the wall; and yet neither of them agree in texture with the sole. The horny substance of the wall is resolvable into fibres, bearing a resemblance to thick or coarse hairs, which in the entire hoof are so intimately matted and glued together, as to have the appearance and strength of solidity. By close and accurate inspection these fibres may be seen, descending in parallel lines, taking the obliquity of the wall, from the coronet to the inferior or solar border: they do not run promiscuously, but are arranged in rows, forming sorts of beds or *strata*, lying one upon another—a disposition made manifest in the foot of the fœtus. A clean-cut transverse section of the wall exhibits upon its surface numerous minute, circular, whitish spots, which grow larger and more distinct towards the internal part, and through a glass appear to be hollow or tubular. These spots I take to be produced by section of the horny tubes, apparently containing a whitish matter, a sort of pith, or pulp, or gelatinous instillation, which pervades them from their origin from the *villi* of the coronary circle; the same as hairs derive their unctuous matter from the bulbs producing them, and (as this matter does the hair) renders the horny fibre tough and elastic—in fact, embues it with the peculiar attributes so well known to smiths by the appellation of *living horn;* the epithet "living" being here used to denote the obvious differences the hoof of a living animal evinces from one that has been long detached from the body, or that is dead. We are too apt to believe that the various agents known to act upon the dead hoof or horn must take similar effect on the living; and upon this erroneous belief we employ hot and cold water, &c., &c., in treating disease of the feet, forgetting that we have opposed to our remedies the resisting or self-preserving properties of living horn.

THE SOLE, as well as the wall, is fibrous in its structure; but its fibres appear to be of a finer quality, and, in course, are very much shorter: they, however, take an oblique direction, from behind forwards, following the same degree of slope as those of the wall. They issue from the *villi* penetrating the superior surface. To the fineness of its fibres, combined with the relative magnitude of the tubular canals, and consequent relative proportions of horny and gelatinous substances, may be ascribed the comparative softness and elasticity of the sole.

THE FROG, however, displays these qualities in such a remarkable degree as to appear, in fact, to be composed of quite another kind of horn; though, on examination, we find it to evince the same fibrous structure, the only perceivable differences being the comparative fineness of the fibres and their proportionably greater tubularity: their direction is oblique, correspondent with those of the wall.

Production of the Hoof.

The wall is produced by the *coronary substance*, a sensitive and glandular part we shall have occasion soon to examine. Its *villi*, by some peculiar, mysterious, secretory process, convert the blood circulating through them into a soft pulpy gelatinous matter, which by exposure becomes hard horn, descending from the villous point that produced it, in the form of a tubular fibre, down to the sole. The fibres are united together at their very origin, but their tubes or canals diminish, the lower they descend; which accounts for the porous or honeycomb-like structure of the interior of the coronary border and the comparative solidity of the parts below. The outer layers or strata of fibres are found to be more compact and of closer texture than the inner; which arises, in part, from the villi producing them being removed to a greater distance, and to the comparative smallness of their canals, and which, consequently, the sooner become obliterated. The use of Mr. Clark's coronary frog-band becomes now more apparent, serving, as it evidently does, to cover and protect these external fibres until they grow sufficiently firm and solid of themselves to bear exposure and resist casualties.

The sensitive laminæ make no addition to the substance or thickness of the wall: they simply produce the horny lamellæ arranged along its interior; as one proof of which, the wall measures as much in thickness at the place where it quits the coronet as it does at any point lower down. Other demonstrations of this fact come every day before such practitioners as have to treat canker, quittor, sandcrack, and other diseases of the feet.

The Horny Sole is a production from the villi of the sensitive sole; after the same process as that by which THE HORNY FROG is secreted from the villi of the sensitive frog.

In a state of health of the foot, the secretion of horn is unceasingly going on. Disease or injury of the glandular parts may diminish, or altogether suspend the process; disease, under certain other forms, appears also to have the effect of increasing it; but whether we have any artificial means of effecting this, seems questionable. The wall grows from above downwards. If a mark be made in any part of the wall, it will remain until it grows down and becomes cut off below, at the inferior border; and by observations made on the gradual descent and disappearance of these marks, calculations may be formed of the period of time required for the renewal or restoration of the wall.

Properties of Horn.

Horn is a tough, flexible, elastic substance, consisting of tubular fibres, more or less intimately connected together, taking the direction from the surface of the body on which it grows. Its property of toughness or resistance much depends on its condition in regard to moisture; for if it is exposed to a degree of heat sufficient to abstract much of its natural juice or imbibed moisture, it loses its flexibility and toughness, and becomes brittle. On the other hand, saturated with moisture, it is converted into a soft and highly flexible substance, but at the same time becomes weak and unresisting. This known effect aids us to account for the flat-footedness of horses reared in low, fenny, or marshy situations: the hoof being constantly in a state of saturation with moisture, the wall and sole yield to the superincumbent burthen of the body, and the latter grows flat (instead of remaining concave or arched), and even in some instances bulges. If oily or unctuous applications have any effect in softening the hoof, they appear to do so by filling the crevices and interstices between the fibres on the surface, and in this manner checking or suppressing evaporation. Horn takes a high and beautiful polish. Although much inferior in transparency to tortoise-shell, it may be worked up to bear so near a resemblance to it as to be often, in manufactures, substituted for it, as in combs, &c. The hoof admits of an elegant polish; and in that altered and improved state has been manufactured into articles no less useful than valuable and ornamental:* even the hoofs of the living animal may, by being kept clean, and when dry rubbed with linseed oil, be numbered among the ornamental beauties Nature has bestowed upon quadrupeds.

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* The Eclipse hoof, presented by his Majesty at Ascot Races, as the reward of the best horse on the turf, forms a notable illustration of this.

By chemical analysis horn has been found to consist of membranous substance, having the properties of coagulated albumen, and of some gelatine. The horns of some animals, the deer species, from containing bone, become exceptions to this. Mr. Hatchett burnt five hundred grains of ox's horn, and the residuum proved only one and a half grain, not half of which was phosphate of lime.

Shavings of hoof thrown into nitric acid become soft, and speedily melt into a yellow mass, which in about eight hours disappear in complete solution.

The same thrown into sulphuric acid, turn black, in becoming soft, and require thrice the time for their solution. Muriatic acid also turns horn black, and corrodes it, but has so little effect towards its solution, that after ten days a piece of hoof soaked in it was found to have become only more brittle or rotten. Common vinegar will turn horn dark-coloured, but does not appear to have any power in impairing its texture, or, at least, in dissolving it. Liquor potassæ will not only turn it black, but will corrode the horn of the hoof. Ammonia does not change its colour, but slowly destroys its texture, rendering it brittle and rotten.

INTERNAL PARTS OF THE FOOT.

The internal, sensitive, organic parts of the foot, comprise the *bones, ligaments, tendons, coronary substance, cartilages, sensitive laminæ, sensitive sole,* and *sensitive frog.*

THE BONES entering into the composition of the foot are the *coffin* and *navicular bones;* to which may be added (as forming part of the coffin-joint, and consequently having intimate relation to them), the *coronet bone.* Their descriptions will be found given at pages 57, 58, 59, and 60.

THE LIGAMENTS have likewise been already described at page 75, in giving the particulars of the coffin-joint.

THE TENDONS immediately connected with the foot are those of the *extensor pedis* and the *flexor pedis perforans:* the former being inserted into the posterior concavity of the coffin-bone; the latter into its coronal process, as described at pages 140 and 144.

The Coronary Substance.

A less inappropriate name for the part commonly called the *coronary ligament.**

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* Averse as I am to changing or altering names, nothing less than a palpable contradiction, in regard both to *structure* and *function*, would have induced me to do so in the present instance.

To revert, for the sake of elucidation here, to former description—after the hoof has been detached by a process of maceration or putrefaction, in a perfectly entire, uninjured condition, it presents around its summit, a circular groove, bounded in front by a soft whitish substance, having a thin edge, and being of a nature between horn and cuticle; and behind, by an attenuated margin, more horny in its character, whose thin edging is denticulated or serrated. Into this circular groove or canal is received the terminating margin of the cutis; the cuticulo-horny layer of the hoof, in front of it, having every appearance of being a continuation of the cuticle.

Situation—Dimension. The coronary substance occupies the concavity formed upon the inside of the superior or coronary border of the wall of the hoof: it is the part constituting the basis of the circular prominence commonly distinguished in the living animal as the *coronet*. It is broadest around the toe of the wall, diminishing in breadth towards the quarters and heels, and being somewhat broader around the outer than the inner side. It is thickest in substance around its middle and most prominent parts, growing gradually thinner both above and below.

Connection. Externally, the coronary substance is connected with the hoof; and the connection appears to be principally, if not entirely, of a vascular nature: the surface of the wall presenting a porous honeycomb-like texture, and the *villi* or vessels issuing from the coronary substance entering the pores, and thus establishing an intimate and extensive vascular union between these organic and inorganic parts. Internally, the coronary substance is connected with the coffin-bone, the extensor tendon, and the cartilages, by a fine, dense, copious cellular tissue, which at the same time forms a bed for the assemblage and ramification of the blood-vessels concerned in the secretion of the wall of the hoof. Superiorly, its union with the skin is so intimate and complete, that one has been thought to be a continuation of the other; and, so far as meets the eye of a common observer, they might be taken as such: but, when we come to examine them by anatomical tests, we not only find a line of external demarcation between them, but discover such difference of internal structure as forbids the adoption of this delusive notion. As it descends upon the coffin-bone, the coronary substance not only grows thinner, but in growing attenuated becomes imperceptibly gathered or puckered into numerous points from which issue a like number of plaits or folds, which afterwards form the sensitive laminæ. It is worthy of remark, that the part of the bone upon which this transformation takes place is smaller in circumference than the coronet; consequently the same measure of coronary substance which but tensely and smoothly covered the latter, admitted of being disposed in gathers or folds so soon as it reached the former. Posteriorly, the coronary substance forms a junction, indeed becomes continuous in substance, with the heels of the sensitive frog.

Structure. The coronary substance discloses three different parts in its composition:—1. *A fibro-cartilaginous circling band,* forming the substratum and basis of the entire structure. 2. *A cuticular covering,* so called from its resemblance in texture to the cutis. 3. *A network of blood-vessels,* reposing upon the former, and covered by the latter. The cartilaginous structure, freed from its vascular connections, is found to be wrought in the form of a coarse, open, irregular network, and appears designed mainly for the purpose of affording a bed for the lodgement and ramification of the blood-vessels destined to produce the wall. The looseness of its connection, added to its own elasticity, renders this substance peculiarly adapted to accommodate itself to the motions of the coffin-joint, and thus preventing those movements from operating prejudicially to the superimposed glandular structure.

Organization. The coronary substance may be ranked among the most vascular parts of the body: no gland even possesses, for its magnitude, a greater abundance of blood-vessels, or of blood-vessels (taking them generally) of larger size; nor does there exist any part in which greater care appears to have been taken to arrange its vessels so as to ensure an uninterrupted supply of blood. These vessels it is that produce the wall: and there is every reason to believe that they perform this office without any assistance from the vessels of the laminæ.

The Cartilages

Are two broad, scabrous, concavo-convex, cartilaginous plates, erected upon the sides and wings of the coffin-bone. Professor Coleman calls them "the *lateral* cartilages," in contradistinction to two others he has named "the *inferior* cartilages."

Situation. The cartilages form the postero-lateral parts of the sensitive foot, extending the surface considerably in both these directions.

Attachment. The cartilages are fixed into fossæ excavated in the supero-lateral borders of the coffin-bone. Their anterior parts become united, on each side, with descending lateral expansions from the extensor tendon, and are also attached to the coronet bone by cellular membrane. Their posterior parts surmount the *alæ* or wings of the bone, to which they are firmly fixed, and from which they project backwards, beyond the bone, giving form and substance to the heel. Supposing one of the cartilages to be divided into two equal parts by a line drawn horizontally across its middle, the superior half, which extends as high as the pastern-joint, is covered by skin only; and on that account is quite perceptible to the feel, and (in form) to the sight, as the animal stands with his side towards us. The lower half is covered, superiorly, by the encircling coronary substance; inferiorly, by sensitive laminæ: consequently, over all by the hoof, which envelopes both the coronary substance and the laminæ. The extreme posterior ends of the cartilages incurvate downward and backward; but, being overreached by the heels of the sensitive frog, any abrupt or exposed termination of them is prevented. Around these points also the coronary substance makes its inflections upon the sensitive frog, thereby giving them additional substance and support.

Form. Considered in the detached state, the cartilage in its general figure describes an irregular quadrangle, of which the supero-anterior and infero-posterior angles are the most projecting; the latter at the same time being incurvated inwards. Externally, the cartilage is pretty regularly convex; internally, it is unevenly concave, the surrounding border turning inwards into the substance of the sensitive frog. The posterior part of the cartilage is somewhat thinner than the anterior, and has several foramina through it—three or four of large size—which transmit vessels to the frog.

THE FALSE CARTILAGES.—From the inferior and posterior sides of the *true* cartilages, proceed in a direction forward—towards the heels of the coffin-bone—two fibro-cartilaginous productions, to which Mr. Coleman has given the name of "*inferior* cartilages." If they are to be considered as *cartilages* at all, I prefer denominating them *false;* they being, as well in structure as in use, different from the *true* or lateral cartilages. They spread inwards upon the surface of the tendo perforans; become united at their inner sides with the superior margin of the sensitive frog; are covered inferiorly by the sensitive sole; and at the same time assist in the support of the sensitive frog. They are triangular in their figure, and are arched in the same manner as the sole.

Use. Their use appears to me to be, to fill up the triangular vacant spaces left between the tendo perforans and heels of the coffin-bone, thereby completing the surface of support for the sensitive frog, and extending that for the expansion of the sensitive sole. Bone in these places must have proved inconvenient by more or less impeding the impression upon—and consequent reaction of—the sensitive frog.

The Sensitive Laminæ or Lamellæ.

So is denominated the laminated, membranous, vascular structure clothing the wall of the coffin-bone.

Production. The sensitive laminæ appear to be derived from the coronary substance—the one, in fact, seems to be a continuation from the other; for if, in a foot in a putrid condition, we attempt to part them by force, we may make an artificial rent somewhere, but can find no natural separation between them. The cuticular covering of the coronary substance having descended upon the coffin-bone, the circumference of which is less than that of the coronet, because thereupon gathered into numerous little plaits or folds, which proceed in parallel slanting lines down the wall of the bone: a transformation it may be difficult to explain, since the laminæ unfolded would occupy a much larger surface than the coronet; at the same time, it is one that has its parallels in the animal constitution, and a remarkable one in the instance of the ciliary processes.

Division. According to this mode of derivation, every lamina consists of one entire plait or duplication of substance, having its *inward sides* intimately and inseparably united; its *outward sides* being the surfaces of attachment for the horny laminæ. It has also two *borders;* one opposed to the coffin-bone, the other to the hoof: and two *ends* or *extremities,* one issuing out of the coronary substance, the other vanishing in the sensitive sole.

Structure. The substance of the laminæ when held to the light evinces a degree of transparency; although its nature is extremely dense, and it possesses extraordinary toughness and tenacity. Veterinary writers and lecturers have endowed the laminæ with a high degree of elasticity: but it appears to me that the property is referable to their *connections,* and not one that is inherent in their own substance.

Elastic Structure. This is a *substratum* of a fibrous periosteum-like texture, attaching the laminæ to the coffin-bone, in which it is that the property of elasticity resides to that remarkable extent usually ascribed to the laminæ themselves: indeed, so elastic is it found to be, that it can be made to stretch and recede the same as a piece of Indian rubber. Its fibres take a direction downward and backward. At the same time, it affords a commodious bed for the ramification of blood-vessels issuing from the substance of the bone, in which they are (particularly in the stretched condition of the substance) protected from injurious compression and consequent interruption to their circulation.

Number. In round numbers we may estimate the laminæ at about 500; not including those of the bars. They vary, however, in number: I have reckoned upwards of 600.

Dimensions. In length they decrease from around the toe towards the sides and heels in a corresponding ratio with the wall: those in front, the longest, being rather more than two inches in extent; the shortest, those at the heels, being rather less than one inch. In breadth there is no variation: all measure alike—one tenth of an inch.

Organization. The laminæ are highly organized, though they are not equally so with either the sensitive sole or sensitive frog; nor are they so red as those parts: and the obvious explanation of this is, that (over and above what is requisite for their own nutrition) all the blood they have occasion for is only that which is sufficient for the secretion of the horny laminæ.

The Sensitive Sole.

The sensitive sole, or (as Sainbel calls it) the fleshy sole, is the fibro-vascular substance covering the arched concave, or ground surface, of the coffin-bone: in fact, is the part corresponding to the horny sole.

Structure. The same kind of elastic fibrous structure that sustains the laminæ is found constituting the groundwork of the sensitive sole; only that in the latter case it is closer, denser, and firmer in its texture. Upon this is spread a remarkably beautiful venous network. And the whole is enveloped in an outer cuticular covering, derived from the heels and frog, from which are sent villous processes, loaded with the points of arteries into the porosities of the horny sole: not, however, perpendicularly downward, but in an oblique direction—downward and forward—the same in which the horny fibres grow.

Connection. Around the circumference of the coffin-bone, the sensitive sole is connected with the fibrous substance descending from the wall, together with the tapering, vanishing points of the laminæ. In the centre, it is united with the bars and frog. But its principal attachment consists in its being firmly rooted into the sole of the coffin-bone; a connection that receives considerable addition from the blood-vessels issuing out of the substanee of the bone.

Thickness. The sensitive sole varies in thickness at different places. On an average, it may be said to measure one eighth of an inch in thickness. In the vicinity of the frog, it is something less than this. At the heels, it possesses double that thickness.

Organization. This is one of the most vascular and sensitive parts in the body. Independently of the much admired venous network expanded over the fibrous substance of the sole, arteries enter it issuing from the substance of the bone, and penetrate its villi, which, by taking this course, elude all compression and obstruction: there are also others—the nutrient arteries; but these have an external origin, from the inferior coronary artery. The chief assemblage of arteries takes place within the villi, upon the cuticular surface—those issuing out of the interior of the bone simply passing through (without ramifying within) the fibrous substance: so that, if the substance of the sole is laid open by transverse section, the incised edge, near the surface, exhibits a deep red tint; while the interior, nearer the bone, has a pinkish or pale red aspect.

The Sensitive Frog.

Under this head is included the cleft cuneiform body, projecting from the bottom of the foot, together with the substance continued from it and filling the interval between the cartilages. Sainbel calls it "the fleshy frog."

Division. We distinguish, in the sensitive as in the horny frog, an *apex* or *toe*; two *heels*, separated by the *cleft*; and a portion intermediate between these, which is the *body*.

Situation and Connection. The sensitive frog occupies, the posterior and central parts of the bottom of the foot, forming in the tread a firm and secure *point d'appui*. Being in the hoofless foot equally prominent with the projecting edge of the coffin-bone, one might be led to infer that the horny frog should take the same line of bearing with the crust. The frog, altogether, is lodged in a capacious irregular space, bounded superiorly by the tendo-perforans and common skin, laterally by the cartilages, and inferiorly by the horny frog: with all which parts it has connections; besides being continuous with the sensitive bars and sole, and at the heels with the coronary substance. On its sides are two shallow ill-defined hollows, corresponding to the commissures of the horny frog, into which are received the horny prominences opposed to them.

Structure. Entering into the composition of this body we distinguish four parts:—An exterior or cuticular covering; a *congeries*, or network of blood-vessels; a fibro-cartilaginous texture: and an elastic interstitial matter.

The exterior or *cuticular covering* invests the prominent bulbous portion of the frog, and also gives a lining to the cleft. Superiorly, it is continuous with the skin descending upon the heels; anteriorly, with the cuticular covering of the coronet; inferiorly, with that of the sole. Numerous villous processes sprout from its surface, and enter the porosities in the interior of the horny frog, taking a direction downward and forward, the same as that in which the fibres of the horn grow.

The vascular covering succeeds the cuticular, lying immediately underneath it. It consists of a network of blood-vessels, principally veins, but which are not so thickly set as upon the sole.

The fibro-cartilaginous case comes next. We find it spread over those parts most subjected to pressure, and to be, in many places, one fourth of an inch in thickness. From its interior are sent off numerous processes, pervading the elastic matter of the frog, forming so many *septa* intercrossing one another, and dividing it without any notable regularity into many unequal compartments. In the posterior and bulbous parts, the septa exist in greater numbers, aad are closer arranged than in the middle parts. The fibres of this vaginal substance run obliqucly downward and forward, and become intermixed around the borders with those of the bars and sole.

The elastic interstitial matter, however, composes the bulk of the sensitive frog. It consists of a pale yellowish soft substance, which has been mistaken for fat or oil, and hence has been named "the fatty frog." When cut dceply into, it exhibits a granulated appearance, and the fibrous intersecting chords become apparent, putting on the ramous arrangement of a shrub or tree. Altogether, the sensitive frog forms a peculiar, spongy, elastic body, for which we lack some more appropriate name.

⁂ THE BLOOD-VESSELS AND NERVES of the Foot will be found described in their places, in the circulatory and nervous systems.

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