

A
S Y S T E M
OF
A N A T O M Y.

F R O M
MONRO, WINSLOW, INNES,
And the LATEST AUTHORS.

ARRANGED,
AS NEARLY AS THE NATURE OF THE WORK WOULD ADMIT,
IN THE
Order of the LECTURES delivered by the PROFESSOR of ANATOMY
in the UNIVERSITY of EDINBURGH.

IN TWO VOLUMES.

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* From Professor HAMILTON's *First Lines of the Theory and Practice of Midwifery*.—This acknowledgment was omitted to be made in its proper place.

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P A R T V.

Containing a DESCRIPTION of the

I N T E G U M E N T S.

By DR WINSLOW.

With ADDITIONS and IMPROVEMENTS.

OF THE COMMON INTEGUMENTS.

“ **A**LL the parts of the human body are invested by several common and universal coverings, to which anatomists give the name of *integuments*.

“ There have been many disputes about the number of these integuments. The ancients reckoned up five, viz. the *epidermis*, *skin*, *membrana adiposa*, *panniculus carnosus*, and *membrana muscutorum communis*.

“ The three first of these coverings are truly common or universal, that is, extended over all parts of the body.

“ The two other coverings are not universal, but confined to particular parts of the body.

“ The moderns divide the integuments into *cuticula*, *rete mucosum*, *cutis vera*, and *corpus adiposum*.

THE CUTICULA.

“ THE outside of the skin is covered by a thin transparent insensible pellicle, closely joined to it, which is called *epidermis*, *cuticula*, or *scarf-skin*.

“ The substance of the cuticle appears to be very uniform on the side next the skin ; and to be composed on the other side, of a great number of very fine small squamous laminæ, without any appearance of fibrous or vascular texture, except some small filaments by which it is connected to the parts below.

“ This substance is very solid and compact, but yet capable of being extended and thickened, as we see by steeping it in water, and by the blisters raised on the skin by vesicatories or any other means; and from thence it would seem, that it is of a spongy texture. It yields very much in swellings; but not so much as the skin without breaking or cracking.

“ With respect to its origin, some authors have supposed it to be formed by a moisture exhaled from the whole surface of the body, which gradually hardens when it is exposed to the air: but the foetus in utero, where no air is admitted, is a proof against this opinion; and it grows readily under plasters applied to any part of the body.—Leeuwenhoeck supposed its formation to be owing to the expansion of the extremities of the excretory vessels, which are found every where upon the surface of the true skin. Ruysch attributed its origin to the nervous papillæ of the skin; and Heister thinks it probable that it may be owing both to the papillæ and the excretory vessels. Morgagni, on the other hand, contends, that it is nothing more than the surface of the

the cutis, hardened and rendered insensible by the liquor amnii in the uterus, or by the pressure of the air. In fact, we know little about its origin: but the regeneration of it is very evident, sudden, and surprising; for, let it be destroyed ever so often, it still grows again.

“ Hard and reiterated frictions loosen it insensibly; and presently afterwards a new stratum arises; which thrusts the first outward, and may itself be loosened and thrust outward by other strata.

“ It is nearly in this manner that callosities are formed on the feet, hands, and knees; and the several laminæ or strata observable at the same time on many other parts of the body, are owing to the same cause, though many anatomists have looked upon them to be natural. But it must be acknowledged, that, on the palms of the hands and soles of the feet, the cuticle is commonly thicker than on any other part.

“ The cuticle adheres very closely to the cutaneous papillæ under it; but it may be separated by boiling, or steeping for a long time in cold water. It is not impossible to separate it with the knife; but this management teaches us nothing of its structure.

“ It adheres still closer to the corpus mucosum, which is easily raised along with it; and they seem to be true portions or continuations of each other.

“ The colour of the cuticle is naturally white; and the apparent colour thereof is owing to that of the corpus mucosum. For, if we examine the European and African, we find the cuticle to be nearly of the same colour in both, whereas their corpus mucosum is very different.

“ The cuticle covers the skin through its whole extent, excepting at places where the nails lie. It is marked with the same furrows and lozenges as the skin, and has the same openings and pores; and may be said to cover not only the whole external part of the body, but to line many of the large passages, as the alimentary canal, the lungs, vagina, urethra, &c.

“ When we examine narrowly the small passages thro’

which the sebaceous matter of the skin passes, the cuticle seems to enter these, in order to complete the secretory tubes. The folliculæ of the hairs have likewise the same productions of the cuticle; and it seems to give a kind of covering to the hairs themselves. Lastly, the almost imperceptible ducts of the cutaneous pores are lined by it.

“ If the skin be macerated for a long while in water, the cuticle, with its elongations, may be separated from it. By this observation we may explain how blisters may remain for a long time on the skin without giving passage through these holes to the matter which they contain; which holes one would think ought to be increased by this dilatation and tension of the cuticle.

“ But when the cuticle is separated from the skin, it carries along with it part of these cutaneous fibres; which being compressed by the matter contained in the blister, shut the pores of the separated cuticle like so many valves; and it is probably these small portions which have been taken for valves of the cutaneous tubes.

CORPUS MUCOSUM.

“ UNDER the cuticle, we meet with a substance of a greyish colour, which has been thought to represent a net-work; hence it has got the name of *corpus reticulare*, or *mucosum*. It is of a soft, mucilaginous, and viscid nature; and fills up the interstices of the fibres running between the cutis vera and cuticula. After raising the cuticle in a negro, this substance appears of a black colour, and is composed of two layers. It is this that chiefly gives the colour to the skin; for it is black in the African; white, brown, or yellowish, in the European.

“ The origin of this mucous substance has not hitherto been sufficiently explained; nor has it been fully determined what purposes it serves in the human body. The reason why it is black in the negro has been supposed

posed to be for serving as a defence against the external heat, by preventing the rays of the sun from penetrating his body; but the matter still lies hid in obscurity.

CUTIS VERA.

“The cutis vera, or *skin* properly so called, is a substance of very large extent, made up of several kinds of fibres, closely connected together, and running in various directions, being composed of the extremities of numerous vessels and nerves.”

This texture is what we commonly call *leather*; and it makes, as it were, the body of the skin. It is not easily torn; may be elongated in all directions, and afterwards recovers itself, as we see in fat persons, in women with child, and in swellings; and it is thicker and more compact in some places, than in others.

Its thickness and compactness are not, however, always proportionable: for on the posterior parts of the body, it is thicker and more lax than on the fore-parts; and on the palms of the hands, and soles of the feet, it is both very thick and very solid. It is generally more difficult to be pierced by pointed instruments in the belly, than in the back.

The outer surface of this substance is furnished with small eminences, which anatomists have thought fit to call *papillæ*. “They appear through its whole surface like small granulations; and seem to be calculated to receive the impressions of touch, being the most easily observed where the sense of feeling is the most delicate, as in the points of the fingers and palms of the hands; and are supposed by many to be the capillary filaments of the cutaneous nerves, which terminate by small radiated pencils: but they must be allowed to be formed like the other parts of the cutis; only the nervous fibrillæ will be found to be more numerous in them than in other parts.”

These papillæ differ very much in figure and disposition,

tion in the different parts of the body, and they may be distinguished into several kinds.

The greatest part of them is flat, of different breadths ; and separated by sulci, which form a kind of irregular lozenges. The pyramidal figure ascribed to them, is not natural ; and appears only when they are contracted by cold, by diseases, by boiling, or by some other artificial preparation which alters their ordinary structure.

The papillæ of the palm of the hand, of the sole of the foot, and of the fingers and toes, are higher than on the other parts of the body ; but they are likewise smaller, closely united together, and placed as it were endwise with respect to each other, in particular rows, which represent on the skin all kinds of lines, straight, crooked, waving, spiral, &c. These several lines are often distinctly visible in those parts of the palm of the hand which are next the first phalanges of the fingers.

The red part of the lips is made up of papillæ, representing very fine hairs or villi closely united together,

There is another particular kind under the nails ; the papillæ being there more pointed, or in a manner conical, and turned obliquely toward the ends of the fingers. Those which are found in the hairy scalp, scrotum, &c. are still of other kinds.

In inflammations, we observe a reticular texture of capillary vessels, more or less extended on the surface of the skin ; and curious anatomists demonstrate the same thing by fine injections, which may be looked upon as artificial inflammations. But neither of these methods proves, that, in the natural state, these vessels are blood-vessels ; that is, that they contain the red portion of the blood.

It

* “ Something similar to this has been injected lately by Mr Baynham of London, who thought it *rete mucosum* ; and afterwards by Mr Cruikshank, who calls it *cuticula quarta*. See Mr Cruikshank's *Letter to Mr Clare*.”

It is more probable that this vascular texture is only a continuation or production of the very small capillaries of the arteries and veins; which, in the natural state, transmit only the serous part of the blood, while the red part continues its course through wider ramifications, which more properly retain the name of *blood-vessels*.

This vascular texture is of various forms and figures in the different parts of the body. It is not the same in the face with what it is elsewhere; neither is it alike on all the parts of the face, as may be discovered by the most ordinary microscopes: and from hence we might perhaps be enabled to give a reason, why one part of the body turns red more easily than another.

The skin has several considerable openings, some of which have particular names; such as the fissure of the palpebræ, the nares, the mouth, the external foramen of the ears, the anus, and openings of the parts of generation.

Besides these, it is perforated by an infinite number of small holes, called *pores*, which are of two kinds. Some are more or less perceivable by the naked eye; such as the orifices of the milky ducts of the mammæ, the orifices of the excretory canals of the cutaneous glands, and the passage of the hairs.

The other pores are imperceptible to the naked eye, but visible through a microscope; and their existence is likewise proved by the cutaneous transpiration, and by the effects of topical applications; and from these two phenomena, they have been divided into arterial and venal pores.

We ought likewise to observe the adhesions and folds of the skin. It is everywhere united to the corpus adiposum; but it adheres to it much more closely in some parts than in others, as in the palm of the hand, sole of the foot, elbow, and knee.

Some plicæ or folds in the skin depend on the structure of the membrana adiposa or cellularis, as those in

the neck and buttocks : others do not depend on that membrane, such as the rugæ in the forehead, palpebræ, &c. which are formed by cutaneous muscles, and disposed more or less in a contrary direction to these muscles. These folds increase with age.

There is besides a particular kind of folds in the skin of the elbow, knee, and condyles of the fingers and toes ; which are owing neither to the conformation of the membrana adiposa, nor to any muscle.

Lastly, there is a kind of plicæ, or rather lines, which cross the palm of the hand, sole of the foot, and corresponding sides of the fingers and toes, in different directions. These serve for employment to fortune-tellers ; whose pretended art is contrary to religion, and despised by all men of sense.

GLANDS OF THE SKIN.

“ IN different parts of the body, we meet with small glands or follicles of an oval form, and seated chiefly under the skin in the corpus adiposum.

“ They are composed of convoluted vessels ; but in some parts of the body they appear to be formed of small cylindrical tubes or simple follicles, continued from the ends of the arteries, and discharging, by small excretory ducts, a fat and oily matter, that serves to lubricate and moisten the surface of the skin. When the fluid they secrete has acquired a certain degree of thickness, it approaches to the colour and consistence of suet : and from this appearance they have derived the name of *sebaceous glands*. They are found chiefly on the nose, ears, axillæ, likewise round the nipple, and about the external parts of generation in both sexes.

“ Besides the sebaceous glands, anatomical writers mention other small spherical bodies placed every where over the surface of the body, in much greater abundance than those just mentioned, and named *miliary*. They are said to have excretory ducts that open on the

the surface of the cuticle, and distil the sweat and matter of insensible perspiration ; but after all that has been said by different authors about them, their existence is now generally denied."

USES OF THE SKIN.

It is chiefly and properly the filamentary substance, called the *body of the skin*, which is the universal integument of the body, and the basis of all the other cutaneous parts ; each of which has its particular uses.

The skin is able to resist external injuries to a certain degree, and such impressions, frictions, strokes, &c. to which the human body is often liable, as would hurt, wound, and disorder the parts of which it is composed, if they were not defended by the skin.

The papillæ are the organ of feeling, and contribute to an universal evacuation, called *insensible transpiration*. They likewise serve to transmit from without, inwards, the subtle particles or impressions of some things applied to the skin. The first of these three uses depends on the extremities of the nerves ; the second on the arterial productions ; and the third on the productions of the veins.

The cutaneous glands secrete an oily humour of different consistences ; and they are likewise the origin of sweat. But without the epidermis, both papillæ and glands would be disturbed in their functions ; on which great disorders must ensue.

In order to explain the mechanism of feeling, or of the touch, we should first be made acquainted with the senses in general, for which this is not a proper place ; and therefore all that I should observe here, is, that there are at least two sorts of feeling ; one general, the other particular.

Particular feeling is accompanied with a certain determinate impression, by which we are enabled to discern objects in a very distinct manner ; and this is properly what is called the *touch*, the proper organ of which

which is at the inside of the ends of the fingers. General feeling is indeterminate and indistinct, not being accompanied with the same impression as the former.

These differences, in the sense of feeling, depend on those of the papillæ; which, in effect, appear to be more close, and made up of a greater number of nervous filaments, at the ends of the fingers than any where else; for the nervous ropes that go to the fingers are proportionably larger than those that go to any other part of the body.

The epidermis serves to keep the pencils or nervous filaments of the papillæ in an even situation, and without confusion; and it likewise moderates the impressions of external objects. Particular, as well as general feeling, is more or less perfect, in proportion to the thinness of the epidermis; callosities in which, weaken, and sometimes destroy both.

Another use of the epidermis is to regulate the cutaneous evacuations already mentioned; the most considerable of which is insensible transpiration. By this we understand a fine exhalation, or a kind of subtle smoke, which flows out of the body imperceptibly, and in different quantities. It might be called *cutaneous transpiration*, to distinguish it from *pulmonary transpiration*; of which hereafter.

This cutaneous exhalation becomes sensible, by applying the end of the finger, or palm of the hand, to the surface of a looking-glass, or of any other polished body; for it presently looks dull, and appears to be covered with a condensed vapour. It seems to me, that the convex side of the hand and fingers does not furnish so great a quantity of this exhalation as the palm of the hand, and the insides of the fingers, especially the extremities; which points out one use of this transpiration, *viz.* to keep the nervous filaments in due order for particular feeling.

Another proof of insensible transpiration, is the famous experiment of Sanctorious, continued for thirty years

years without interruption; by which he found, that this evacuation in one day was equal to all the sensible evacuations for fifteen days.

This calculation is not agreeable to what has been made in other countries, particularly those from the like experiments made by M. Dodart and Morin of the royal academy of sciences, and by Dr James Keill as published in his *Statica Britannica*. Neither can the balance inform us, whether the cutaneous transpiration is greater or less than the pulmonary.

A long time ago, I discovered a method to render this transpiration visible, to the distance of about half a foot from the body; and I mentioned it in a thesis printed at Copenhagen. If we look at the shadow of a bare head on a white wall, in a bright sunshiny day, and in the summer-season, we will perceive very distinctly the shadow of a flying smoke rising out of the head, and mounting upward, though we cannot see the smoke itself. We may try the same experiment with a dog or fowl, &c.

It is much in the same manner, that the invisible exhalations from burning charcoal throw a very distinct shadow; and that the invisible smoke of a chafing-dish, warming-pan, stove, &c. make all distant objects appear trembling, when viewed either over or on either side of those utensils.

The insensible cutaneous evacuation is performed simply, and without any artifice, through the small pores already mentioned, much in the same manner as we observe the smoke to arise from the entrails of an animal newly killed and opened. It is a particular and continual discharge of the serum of the blood through the capillary vessels of the skin.

It is naturally very moderate; and it is more abundant in the summer, before a good fire, after strong exercise, and during the distribution of the chyle, than in the winter, in cold places, during inaction, and before meals.

The

The transpired matter appears to be in some degree saline, as may be observed by applying the tongue to the palm of the hand when it has not been washed lately before. This is perhaps the reason why we feel less pain when a wound is touched with the finger covered with silk, than with the naked finger: but this inconveniency might easily be prevented by washing the hands and fingers very well immediately before we begin to dress wounds.

The matter of the other two cutaneous evacuations, the sweat and thick oily substance, comes chiefly from the glands of the skin. Each of them differs according to the different parts of the body where they are found, as may be observed both of the filth and sweat of the head, arm-pits, hands, feet, &c.

This filth or nastiness of the skin, is an unctuous or fatty matter, collected insensibly on the epidermis, where it thickens, and forms a sort of varnish, which in time becomes prejudicial, by stopping up the passages of cutaneous transpiration.

This collection is more readily made in winter than in summer; and this is the reason why it is more difficult to keep the hands clean in cold than in warm weather. And while I am dissecting in winter, the oftener I wash my hands the less sensible they are of cold.

MEMBRANA ADIPOSA, AND FAT.

THE last universal integument of the human body, is the membrana adiposa, or corpus adiposum. This is not, however, a single membrane, but a congeries of a great number of membranous laminæ, joined irregularly to each other at different distances, so as to form numerous interstices of different capacities, which communicate with each other. These interstices have been named *cellulæ*, and the substance made up of them the *cellular substance*.

The thickness of the membrana adiposa is not the same all over the body, and depends on the number of laminæ

laminæ of which it is made up. It adheres very closely to the skin ; runs in between the muscles in general, and between their several fibres in particular ; and communicates with the membrane which lines the inside of the thorax and abdomen.

This structure is demonstrated every day by butchers, in blowing up their meat when newly killed ; in doing which, they not only swell the membrana adiposa, but the air insinuates itself likewise in the interstices of the muscles, and penetrates even to the viscera, producing a kind of artificial emphysema.

These cellular interstices are so many little bags or satchels, “ which communicate freely with each other, and are” filled with an unctuous or oily juice, more or less liquid, which is called fat ; the different consistence of which depends not only on that of the oily substance, but on the size, extent, and subdivision of the cells.

It is generally known, that the illustrious Malpighi took a great deal of pains about this substance ; that in birds and frogs, the viscera and vessels of which are transparent, he thought he saw a kind of ductus adiposi ; and that, by pressing these ducts, he observed oily drops to run distinctly into the small ramifications of the vena portæ.

The manufacture of soap, the composition of the unguentum nutritum, and the different mixtures of oils with saline and acid liquors, give us some idea, at least, of the formation of the fat in the human body ; but the organ which separates it from the mass of blood, which ought to be the subject of our present inquiry, is not as yet sufficiently known.

Fat is more fluid in living than in dead bodies. It melts with the heat of the fingers in handling it ; and its fluidity is in part obstructed by the sacculi which contain it. To take it entirely out of these bags, the method is to set the whole over the fire in a proper vessel ; for then the bags burst, and swim in clusters in a true oily fluid.

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This substance increases in quantity in the body by rest and good living; and, on the contrary, diminishes by hard labour and a spare diet. Why nourishment should have this effect, is easily conceived; and it is likewise easy to see, that an idle sedentary life must render the fat less fluid, and consequently more capable of blocking up the passages of insensible transpiration, through which it would otherwise run off.

Hard labour dissolves it, and consequently fits it for passing out of the body, with the other matter of insensible transpiration. Some are of opinion, that it returns into the mass of blood, "by the lymphatics;" and that it can, for some certain time, supply the want of nourishment.

By this, they think, the long abstinence of some animals may be explained; but I am apt to believe, that the mere decrease of cutaneous transpiration, occasioned by the continual rest and inaction of these animals, has a great share in this effect.

The proportional differences, in the thickness of this *membrana adiposa*, are determined, and may be observed to be regular in some parts of the body, where either beauty or use require it.

Thus we find it in great quantities where the interstices of the muscles would otherwise have left disagreeable hollow or void places; but being filled, and as it were padded with fat, the skin is raised, and an agreeable form given to the part.

The appearance of a person moderately fat, of a person extremely lean, and of a dead carcase from which all the fat has been removed, proves sufficiently what I have said.

In some parts of the body the fat serves for a cushion, pillow, or mattress; as on the buttocks, where the *laminæ* and cells are very numerous. In other parts, this membrane has few or no *laminæ*, and consequently little or no fat; as on the forehead, elbows, &c.

In some places it seems to be braced down by a kind of
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of natural contraction in form of a fold ; as in that fold which separates the basis of the chin from the neck, and in that which distinguishes the buttocks from the rest of the thigh. We observe it likewise to be entirely sunk, or as it were perforated by a kind of dimple or fossula, as in the navel of fat persons.

These depressions and folds are never obliterated, let the person be ever so fat ; because they are natural, and depend on the particular conformation of the membrana adiposa, the laminae of which are wanting at these places.

The fat is likewise of great use to the muscles in preserving the flexibility necessary for their actions, and in preventing or lessening their mutual frictions. This use is of the same kind with that of the unctuous matter found in the joints, which was explained in the description of the fresh bones.

Lastly, the fat, as a fine oily substance in its natural state, may be some defence against the cold, which we find makes more impression on lean than on fat persons. It is for this reason, that to guard themselves against the excessive colds of hard winters, and to prevent chilblains, travellers rub the extremities of their bodies, and especially their feet, with spirituous oils, such as that of turpentine, &c.

This mass of fat, which makes an universal integument of the body, is different from that which is found in the abdomen, thorax, canal of the spina dorsi, articulations of the bones, and in the bones themselves.

But the difference of all these particular masses of fat consists chiefly, as I have said, in the thickness or fineness of the pellicles, in the largeness or smallness of the cells, and in the consistence, fluidity, and subtilty of the oily matter.

THE NAILS.

THE nails are looked upon by some as productions of the cutaneous papillæ, and by others as a continuation of the epidermis. This last opinion agrees with experiments made by maceration, by means of which the epidermis may be separated entire from the hands and feet, like a glove or sock.

In this experiment we see the nails part from the papillæ, and go along with the epidermis, to which they remain united like a kind of appendix; and yet their substance and structure appears to be very different from that of the epidermis.

Their substance is like that of horn, and they are composed of several planes of longitudinal fibres soldered together. These strata end at the extremity of each finger; and are nearly all of an equal thickness, but of different lengths.

The external plane or stratum is the longest, and the rest decrease gradually, the innermost being the shortest; so that the nail increases in thickness from its union with the epidermis where it is thinnest, to the end of the finger where it is thickest.

The graduated extremities or roots of all the fibres of which these planes consist, are hollowed for the reception of the same number of very small oblique papillæ, which are continuations of the true skin, which having reached to the root of the nail, forms a semilunar fold in which that root is lodged.

After this semilunar fold, the skin is continued on the whole inner surface of the nail, the papillæ insinuating themselves in the manner already said. The fold of the skin is accompanied by the epidermis, to the root of the nail exteriorly, to which it adheres very closely.

Three parts are generally distinguished in the nail; the root, body, and extremity. The root is white and
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in form of a crescent; and the greatest part of it is hid under the femilunar fold already mentioned.

The crescent and the fold lie in contrary directions to each other. The body of the nail is naturally arched, transparent, and appears of the colour of the cutaneous papillæ which lie under it. The extremity of the nail does not adhere to any thing, and still continues to grow as often as it is cut.

The principal use of the nails is to strengthen the ends of the fingers and toes, and to hinder them from being inverted towards the convex side of the hand or foot, when we handle or press any thing hard. For in the hand, the strongest and most frequent impressions are made on the side of the palm; and in the foot, on the sole: and therefore the nails serve rather for buttresses than for shields.

“The nails seem to possess several properties in common with the cuticle:—like it they are neither vascular nor sensible; and when the cuticle is separated from the true skin by maceration or other means, the nails come away without it.”

THE HAIRS.

THE hairs belong as much to the integuments as the nails. The roots or bulbs lie toward that side of the skin which is next the membrana adiposa. The trunk or beginning of the stem perforates the skin, and the rest of the stem advances beyond the outer surface of the skin, to a certain distance, which is very various in the different parts of the body.

When the different hairs are examined by a microscope, we find the roots more or less oval, the largest extremity being either turned toward or fixed in the corpus adiposum. The smallest extremity is turned towards the skin, and in some places fixed in the skin.

This oval root is covered by a whitish strong membrane, in some measure elastic; and it is connected ei-

ther to the skin, to the corpus adiposum, or to both, by a great number of very fine vessels and nervous filaments.

Within the root, we observe a kind of glue, some very fine filaments of which advance toward the small extremity, where they unite and form the stem, which passes through this small extremity to the skin. As the stem passes through the root, the outer membrane is elongated in form of a tube, which closely invests the stem, and is entirely united to it.

The stem having reached the surface of the skin, pierces the bottom of a small fossula between the papillæ, or sometimes a particular papilla; and there it meets the epidermis, which seems to be inverted round it, and to unite with it entirely. A sort of unctuous matter transudes through the sides of the fossula, which is bestowed on the stem, and accompanies it more or less, as it runs out from the skin, in form of an hair.

Hairs differ in length, thickness, and solidity, in the different parts of the body. Those on the head, are called in English by the general name of *hairs*; those which are disposed archwise above the eyes, *supercilia* or the *eye-brows*; those on the edges of the palpebræ, *cilia* or the *eye-lashes*; and those which surround the mouth, and cover the chin, the *beard*. In other parts of the body, they have no particular names; and their different lengths, thicknesses, &c. in all these parts, are sufficiently known.

Their natural figure seems to be rather cylindrical than angular, which is chiefly accidental. Their colour is probably the same with that of the glue, or medullary matter of the root, the different consistence of which makes the hairs more or less hard, flexible, &c. Lastly, their straight or crooked direction must depend on that of the holes through which the stems pass.

The use of the hairs, with respect to the human body, in general, is not sufficiently known to be determined

ned with certainty. Their uses with regard to some particular parts may be discovered; as we shall see in the description of these parts.

THE SUPPOSED INTEGUMENTS OF THE ANCIENTS.

“ BESIDES the integuments which I have already described, the ancients reckoned the panniculus carnosus, and membrana communis musculorum.

“ The panniculus carnosus is found in quadrupeds, but not in men, whose cutaneous muscles are in a very small extent, except that which I call *musculus cutaneus* in particular; but even that muscle cannot in any tolerable sense be reckoned a common integument.

“ There is no common membrane of the muscles, which covers the body like an integument; it being no more than particular expansions of the membranes of some muscles, or aponeurotic expansions from other muscles.

“ The elongations from the lamina of the membrana adiposa or cellularis, may likewise have given rise to this mistake, especially in such places where this membrane is closely united to the proper membrane of the muscles.”



A
SYSTEM OF ANATOMY.

P A R T VI.

Containing a DESCRIPTION of the

VISCERA AND ORGANS.

By DR WINSLOW.

With ADDITIONS and IMPROVEMENTS.

C H A P. I.

Of the HEAD.

“ **I**N describing the head, I shall first explain the parts which surround the cranium, and afterward those which are contained within it; and it is very proper that the reader should review what has been said concerning the structure of the cranium in both treatises of the bones, before he begins this chapter.

THE PERICRANIUM.

“ Besides the external integuments of the head, viz.
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the hair, skin, and cellular substance, there is another aponeurotic expansion, which covers the head like a cap, and is spread round the neck and on the shoulders like a riding hood.

This aponeurosis is very strong on the head, and it is made up of layers of fibres crossing each other. As it is spread on the neck it becomes gradually thinner, and ends insensibly on the clavicles. It sends out a production on each side, from above downwards, and from without inward, which having passed over the superior extremity of the musculus sterno-mastoidæus, runs behind that muscle toward the transverse process of the vertebræ of the neck, where it is connected with the ligamenta intertransversalia.

“The external surface of all the bones of the head, as well as of all other bones of the body excepting the teeth, and where tendons or ligaments are fixed, is covered by a particular membrane, of which that portion which particularly invests the cranium is named *pericranium*, and that which invests the bones of the face is simply termed *periosteum*..

“The internal part of the pericranium, which has by some been taken for a membrane peculiar to the upper part of the head, covers immediately all the bony parts of this region; and the external part has been looked upon as a membrane distinct from the internal, and named *pericranium* particularly.

“The external part of the pericranium separates from the other, at the semicircular plane upon the side of the cranium, mentioned in the description of the bones; and becomes a very strong aponeurosis, which covers the temporal muscle, and is afterwards fixed to the external process of the os frontis, and to the upper edge of all the zygoma. The other parts of the pericranium are connected to the neighbouring parts of the head.”

The head, being considered in general as one of the
three

three principal cavities of the human body, has this peculiar to it, that its outside is the seat and basis of several very complex particular organs, whereas on the inside it contains only one, which is indeed the organ of organs, and the primum mobile of the whole animal œconomy; I mean, the brain; the mechanism of which is very little known; and the structure of its different parts, even of those which we are supposed to be most acquainted with, is very difficult to be demonstrated.

SECT. I. *Of the BRAIN and its APPENDAGES.*

THE name of *brain* is given to all that mass which fills the cavity of the cranium, and which is immediately surrounded by two membranes, called *meninges* by the Greeks, and *matres* by other ancients, because they were commonly of opinion that these membranes were the origin, and, as it were, the mother, of all the other membranes of the body.

This general mass is divided into three particular portions; the cerebrum or *brain* properly so called, the cerebellum, and medulla oblongata. To these three parts contained within the cranium, a fourth is added, which fills the great canal of the spina dorsi, by the name of *medulla spinalis*, being a continuation of the medulla oblongata.

The meninges, or membranes, are two in number; one of which is very strong, and lies contiguous to the cranium; the other is very thin, and immediately touches the brain. The first is named *dura mater*; the second *pia mater*. This last is again divided into two; the external lamina being termed *arachnoides*, the internal retaining the common name of *pia mater*. I begin with these meninges.

§ 1. *Dura Mater.*

Situation in general. The dura mater incloses the brain and all its appendages. It lines the inside of the cranium, and supplies the place of an internal periosteum, being spread in holes and depressions, and covering all the eminences in such a manner as to prevent their being hurtful to the brain.

Division. In describing the dura mater, we must take notice, 1. Of its composition. 2. Its adhesions to the cranium. 3. Its folds or septa. 4. Its productions, vessels, and nerves.

Composition. The dura mater is composed of one lamina; although it may, by maceration, be divided into two or more. Their texture is very close and strong, appearing to be partly ligamentous and partly tendinous.

Adhesion. The dura mater sticks closely to the cranium by a great number of filaments of the external lamina, which enter the pores of the bones, almost every where, but more particularly at the sutures both above and below; and by penetrating these joints, they communicate with the external periosteum. These filaments are, for the most part, small vessels, which being broken in separating the dura mater from the skull, a great number of red points appear on the external surface of that membrane.

It adheres much more to the whole inner surface of the cranium in children and young persons than in those of an advanced age; the filaments become then very small, being compressed by the contraction of the bony pores; and consequently they are more easily ruptured by any force applied to them.

Internal lamina. These adhesions are formed entirely by the outer surface of this membrane, the inner part of it being very smooth and polished, and is also continually moistened by a fine fluid discharged thro' its

its pores, much in the same manner as the peritonæum and pleura.

Folds and septa. The dura mater sends off several processes; three of which form particular septa that divide the brain into certain parts. One of them is superior, representing a kind of mediastinum between the two great lobes of the brain: The second is in a middle situation like a diaphragm, between the cerebrum and cerebellum: the third is inferior, between the lobes of the cerebellum. The superior septum is longitudinal in form of a scythe, from whence it is termed the *falx of the dura mater*; and it may likewise be called *septum sagittale*, *verticale*, or *mediastinum cerebri*. The middle septum is transverse; and might be called *the floor of the cerebrum*, *the diaphragm of the brain*, *tentorium cerebelli*. The inferior septum is very small, and runs down between the lobes of the cerebellum; on which account it may be termed either simply *septum cerebelli*, or *septum occipitale minus*, the middle partition being looked upon as the *septum occipitale majus*.

The superior or vertical septum, called the *falx of the dura mater*, is a long and broad fold or duplicature of the internal lamina, reaching from the edge of the crista Offis Cribrosi, along the sagittal future, to the middle of the transverse septum; which it joins in such a manner, as that the lateral laminæ of the falx are continuous on each side with the neighbouring portions of the superior lamina of the middle septum.

It is broader where it joins the middle septum than at the os ethmoides; and it is thicker at that edge which adheres to the cranium, than at the other, which lies loose and is very sharp; and from this resemblance to a scythe, it had the name of *falx*.

The transverse or middle septum is fixed to the os occipitis along the grooves of the lateral sinuses, and those of the great angles of the apophyses petrosæ all the way to the posterior clinoid apophyses of the os sphenoidale. By this situation it forms a sort of floor, tent, or shal-
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low vault, on the fore-part of which is a large notch almost of an oval figure.

This septum divides the cranium into two cavities, one large or superior, and the other small or inferior, which communicate together by the great oval notch. It is formed by a particular fold, and a very broad membrane of the internal lamina of the dura mater; and in the natural state it is very tense, because of its union or rather continuity with the falx.

This union or continuity of these two septa, keeps them both very tense, so that the middle septum is capable of sustaining a considerable weight without sinking downward; and the falx is able to resist lateral pressures, without giving way to the right hand or to the left.

We may be convinced of this reciprocal tension, by first touching these two septa in their natural state; and again, after they have been cut one after the other according to their breadth; or rather after having cut in this manner the falx in one subject, and the transverse septum in another: for as soon as the falx is cut, the other will be perceived immediately to loose its tension and firmness; and the same thing will be observed in the falx as we cut the septum medium.

The small occipital septum is both very short and narrow. It runs down from the middle of the transverse septum to the edge of the great occipital hole, being fixed to the internal spine of the os occipitis. It is formed by a fold and duplicature of the internal lamina of the dura mater, in the same manner as the other two, and distinguishes the lower part of the occipital cavity of the cranium into two lateral parts. In some subjects this septum is double, answering to the double spine of the os occipitis.

Sphenoidal folds. Besides these large folds, there are two small lateral ones on each side of the fella turcica, each running from the posterior to the anterior clinoid apophysis on the same side. These two folds, together
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with the anterior or posterior parts of the sella turcica, form a small fossula, in which the pituitary gland is lodged. There are likewise two anterior folds at the edges of the sphenoidal or superior orbitary fissures, which augment the depth of the middle fossulæ of the basis cranii. Thus we have seven folds of this membrane, three large and four small, which may be termed *internal productions or processes of the dura mater*.

Elongations. The elongations of the dura mater go beyond the general circumference, and pass out of the cranium, through the openings described in the treatise of the skeleton, and may be named *external productions of the dura mater*.

The most considerable of these elongations passes through the great occipital foramen, and runs down the common canal of the vertebræ in form of a tube, lining the inside of that canal, and inclosing the medulla spinalis, by the name of the *dura mater* of that medulla. The other elongations accompany the nerves out of the cranium in form of vaginæ, which are more numerous than the nervous trunks reckoned in pairs. For the olfactory nerves, there is the same number of distinct vaginæ as there are holes in the lamina ethmoidalis; and some nerves are accompanied by several vaginæ through one hole, as those of the ninth pair.

There are two particular elongations which form the periosteum of the orbits, together with the vaginæ of the optic nerves. These orbitary elongations go out by the superior orbitary fissures, "or foramina lacera of the sphenoid bone;" and, increasing in breadth in their passage, line the whole cavity of the orbits, at the edges of which they communicate with the pericranium and periosteum of the face. They communicate likewise, through the sphenomaxillary or inferior orbitary fissures, with the pericranium of the temporal and zygomatic fossæ; and by these communications we may

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explain the accidents which happen to these parts in wounds of the head.

The elongations of the dura mater which accompany the blood-vessels through the foramina of the cranium, unite with the pericranium immediately afterwards. Such, for instance, are the elongations which line the fossulæ of the foramina laceræ or jugularia, and the bony or carotid canals of the apophysis petrosa, &c.

Arteries. The vessels of the dura mater are arteries, veins, and sinuses. The arteries in general are distinguished into anterior, middle, and posterior; and come from the carotids and vertebrales on each side. The external carotid sends a branch through the spinal hole of the os sphenoidale, which is the middle artery of the dura mater; and is called, by way of eminence, *arteria duræ matris*. It is divided into a great number of branches, which are plentifully dispersed through the substance of the external lamina as high as the falx, where these ramifications communicate with their fellows from the other side. The impressions of this artery are seen on the inside of the parietal bones; the anterior and lower angle of which, instead of a simple impression, contains a canal for the passage of a trunk or branch of this artery; on which account several accidents happen in fractures of the skull, as I demonstrated at the royal garden above eight years ago.

The external carotid sends another small ramus thro' the corner or small end of the sphenoidal or superior orbital fissure; where there is sometimes a little notch on purpose, mentioned in the description of the skeleton. This branch is the anterior artery of the dura mater; and it gives off ramifications in the same manner as the former with which it communicates, but its ramifications are not so numerous. The internal carotid, as it enters the cranium, gives off a small branch to the substance of the dura mater.

The two vertebral arteries enter by the great occipital foramen, and unite in one trunk on the anterior or sphen-

sphenoidal apophysis of the os occipitis. Immediately afterwards they enter the substance of the dura mater on both sides, each of them by one or two branches. These are the posterior arteries of the dura mater; and they communicate by some ramifications with the middle or spinal artery above mentioned.

Veins and sinuses. The dura mater contains in its duplicature several particular canals; into which the venous blood, not only of that membrane, but of the whole brain, is carried. These canals are termed *sinuses*; and some of them are disposed in pairs, others in uneven numbers: that is, some of them are placed alone in a middle situation; others are disposed laterally on each side of the brain. The most ancient anatomists reckoned only four; to which we can now add four times as many.

These sinuses are in the duplicature of the dura mater; and their cavities are lined on the inside by particular very fine membranes. They may be enumerated in this manner: The great sinus of the falx, or superior longitudinal sinus, which was reckoned the first by the ancients. Two great lateral sinuses, the second and third of the ancients. The sinus, called *torcular Herophili*, the fourth of the ancients. The small sinus of the falx or inferior longitudinal sinus. The posterior occipital sinus, which is sometimes double. Two inferior occipital sinuses, which form a portion of a circle, and may likewise be called *the inferior and lateral sinuses*. Six sinus petrosi; three on each side, one anterior, one middle or angular, and one inferior. The two inferior, together with the occipital sinuses, complete a circular sinus round the great foramen of the os occipitis. The inferior transverse sinus. The superior transverse sinus. Two circular sinuses of the sella sphenoidalis; one superior and one inferior. Two sinus cavernosi, one on each side. Two orbitary sinuses, one on each side.

All these sinuses communicate with each other; and
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with the great lateral sinuses, by which they discharge themselves into the internal jugular veins, which are only continuations of these lateral sinuses. They likewise unload themselves, partly into the vertebral veins, which communicate with the small lateral or inferior occipital sinuses; and partly into the external jugular veins, by the orbitary sinuses, which communicate with the *venæ angulares, frontales, nasales, maxillares, &c.* as the lateral sinuses likewise communicate with the *venæ occipitales, &c.*

Thus the blood, which is carried to the dura mater, &c. by the external and internal carotid, and by the vertebral arteries, is returned to the heart by the external and internal jugular and vertebral veins; so that, when the passage of the blood is obstructed in any particular place it finds another way by virtue of these communications, though not with the same ease. This observation is of consequence, in relation not only to obstructions, but to the different situations of the head.

The great sinus of the falx reaches from the connection of the ethmoidal crista with the *os frontis*, along the upper edge of the falx, all the way to the posterior edge of the transverse septum, where it ends by a bifurcation in the great lateral sinuses. It is very narrow at its anterior extremity, and from thence becomes gradually wider all the way to its posterior extremity.

The cavity of this sinus is not cylindrical, but triangular, having in a manner three sides; one superior, parallel to the cranium; and two lateral, inclined to the plane of the falx. The upper side is formed by the external lamina of the dura mater; and through the middle of its breadth a kind of fine raphe or suture runs from one end to the other.

The two lower or lateral sides are productions of the "inner surface of the dura mater;" which having parted from the external, are inclined toward each other, and then unite; forming first the sinus, and afterwards the duplicature of the falx. This sinus is lined

ned interiorly by a fine proper membrane, which forms likewise a kind of raphe or future along the bottom of the sinus, that is, along the union of the two lateral sides.

In this sinus we observe several openings and several ligamentary fræna. The openings are orifices of veins; the smallest of which belong to the dura mater, the largest to the brain. The veins of the brain enter the sinus, for the most part, obliquely from behind forward, after they have run about a finger's breadth in the duplicature of the dura mater.

It has been thought that the arteries of the dura mater discharged themselves immediately into the sinuses; because injections made by the arteries, or a hog's bristle thrust into them, have been found to pass into these sinuses: but, on a more close examination, it has been discovered, that the injections passed from the arteries into the veins, and from thence into the sinuses, through the small orifices already mentioned; and that the hog's bristle pierced the sides of the artery, which near the sinuses are very thin.

This mistake gave rise to another, that the dura mater had no veins; and what confirmed it was, that the arteries of the dura mater cover the veins so entirely, that the edges of the veins are hardly perceivable on either side of the arteries. There are, however, some places where the veins being broader than the arteries, their two edges are seen on each side of the arteries like capillary vessels. These veins are, for the most part, branches of the sinuses; and the small trunks of some of them open into the head of the vena jugularis interna. We may easily be satisfied that the arteries on both sides of the dura mater communicate with each other above the falx, either by injecting or blowing into them.

The internal fræna of this great sinus appear to be tendinous, and to be designed to prevent the too great dilatation of the sinus by the blood. They vary, however,

ever, in different subjects, and do not always reach from one side to the other. It has been pretended, that glands have been found there; but we ought to take care not to mistake for such certain small corpuscles, “ which seem to have about them very little of the nature of glands.”

The inferior sinus of the falx is situated in the lower edge of its duplicature, being very narrow, and, as it were, flattened on both sides. It communicates immediately with the fourth sinus of the ancients; and in some subjects seems even to be a continuation thereof. It likewise communicates with the great or superior sinus by small veins which go from one to the other, and with the veins of the cerebrum by the same means.

The lateral sinuses represent two large branches of the superior longitudinal sinus, one going to the right hand, the other to the left, along the great circumference of the transverse septum, all the way to the basis of the apophysis petrosa of the ossa temporum. From thence they run down, having first taken a large turn, and then a small one; and being strongly fixed in the lateral grooves of the basis cranii, they follow the course thereof all the way to the foramina lacera and fossulae of the jugular veins.

They do not always arise by an equal and symmetrical bifurcation of the superior longitudinal sinus; for, in some subjects, one of the lateral sinuses appears to be a continuation of the longitudinal, and the other to be a branch from it. This variety may happen on either side; and, in a word, we sometimes find one of these sinuses higher or lower, larger or smaller, than the other.

The cavity of these lateral sinuses is likewise triangular, and furnished with a proper membrane and with fræna: and it has also the small venal openings; which indeed are common to it, not only with the longitudinal sinus, but with most part of the others. The posterior or outer side of this cavity, is formed by the external

ternal part of the dura mater, and the other two by the internal part.

As these two sinuses go out by the posterior portions of the openings of the basis cranii, called *foramina lacerata*, they are dilated into a kind of bag, proportioned to the fossulæ of the venæ jugulares, where they terminate in these veins.

Near the concurrence of the superior longitudinal and lateral sinuses, we observe an opening (sometimes double), which is the orifice of a sinus situated along the union of the falx and transverse septum. It does not always end directly at the lower part of the superior sinus, but sometimes opens at the beginning of one of the lateral sinuses, especially when the bifurcation is not equal; and in this case it often terminates in that lateral sinus, which appears like a branch from the common trunk of the superior and other lateral sinus.

This sinus has been named *torcular Herophili*, from an ancient author, who imagined that the blood was in a manner in a press, at the union of these four sinuses. Its diameter is but small; and it forms a kind of bifurcation with the inferior longitudinal sinns, and with a vein of the cerebrum, which is sometimes double, called *vena magna Galeni*.

The cavernous or lateral sinuses of the os sphenoides, are reservatories of a very particular kind; containing not only blood, but considerable vessels and nerves, as we shall see hereafter; and likewise a spongy or cavernous substance full of blood, much like that of the corpus cavernosum of the urethra.

Nerves and glands. We observe some nervous filaments which go to the dura mater, from the trunk of the fifth pair, at the entry of the cavernous sinus; and from the common trunk of the eighth pair and nervus accessorius or spinalis, as they pass through the foramen lacerum. The small tubercles sometimes found on the lateral sides of the longitudinal sinus of the falx, deserve still to be examined before we can determine

any thing about them. The whole inside of the dura mater is moistened in the same manner as the peritonæum and pleura.

The prominent fibres intersecting each other in different manners which appear on the inside of the dura mater, especially near the falx and transverse septum, and which have been taken for a kind of fleshy fibres, seem to be only ligamentary and elastic. The universal adhesion of this membrane to the cranium, proves that it can have no particular motion, and consequently that such fleshy or muscular fibres would be altogether useless. This adhesion was plainly demonstrated by Vesalius, Riolan, &c. long before Roonhuysen.

§ 2. *Pia Mater.*

Situation in general. “ This membrane is a much softer and finer substance than the former; being exceedingly delicate, transparent, and vascular;” and is connected to the dura mater only by the veins which open into the sinuses as has been already said.

Structure. “ It is composed of two laminæ, of which the external one is named *tunica arachnoidea*, from its resemblance to a cobweb. They adhere closely to each other at the upper part of the brain; but are easily separable at the basis, and through the whole length of the spinal marrow.

“ The *tunica arachnoidea* is spread uniformly over the surface of the brain, inclosing all the circumvolutions, but without entering in between any of them; while the *pia mater*,” or internal lamina, forms a great number of plicæ, duplicatures, and septa; which “ not only cover the brain in general, but” insinuate themselves into all the folds and circumvolutions, and between the different strata of the cerebrum and cerebellum, “ and are likewise continued into the different cavities.”

The

The two laminæ of the pia mater are not so closely united as those of the dura mater, being connected only by a cellular substance, which accompanies them thro' their whole extent, except at some places of the basis of the cerebrum, &c. where, the internal lamina continuing its insertions, the external remains uniformly stretched over the prominent parts, the interstices of which are entirely separated from the other lamina without any cellular substance between them. These separate portions of the external lamina have made it be looked upon as a third membrane of the brain, distinct from the pia mater.

§ 3. Cerebrum.

Situation and figure. THE cerebrum properly so called, is a kind of medullary mass, of a moderate consistence, and of a greyish colour on the outer surface, filling all the superior portion of the cavity of the cranium, or that portion which lies above the transverse septum. The upper part of the cerebrum is of an oval figure, like half an egg cut lengthwise, or rather like two quarters of an egg cut lengthwise, and parted a little from each other. It is flatter on the lower part, each lateral half of which is divided into three eminences, called *lobes*, one anterior, one middle, and one posterior.

Substance. The substance of the cerebrum is of two kinds, distinguished by two different colours; one part of it, which is softest, being of a greyish or ash colour; the other, which is more solid, being very white. The ash-coloured substance lies chiefly on the outer part of the cerebrum like a kind of cortex, from whence it has been named *substantia corticalis* or *cinerea*. The white substance occupies the inner part, and is named *substantia medullaris*, or simply *substantia alba*.

Division and lobes. The cerebrum is divided into two lateral portions, separated by the falx, or great lon-

gitudinal septum of the dura mater. They are generally termed *hemispheres*, but they are more like quarters of an oblong spheroid. Each of these portions is divided into two extremities, one anterior, and one posterior, which are termed the *lobes of the cerebrum*, between which there is a large inferior protuberance which goes by the same name; so that in each hemisphere there are three lobes, one anterior, one middle, and one posterior.

The anterior lobes lie upon those parts of the os frontis which contribute to the formation of the orbits and of the frontal sinuses, commonly called the *anterior fossæ of the basis cranii*. "The middle lobes lie in the middle or lateral fossæ of the basis cranii, and the posterior lobes on the transverse septum of the dura mater called the *tentorium*."

Sides and inequalities. Each lateral portion of the cerebrum has three sides; one superior, which is convex; one inferior, which is uneven; and one lateral, which is flat, and turned to the falx. Through the whole surface of these three sides we see inequalities or windings like the circumvolutions of intestines, formed by weaving streaks or furrows very deep and narrow, into which the septa or duplicatures of the pia mater insinuate themselves, and thereby separate these circumvolutions from each other.

Near the surface of the cerebrum, these circumvolutions are at some distance from each other, representing serpentine ridges; and in the interstices between them, the superficial veins of the cerebrum are lodged, between the two laminæ of the pia mater, from whence they pass into the duplicature of the dura mater, and so open into the sinuses.

These circumvolutions are fixed through their whole depth to the septa or duplicatures of the pia mater, by an infinite number of very fine vascular filaments, as may be seen by pulling the circumvolutions a little asunder with the fingers.

When

When they are cut transversely, we observe that the *substantia alba* lies in the middle of each circumvolution, so that there is the same number of internal medullary circumvolutions as of external cortical ones; the first representing white laminæ invested by others of an ash-colour; but the cortical substance is in many places thicker than the medullary.

Figure. The anterior and middle lobes of the cerebrum on each side are parted by a deep narrow sulcus, which ascends obliquely backward, from the temporal ala of the *os sphenoides* to near the middle of the *os parietale*; and the two sides of this division have each their particular ridges and circumvolutions, which gives a very great extent to the cortical substance. This sulcus is termed *fissura magna Silvii*, or simply *fissura cerebri*.

Corpus callosum. Having cut off the falx from the *crista galli*, and turned it backward; if we separate gently the two lateral parts or hemispheres of the cerebrum, we see a longitudinal portion of a white convex body which is named *corpus callosum*. It is a middle portion of the medullary substance, which under the inferior sinus of the falx, and also a little toward each side, is parted from the mass of the cerebrum, to which it is simply contiguous from one end of that sinus to the other; so that, at this place, the edge of the inside of each hemisphere only lies on the corpus callosum, much in the same manner as the anterior and posterior lobes lie on the *dura mater*. Both extremities of this medullary body terminate by a small edge bent transversely downward.

The surface of the corpus callosum is covered by the *pia mater*, which runs in between the lateral portions of this body, and the lower edge of each hemisphere. Along the middle of its surface from one end to the other, there is a kind of raphe formed by a particular intertexture of fibres which cross each other; for though these fibres appear to be transverse, yet they are really a

little oblique, and those that come from the right side intersect those that come from the left. This raphe is made more perceivable by two small medullary cords which accompany it on each side, and adhere closely to the transverse fibres.

Medullary arch and centrum ovale. The corpus callosum becomes afterwards continuous on each side, with the medullary substance, which, through all the remaining parts of its extent, is entirely united with the cortical substance, and together with the corpus callosum forms a medullary arch or vault of an oblong or oval figure. To perceive this, the whole cortical substance, together with the medullary laminæ mixed with it, must be cautiously and dexterously cut in the same direction with the convexity of the cerebrum. After which we will observe a medullary convexity much smaller than that which is common to the whole cerebrum, but of the same form; so that it appears like a medullary nucleus of the cerebrum, especially when we consider it together with the medullary substance of the inferior part or basis of the cerebrum. And from thence M. Vieussens took occasion to name this nucleus the *centrum ovale*.

Ventriculi laterales. Under this arch are two lateral cavities, much longer than they are broad, and very shallow, separated by a transparent medullary septum, of which hereafter. These cavities are generally named *the anterior superior ventricles of the cerebrum*, to distinguish them from two other smaller cavities which are situated more backward, as we shall see presently; but the name of *lateral* or *great ventricles* given them by Steno, is more proper than either of the other two.

The lateral ventricles are broad, and rounded at those extremities which lie next the transparent septum. They go from before backward, contracting in breadth, and separating from each other gradually in their progress. Afterwards they bend downward, and return obliquely from behind forward, in a course like
the

the turning of a ram's horn, and terminate almost under their superior extremities, only a little more backward and outward.

At the posterior part where they begin to bend downward, there is on each side a particular elongation, which runs backward, and terminates in a triangular pointed cavity turned a little inward, the two points resembling horns. These ventricles are every where lined with a continuation of the pia mater.

Septum lucidum. The transparent partition, or *septum lucidum*, as it is commonly called, lies directly under the raphe or future of the corpus callosum, of which it is a continuation and a kind of duplicature. It is made up of two medullary laminæ, more or less separated from each other by a narrow medullary cavity, sometimes filled with a serous substance. This cavity, in some subjects, reaches a great way backward; and seems to communicate with the third ventricle.

Fornix. The septum lucidum is united, by its lower part, to the anterior portion of that particular medullary body, called improperly *the fornix* with three pillars, because of some resemblance it is thought to bear to the arches of ancient vaults. It is in reality nothing but the corpus callosum; the lower side of which is like a hollow ceiling with three angles, one anterior and two posterior; and three edges, two lateral and one posterior. The lateral edges are terminated each by a large semicylindrical border, like two arches; which uniting at the anterior angle, form by their union what is called *the anterior pillar of the fornix*; and as they run backward separately toward the two posterior angles, they have then the name of *the posterior pillars*.

The anterior pillar being double, is larger than either of the posterior; and the marks of this duplicity always remain. Immediately below the basis of this pillar we observe a large, white, short, medullary rope stretched transversely between the two hemispheres, and

commonly called *the anterior commissure of the cerebrum*. It is to this pillar that the septum lucidum adheres. The posterior pillars are bent downward, and continued through the lower portions of the ventricles all the way to their extremities, resembling a ram's horn, which is a name that has been given to them. They diminish gradually in thickness during this course; and at their outsidés they have each a small, thin, flat, collateral border, to which the name of *corpora fimbriata* is applied.

“The posterior pillars of the crura of the fornix unite with two medullary protuberances called *pedes hippocampi*.”—The inferior surface of the triangular ceiling, which lies between these arches, is full of transverse, prominent, medullary lines; for which reason the ancients called it *psaloides* and *lyra*, comparing it to a stringed instrument, something like what is now called a *dulcimer*.

“Under the fornix, and immediately behind its anterior crura, there is a hole of a considerable size, by which the two lateral ventricles communicate; and another passage leads down from this, under the different appellations of *foramen commune anterius*, *vulva*, *iter ad infundibulum*, but more properly *iter ad tertium ventriculum*.”

Eminences. The fornix being cut off and inverted, or quite removed, we see first of all a vascular web, called *plexus choroides*, and several eminences more or less covered by the expansion of that plexus. There are four pairs of eminences which follow each other very regularly, two large and two small. The first two great eminences are named *corpora striata*; and the second, *thalami nervorum opticorum*. The four small eminences are closely united together; the anterior being called *nates*, and the posterior *testes*; but it would be better to call them simply *anterior* and *posterior tubercles*. Immediately before these tubercles there is a single eminence, called *glandula pinealis*,

Corpora striata. The corpora striata got that name, because in scraping them with the knife we meet, with a great number of white and ash-coloured lines alternately disposed, which are only the transverse section of the medullary and cortical laminæ mixed together in a vertical position in the basis of the cerebrum, as appears evidently by incisions made from above downward. These two eminences are of a greyish colour on the surface, oblong, roundish, pyriform, and larger on the fore than on the back part, where they are narrow and bent.

They lie in the bottom of the superior cavity of the lateral ventricles, which they resemble in some measure in shape, their anterior parts being near the septum lucidum, from which they separate gradually as they run backward, and diminish in size. They are in reality the convex bottoms of the ventricles; and it is at the lower part of the interstice between the largest portions of them, that we observe the great transverse cord, named *the anterior commissure of the cerebrum*, which I mentioned already in describing the anterior pillar of the fornix callosus. This cord communicates more particularly with the bottom of the corpora striata, by a turn toward each side.

Thalami nervorum opticorum. The thalami nervorum opticorum, are so named, because these nerves arise chiefly from them. They are two large eminences placed by the side of each other, between the posterior portions or extremities of the corpora striata. Their figure is semispheroidal and a little oval; and they are of a whitish colour on the surface; but their inner substance is partly greyish and partly white, so that, in cutting them, we see streaks of different colours like those of the corpora striata.

These two eminences are closely joined together; and at their convex part they are so far united, as really to become one body, the whitish outer substance being continued uniformly over them both.

Immediately within this whitish common substance these two eminences are closely contiguous till about the middle of their thickness : and from thence they separate insensibly toward the bottom, where, by the space left between them, a particular cavity is formed, named *the third ventricle* ; one extremity of which opens forward, the other backward, as we shall see hereafter. Some anatomists have mistaken the superficial connection of these eminences for the pons Varolii.

At the bottom these two eminences are elongated downward toward both sides, into two thick, round, whitish cords, which separate from each other like horns by a large curvature ; and afterwards, by a small curvature turned forward in an opposite direction to the former, and representing the tip of an horn, they approach each other again. The size of these nerves diminishes gradually from their origin to their anterior reunion. I shall have occasion to mention them in another place in speaking of the optic nerves.

Tubercula. The tubercles are four in number, two anterior and two posterior ; adhering together as if they made but one body situated behind the union of the thalami nervorum opticom. They are transversely oblong ; the anterior being a little more rounded, and broader or larger from before backward, than the posterior. Their surface is white, and their inner substance greyish. “ The names of *nates* and *testes*, given by the ancients to these tubercles, are not very proper, there being no great resemblance between them and the things from which the names are taken. Some of the moderns, with perhaps still less propriety, have called them *tubercula quadrigemina*. We shall use the names, however, as we find them.”

Directly under the place where the tubercles of one side are united to those of the other side, lies a small middle canal, “ called *iter ad quartum ventriculum*,” which communicates by its anterior opening with the third ventricle,

ventricle, under the thalami nervorum opticom, and, by its posterior opening, with the fourth ventricle, which belongs to the cerebellum, as we shall afterwards see.

Foramen commune posterius. Where the convex parts of the two anterior tubercles join these posterior convex parts of the thalami nervorum opticom, an interstice or opening is left between these four convexities; but it does not communicate with the third ventricle: "for the bottom of it is shut up by the pia mater. It has the ridiculous name of *anus* applied to it."

Glandula pinealis. The glandula pinealis is a small soft greyish body, about the size of an ordinary pea, irregularly round, and sometimes of the figure of a pine-apple, situated behind the thalami nervorum opticom above the tubercula quadrigemina. It is fixed like a small button to the lower part of the thalami by two very white medullary pedunculi, which at the gland are very near each other, but separate almost transversely toward the thalami.

It seems to be mostly of a cortical substance, except near the footstalks, where it is somewhat medullary. The footstalks are sometimes double, as if they belonged to the two anterior tubercles. This body adheres very close to the plexus choroides, by which it is covered, as we shall see hereafter; and it therefore requires some dexterity to separate it from the glandula, without altering its situation or breaking the pedunculi. This gland has been often found to contain gravel. Below the glandula pinealis there is a medullary transverse cord, called the *posterior commissure of the hemispheres of the cerebrum*.

"Immediately under the union or beginning of the thalami nervorum opticom, lies a particular cavity, called the *third ventricle* of the cerebrum. This cavity communicates at its upper and fore-part with the passage between the two lateral ventricles, and sends down from its under and fore part a passage through the infun-

fundibulum. It opens backwards into the passage called *iter ad quartum ventriculum*."

Infundibulum. Between the basis of the anterior pillar of the fornix, and the anterior part of the union of the optic thalami, lies a small medullary canal, named *infundibulum*. It runs down towards the basis of the cerebrum, contracting gradually, and terminates in a straight course by a small membranous canal, in a softish body situated in the sella turcica, named *glandula pituitaria*.

Plexus choroides. The plexus choroides is a very fine vascular texture, consisting of a great number of arterial and venal ramifications, partly collected in two loose fasciculi, which lie on each lateral ventricle, and partly expanded over the neighbouring parts, and covering in a particular manner the thalami nervorum opticorum, glandula pinealis, tubercula quadrigemina, and the other adjacent parts both of the cerebrum and cerebellum, to all which it adheres.

In each lateral portion of this plexus we observe a venal trunk; the ramifications of which are spread through the whole extent of the two portions. Near the glandula pinealis these two trunks approach each other; and uniting behind that gland, they open into the torcular or fourth sinus of the dura mater. When we blow into one of these trunks toward the plexus, the air passes into all its ramifications; and in some subjects, these two veins form one trunk which opens into the sinus.

The ventricular or loose portions of the plexus often appear to contain a great number of tubercles like glands; which in the natural state are extremely small, but grow bigger in diseases. To be able to examine them as we ought, the loose portions must be made to swim in clear water, and be there carefully expanded. Then, by the help of a microscope, we will see these tubercles in the natural state, like small folliculi or little bags more or less flattened.

Besides

Besides this vascular web or plexus of the septum lucidum, the fides of the fornix, of the eminences, ventricles, canals, and infundibulum, are all covered by a very fine membrane, in which, by injections or inflammations, we discover a great number of very fine vessels. This membrane is in a manner a continuation of the plexus, and that seems to be a detachment from the pia mater. By the same means we likewise discover an extremely thin membrane on the insides of the duplicature of the septum, though, in some subjects, these fides touch each other.

Glandula pituitaria. The pituitary gland is a small spongy body lodged in the sella turcica, between the sphenoidal folds of the dura mater. It is of a singular kind of substance, which seems to be neither medullary nor glandular. On the outside it is partly greyish and partly reddish, and white within. It is transversely oval or oblong; and on the lower part, in some subjects, it is divided by a small notch into two lobes, like a kidney-bean. It is covered by the pia mater as by a bag, the opening of which is the extremity of the infundibulum; and it is surrounded by the small circular sinuses which communicate with the sinus cavernosi.

§ 4. *Cerebellum.*

Situation and figure. THE cerebellum is contained under the transverse septum of the dura mater. It is broader laterally than on the fore or backsides, flatted on the upper side, and gently inclined both ways, answerable to the septum, which serves it as a kind of tent or ceiling. On the lower side it is rounder; and on the back-side it is divided into two lobes, separated by the occipital septum of the dura mater.

Structure. It is made up, like the cerebrum, of two substances, but it has no circumvolutions on its surface. Its sulci are pretty deep, and disposed in such a manner

as to form thin flat strata, more or less horizontal, between which the internal lamina of the pia mater insinuates itself by a number of septa equal to that of the strata.

Under the transverse septum, it is covered by a vascular texture, which communicates with the plexus choroides. It has two middle eminences called *appendices vermiformes*; one anterior and superior, which is turned forward; the other posterior and inferior, which goes backward. There are likewise two lateral appendices, both turned outward. They are termed *vermiformes*, from their resemblance to a large portion of an earth-worm.

Besides the division of the cerebellum into lateral portions, or into two lobes, each of these lobes seems to be likewise subdivided into three protuberances, one anterior, one middle or lateral, and one posterior: but they are not in all subjects equally distinguished either by their convexity or limits; but they may always be distinguished by the direction of their strata, those of the middle and anterior protuberance being less transverse than the posterior.

Fourth ventricle. When we separate the two lateral portions or lobes, having first made a pretty deep incision, we discover, first of all, the posterior portion of the medulla oblongata, of which hereafter; and in the posterior surface of this portion, from the tubercula quadrigemina, all the way to the posterior notch in the body of the cerebellum, and a little below that notch, we observe an oblong cavity which terminates backward like the point of a writing pen. This cavity is what is called the *fourth ventricle*. "Hence the under end of it is called *calamus scriptorius*."

At the beginning of this cavity we meet with a thin medullary lamina, which is looked upon as a valve between that canal and the fourth ventricle. A little behind this lamina, the cavity grows wider towards both sides, and then contracts again to its first size. It is lined

lined interiorly by a thin membrane, and seems often to be distinguished into two lateral parts, by a kind of small groove, from the valvular lamina to the point of the calamus scriptorius.

This membrane is a continuation of that part of the pia mater which lines the small canal, the third ventricle, infundibulum, and the two great ventricles. To be able to see the fourth ventricle in its natural state, in which it is narrowest, it must be laid open while the cerebellum remains in the cranium; and in order to that, the os occipitis must be sawed very low down.

On each side of this ventricle, the medullary substance forms a trunk which expands itself in form of laminæ through the cortical strata. We discover these medullary laminæ according to their breadth, by cutting the cerebellum in slices almost parallel to the basis of the cerebrum; but if we cut one lobe of the cerebellum vertically from above downward, the medullary substance will appear to be dispersed in ramifications through the cortical substance. These ramifications have been named *arbor vitæ*, and the two trunks from whence these different laminæ arise are called *pedunculi cerebelli*.

We cannot go on with the description of the other middle parts of the basis of the cerebellum, before that of the middle parts of the basis of the cerebrum; because these two kinds of parts are united, and jointly form the medulla oblongata. I shall only add here, that the strata of both substances of the cerebellum are not always of the same extent in the same portions or protuberances of each lobe. This appears merely by viewing the convex or outer surface of the cerebellum; for there we see, at different distances, some cortical strata shorter than others, and likewise that the extremities of the short strata diminish gradually in thickness till they are quite lost between two long ones.

If we make a small hole in the external lamina of the

the pia mater over one of the lobes of the cerebellum, without touching the inner lamina, and then blow into the cellular substance, by which these two laminæ are connected, through a small pipe introduced into the hole; the air will gradually swell that substance, and separate the strata more or less equally from each other through their whole extent; and we will see at the same time the disposition of all the membranous septa or duplicatures of the internal lamina of the pia mater, with the numerous distribution of the fine blood-vessels which run upon it, especially after a lucky injection, or in an inflammatory state of these membranes.

§ 5. *Medulla oblongata.*

THE medulla oblongata is a medullary substance, situated from before backward in the middle part of the bases of the cerebrum and cerebellum, without any discontinuation, between the lateral parts of both these bases: and therefore it may be looked upon as one middle medullary basis common to both cerebrum and cerebellum, by the reciprocal continuity of their medullary substances, through the great notch in the transverse septum of the dura mater; which common basis lies immediately on that portion of the dura mater which lines the basis of the cranium. The medulla oblongata is therefore justly esteemed to be a third general part of the whole mass of the brain, or as the common production or united elongation of the whole medullary substance of the cerebrum and cerebellum.

It is extremely difficult, if not altogether impossible, to examine or demonstrate it as we ought, in its natural situation; but we are obliged to do both on a brain inverted.

The lower side of the medulla oblongata, in an inverted situation, presents to our view several parts, which are in general either medullary productions, trunks of nerves, or trunks of blood-vessels.

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The chief medullary productions are these ; the large or anterior branches of the medulla oblongata, which have likewise been named *crura anteriora*, *femora* and *brachia medullæ oblongatæ*, and *pedunculi cerebri* : the transverse protuberance, called likewise *processus annularis* or *pons Varolii* : the small or posterior branches, called *pedunculi cerebelli*, or *crura posteriora medullæ oblongatæ* : the extremity or cauda of the medulla oblongata, with two pairs of tubercles ; one of which is named *corpora olivaria*, the other *corpora pyramidalia* ; and to all these productions we must add a production of the infundibulum and two medullary papillæ.

The great branches of the medulla oblongata are two very considerable medullary fasciculi ; the anterior extremities of which are separated, and the posterior united, so that, taken together, they somewhat represent a Roman V. These fasciculi are flat, much broader before than behind ; their surfaces being composed of several longitudinal and distinctly prominent medullary fibres. Their anterior extremities seem to be lost at the lower part of the corpora striata ; and it is for that reason that they are looked upon as the pedunculi of the cerebrum.

The transverse annular, or rather semi-annular, protuberance, is a medullary production, which seems at first sight to surround the posterior extremities of the great branches ; but the medullary substance of this protuberance is in reality intimately mixed with that of the two former. Varolius, an ancient Italian author, viewing those parts in an inverted situation, compared the two branches to two rivers, and the protuberance to a bridge over them both ; and from thence it has the name of *pons Varolii*. Its surface is transversely streaked ; and it is divided into two lateral parts by a very narrow longitudinal depression, which does not penetrate into its substance.

The small branches of the medulla oblongata are lateral productions of the transverse protuberance, which

by their roots seem to encompass that medullary portion in which the fourth ventricle or calamus scriptorius is formed. They form in the lobes of the cerebellum, on each side, these medullary expansions, a vertical section of which shows the white ramifications commonly called *arbor vitæ*; and they may be justly enough styled *pedunculi cerebelli*.

The extremity is no more than the medulla oblongata contracted in its passage backward to the anterior edge of the foramen magnum of the os occipitis, where it terminates in the medulla spinalis; and in this part of it several things are to be taken notice of. We see first of all, four eminences, two named *corpora olivaria*, and the other two *corpora pyramidalia*. Immediately afterwards, it is divided into two lateral portions by two narrow grooves, one on the upper side, the other on the lower. They both run into the substance of the medulla, as between two cylinders, flatted on that side by which they are joined together.

When we separate these ridges with the fingers, we observe a crucial intertexture of several small medullary cords, which go obliquely from the substance of one lateral portion into the substance of the other. M. Petit, member of the royal academy of sciences, and doctor of physic, is the author of this discovery, by which we are enabled to explain several phenomena both in physiology and pathology; of which in another place.

The *corpora olivaria* and *pyramidalia* are whitish eminences situated longitudinally near each other on the lower side of the extremity or cauda, immediately behind the transverse or annular protuberances. The *corpora olivaria* are in the middle, so that the interstice between them, which is only a kind of superficial groove, answers to the inferior groove of the following portion.

The *corpora pyramidalia* are two lateral eminences depending on the *olivaria*. Willis gave the name of
pyra-

pyramidalia to what I have called *olivaria*, after the late M. Duverney in his treatise of the organ of hearing. These four eminences are situated on the lower half of the medulla ; which observation I here repeat, to make it be remembered, that, in all the figures and demonstrations, these parts are represented as superior, which in their natural situation are inferior. Thus these eminences are under the fourth ventricle, and under the pedunculi cerebelli.

The tubercula mammillaria, which are situated very near the production of the infundibulum, have been taken for glands ; probably because of their greyish inner substance, which, however, does not seem to be different from that of several other eminences of the medulla oblongata. And for that reason I choose rather to call them, from their figure, *tubercula mammillaria*, than *papillæ medullares*.

These tubercles seem to have some immediate relation to the roots or bases of the anterior pillar of the fornix ; so that they might be named, as M. Santorini has done, *the bulbs of these roots*, though they appear to be likewise partly a continuation of other portions of the cortical and medullary substance, of a particular texture.

The beak or tube of the infundibulum is a very thin production from the sides of that cavity ; and it is strengthened by a particular coat given to it by the pia mater. It is bent a little from behind forward, toward the glandula pinealis, and afterwards expands again round this gland.

The membrana arachnoidus, or external lamina of the pia mater, appears to be very distinctly separated from the internal lamina, in the interstices between all these eminences on the lower side of the medulla oblongata, without any visible cellular substance between them. The internal lamina adheres much more to the surface of these interstices than to that of the eminences. The external lamina is as it were buoyed up by the eminences,

ces, and equally stretched between their most prominent parts, to which it sticks very close; and in this respect, the roots or great cornua of the optic nerves may be joined to these eminences.

We must observe in general concerning the eminences of the medulla oblongata, that those which are medullary on their outsides or surfaces, are interiorly either entirely cortical, or partly cortical and partly medullary, or formed by a singular mixture of these two substances, which still remains to be unfolded, as well as many other particularities observable in examining the internal structure of the brain.

From this common portion of the cerebrum and cerebellum, arise almost all the nerves which go out of the cranium, through the different foramina by which its basis is perforated. It likewise produces the medulla spinalis, which is no more than a common elongation of the cerebrum and cerebellum, and of their different substances; and therefore the medulla oblongata may justly be said to be the first origin or primitive source of all the nerves which go out through the spina dorsa, and consequently of all the nerves of the human body.

§ 6. *Medulla spinalis.*

THE medulla spinalis is only an elongation of the extremity of the medulla oblongata; and it has its name from its being contained in the bony canal of the spina dorsa. It is consequently a continuation or common appendix of the cerebrum and cerebellum, as well because of the two substances of which it is composed, as because of the membranes by which it is invested.

In the description of the fresh bones, I mentioned a ligamentary tube which lines the inner surface of this bony canal from the great occipital foramen to the os sacrum, representing a very long flexible funnel. I
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likewise mentioned the yellowish and very elastic ligaments that lie in the great posterior notches of all the vertebræ, and adhere very closely to the ligamentary tube.

The dura mater, after it has lined the whole internal surface of the cranium, goes out by the foramen magnum occipitis; and forms a kind of funnel, in its progress downward, through the bony canal of the vertebræ. As it goes out at the occipital hole, it joins the beginning of the ligamentary funnel already mentioned, and adheres very strongly to it. That portion of the pericranium which terminates exteriorly at the edge of the great foramen, joins the funnel likewise; which by all these successions becomes very strong, and capable of resisting the greatest violences.

This adhesion of the dura mater to the ligamentary funnel is gradually discontinued below the first vertebra; and from thence the dura mater forms a separate tube, which runs down in the bony canal all the way to the os sacrum, the capacity of it answering to that of the canal; but it does not adhere closely to the sides, as it does to that of the cranium. It is surrounded by a slimy substance, which, near the lower end of the canal, resembles fat.

The spinal marrow is made up of a cortical and medullary substance, as the cerebrum and cerebellum; but with this difference, that the ash-coloured substance lies within the other; and in a transverse section of this medulla the inner substance is "somewhat of an oblong form, but has its sides bent inwards."

The body of the medulla spinalis runs down all the way to the first vertebra of the loins, where it terminates in a point. The size of it is proportionable to that of the bony canal, so that it is larger in the vertebræ of the neck than those of the back. It is a little flattened on the fore and back sides; so that we may distinguish in it two sides, one anterior, the other posterior, and two edges. It is likewise in a manner divided into two lateral

teral halves by a groove, which runs along the middle of each side, being a continuation of those in the extremity of the medulla oblongata.

Each lateral portion sends off from both the fore and back sides, between the grooves and the edges, at different distances, flat fasciculi of nervous filaments turned toward the nearest edge. The anterior and posterior fasciculi having got a little beyond the edge of the medulla, unite in pairs, and form on each side a kind of knots called *ganglions* by anatomists, each of which produces a nervous trunk. These ganglions are made up of a mixture of cortical and medullary substance, accompanied by a great number of small blood-vessels.

The dura mater which invests the medulla, sends out on each side the same number of *vaginæ*, as there are ganglions and nervous trunks. These *vaginæ* are productions of the external lamina; the internal lamina, which is very smooth and polished on the inside, being perforated by two small holes very near each other, where each vagina goes off, through which holes the extremities of each anterior and posterior fasciculus are transmitted; and immediately after their passage through the internal lamina, they unite.

The triangular spaces left between the anterior and posterior fasciculi and edge of the medulla, are filled from one extremity to the other by an indented ligament, very thin and shining, having the same number of indentations as there are pairs of fasciculi. It is fixed at different distances to the edge of the medulla, from whence it sends filaments to the internal lamina of the dura mater, by which the anterior fasciculi are distinguished from the posterior.

The *membrana arachnoides* is here very distinct from the internal lamina of the pia mater: so that, by blowing through a hole made in the arachnoides, it will swell from one end to the other, like a transparent gut. The internal lamina, called in this place simply the *pia mater*,

mater, adheres very closely to the medulla spinalis, and sends many productions and septa through its substance. When we blow through a hole made in the pia mater, through the substance of one lateral portion of the medulla, the air penetrates through the whole, and the pia mater, which covers the other lateral portion, is separated from it.

The membrana arachnoides adheres here more closely to the pia mater at the lower than at the upper part, being in a manner suspended by the indented ligament which runs along both edges of the medulla, and is fixed by a filament to the internal lamina of the dura mater in each interstice between the nervous fasciculi, as has been already said. It also gives off elongations in the same manner as the dura mater to each nervous trunk or rope, as we shall see hereafter.

§ 7. *The Nerves of the Brain and Spinal Marrow, from their origin to their going out of the Cranium and Spine.*

WE shall afterward find, that the nerves arise either from the brain, medulla oblongata, or spinalis; that they go out in fasciculi disposed in pairs; that then pairs are reckoned to belong to the brain and medulla oblongata, of which nine go out through the foramina of the cranium, and the tenth arises from the extremity of this medulla as it passes through the great occipital hole; and lastly, that about 30 pairs are reckoned to belong to the medulla spinalis, of which seven pass through the lateral notches of the vertebræ cervicis, twelve through those of the back, five through those of the loins, and five or six through the anterior holes of the os sacrum, and one at the sides of the os coccygis.

My design is here principally to mention some particular observations about the nerves, while they remain within the cranium; the rest of the course through the whole body shall be afterward sufficiently described.

Nerves of the medulla oblongata. The first pair of nerves that arise from the medulla oblongata are the olfactory, anciently called *processus mammillares*. These are two very flat and soft medullary ropes, each arising first by medullary fibres from the outside of the lower part of the corpora striata, between the anterior and middle lobe, on each side of the cerebrum, and afterwards by another filament more internally, and by a third, which is more posterior and very long. They run under the anterior lobes of the cerebrum, being lodged in two superficial grooves in the basis of these lobes, and lying immediately on the dura mater, from the clinoid apophyses to the os ethmoides.

They are first of all considerably incurvated from without inwards or toward each other, and having reached near the back-side of the os ethmoides, they run for a small space parallel to and at some distance from each other. Backward they are very thin; but they gradually increase in bulk in their course forward, toward each side of the crista of the ethmoidal bone, where they terminate in elongated papillæ, the substance of which appears to be softer and less white than that of the ropes.

These papillæ lie on the two sides of the lamina cribrosa, and send down a nervous filament into each hole of that lamina. At the same place, the dura mater sends off the same number of vaginæ which invest and accompany the nervous filaments and their ramifications on the internal parts of the nose.

I have already related the origin of the second pair, or optic nerves, from the eminences called *thalami nervorum opticomum*; and I have described their great curvature, and traced them all the way to their re-union, which happens immediately before the superior part of the glandula pituitaria, and consequently before the beak or production of the infundibulum. The internal carotids run upon the outsides of these nerves, immediately

diately after their union, and before they pass thro' the foramina optica.

Besides their origin from the optic thalami, these nerves have likewise a kind of communication with the tubercula quadrigemina anteriora by very fine filaments, one extremity of which is lost in the tubercles, the other in the roots of the great arches or bodies of the optic nerves. The internal structure of these nerves seems to change at their entrance into the optic holes, as we shall see in another place.

The union of these nerves by the small curvatures of their cornua, is very difficult to be unfolded in human bodies. This union is commonly found to be very close: but, in some subjects, it seems to be no more than a strong adhesion; in others, to be partly made by an interfection or crossing of fibres. They have been found quite separate; and in other subjects one of them has been observed to be very much altered both in size and colour through its whole passage, the other remaining in its natural state.

The third pair, called *nervi motores, oculi communes, oculares communes*, and *oculo-musculares*, arise from the union of the anterior edge of the great transverse protuberance, with the two great branches of the medulla oblongata. They pierce the dura mater behind the lateral parts of the posterior apophysis of the sella sphenoidalis, and pass afterwards each in the neighbouring sinus cavernosi, by the side of the carotid artery, and all the way to the broad portion of the superior orbital fissure, where they are divided in the manner to be afterward described.

The fourth pair, called *nervi trochleares, musculares obliqui superiores*, and most commonly *pathetici*, are very small and tender, and, in proportion, very long. They arise each behind the tubercula quadrigemina, and from the lateral part of the valviform expansion at the entry of the fourth ventricle. From thence they take their course forward all the way to the edge of the anterior

extremities of the transverse sinus, where on each side they enter the duplicature of the dura mater, and advancing into the sinus cavernosi, they accompany the third pair to the superior orbital fissure.

The fifth pair, called *nervi innominati*, or *trigemini*, are at first large trunks arising chiefly from the lateral and posterior parts of the great transverse protuberance, and a little from the corpora olivaria and pyramidalia. They run down obliquely forward on the extremity of the upper or anterior side of the apophysis petroso, very near the side of the sella sphenoidalis, where they enter the duplicature of the dura mater and sinus cavernosi.

At their entry into the sinus, they form a kind of flat irregular ganglion, from which some filaments are sent off to the dura mater; and immediately afterward, each of them is divided into three great branches, one superior or anterior, one middle, and one inferior or posterior. The first branch, which may be termed *ocularis* or *ophthalmicus*, accompanies the nerves of the third and fourth pairs, to the superior or orbital fissure. The second, called *maxillaris superior*, goes out by the superior maxillary hole; and the third, named *maxillaris inferior*, by the inferior maxillary hole. As the great trunk of this nerve runs down, it perforates the membrana arachnoides, which at this place forms a kind of ceiling.

The sixth pair, named *motores oculorum externi*, *oculares* or *ophthalmici externi*, and *oculo-musculares externi*, are small nerves, but still not so small as the fourth pair; and I have sometimes found them double. They arise partly from the oblong inferior eminences, immediately behind the transverse protuberance, and partly from this protuberance; and passing immediately under it, they pierce the dura mater behind the occipital symphysis of the sphenoidal bone.

They run on each side in the duplicature of the dura mater to the cavernous sinus; and having entered that sinus, each of them accompanies the first branch
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of the fifth pair to the superior orbitary fissure. In this course they communicate with the first branch just mentioned, and are increased on the fore-part by a filament or two, which arise from the great sympathetic nerve, and run up with the carotid.

The seventh pair, named *auditorii*, arise from the lateral and posterior part of the transverse protuberance, near the pedunculi of the cerebellum, by two cords, one small and solid, the other large and soft, which from thence is called *portio mollis*, and the first, *portio dura*, or, as I have named it, *nervus sympathicus minimus*. The two nerves on each side accompany each other very closely, all the way to the internal foramen auditorium.

The eighth pair, named *par vagum*, *nervi vagi*, or *sympathetici medii*, arise from the posterior extremities of the large branches or crura of the medulla oblongata, from the transverse protuberance, and from the anterior part of the inferior oblong eminences behind the transverse protuberances, by numerous filaments, which all together make a broad band on each side, which runs toward the foramen lacrum, where it pierces the dura mater, and goes out through the anterior part of that hole, having been first joined by a nervous portion that runs up from the medulla spinalis through the great occipital foramen by the name of *nervus accessorius octavi paris*, or *nervus spinalis*. This additional nerve goes out with that of the eighth pair through the foramen lacrum, lying behind it, but distinguished from it by a membranous septum.

The ninth pair, called *nervi hypoglossi externi*, *hypoglossi majores*, and commonly *gustatorii*, arise each from the lateral part of the extremity of the medulla oblongata, between the oblong inferior eminences, by several filaments, which uniting together, form commonly two small ropes on each side, which pierce the dura mater separately, and presently afterwards form one rope, which

which goes out of the cranium through the anterior condyloide hole.

The tenth pair, called *nervi sub-occipitales*, arise under the ninth pair, chiefly from the anterior and a little from the lateral part of the extremity of the medulla oblongata, opposite to the posterior part of the condyloide apophysis of the occipital bone, by a single plane or fasciculus of small filaments which pierce the dura mater directly from within outward, at the same place where the vertebral arteries perforate it from without inwards.

Nerves of the medulla spinalis. The nerves formed by the lateral union of the anterior and posterior filaments of the medulla spinalis, go out of the bony canal of the spina dorſi, toward each ſide, through the intervertebral holes, through the anterior holes of the os ſacrum, and the lateral notches of the os coccygis; and from thence they have the general name of *nervi vertebrales*. They are divided in the ſame manner as the vertebrae, into ſeven pair of cervical nerves, twelve pair of dorſal, five pair of lumbar, and five or ſix pair of *nervi ſacri*.

I begin the enumeration of the vertebral nerves by thoſe which go out between the firſt and ſecond vertebrae; and the ſituation of the dorſal or coſtal nerves, which are true intercoſtals, determined me to this diſpoſition, the firſt pair of theſe nerves paſſing between the firſt and ſecond true ribs.

As the ſpinal marrow which furniſhes all theſe nerves ſeldom goes lower than the firſt or ſecond vertebra of the loins, the ſituation of the fasciculi of nervous filaments muſt be different from that of the holes through which they paſs; and ſeveral of theſe fasciculi, both anterior and poſterior, muſt be longer than the reſt. This we find from experience to be the caſe in the following manner.

The fasciculi of nervous filaments of the medulla ſpinalis, which produce the cervical nerves, run more or leſs tranſverſely toward each ſide from their origin to their

their passage through the intervertebral holes. The fasciculi which form the dorsal nerves run a little obliquely downward from their origin to the intervertebral holes; and those which form the lumbar nerves run down more and more longitudinally from the medulla to the holes by which they go out.

Therefore the cervical fasciculi are very short in the spinal canal; the dorsal fasciculi are longer, and the fasciculi from the loins and os sacrum very long. It must likewise be observed, that the fasciculi of the four lowest pairs of the cervical nerves, and first pair of the dorsal nerves, are broader and more compounded than the following, because the brachial nerves are a continuation of these. The filaments belonging to the lumbar nerves, and those of the os sacrum, are likewise very broad, and made up of numerous filaments, as being the roots of the large nerves which go to the lower extremities. The dorsal filaments are very small.

The cervical and lumbar fasciculi are not only broader and made up of more filaments than the dorsal, but also situated much closer to each other, the lumbar fasciculi being still more so than the cervical; whereas in the dorsal, a considerable interstice is left between the fasciculi.

These lumbar fasciculi, from their origin to the extremity of the os sacrum, form, through the whole canal of the lumbar vertebræ and of the os sacrum, a large bundle of nervous ropes, called by anatomists *cauda equina*, because of some resemblance which it bears to a horse's tail, especially when taken out of the canal, and extended in clear water.

Though the medulla spinalis ends at the first vertebra of the loins, the vagina of the dura mater by which it is invested, is continued through the rest of the bony canal all the way to the extremity of the os sacrum, and involves the great bundle or *cauda equina*, the cords of which pierce it on each side nearly opposite to the places where they pass through the intervertebral holes,

holes, and the anterior holes of the os sacrum, almost in the same manner as was said above in describing the general formation of the vertebral nerves.

This vagina of the dura mater being separated from the canal of the vertebræ, and the lateral elongations which serve for particular vaginæ to the cords being cut off, it presently shrinks up and contracts in the same manner as all the other elastic parts of the human body; for instance, as an artery does when cut transversely soon after death. Therefore its true length must be taken while it is *in situ*, and likewise the true situation of the lateral elongations.

From all this a conclusion may be drawn of great importance, not only in anatomical and philosophical inquiries, but also for understanding local diseases, wounds, &c. which is, that when we have occasion to consider any particular nerves near the vertebræ of the back or loins, or near the os sacrum, we must remember, that in the spina dorsi, the origin of these nerves is not even with their passage out of the spine, but proportionably higher. If, for instance, we inquire about any of the lowest nervi sacri near the os coccygis, we must not stop at the extremity of the os sacrum, but trace its origin as high as the last vertebra of the back, or first of the loins.

The membrana arachnoides accompanies the original fasciculi separately, to their passage through the lateral elongations of the dura mater, forming a kind of duplicature, breaks, or discontinuations, between the cords which run in the vagina of the dura mater. The internal lamina of the pia mater, or the pia mater simply, as it is here reckoned, adheres very closely both to the fasciculi and filaments of which they are composed.

Among the original productions of the nerves of the medulla spinalis, we ought still to reckon the formation of the nervi accessorii of the eighth pair, or of those that I call *sympathetici medii*. They arise from the lateral

teral parts of this medulla by several filaments, about the third or fourth vertebræ of the neck, and sometimes lower. And, if my memory does not fail me, I once traced them to the middle of the back. They run up on each side between the anterior and posterior ranks of the nervous fasciculi, increasing gradually in size by the accession of new filaments from the posterior fasciculi.

Having reached above the first vertebra of the neck, they have a kind of adhesion or communication with the neighbouring ganglions of the nervi sub-occipitales, or those of the tenth pair. Above this adhesion they receive two filaments each, from the back-side of the medulla, and afterwards continue their course towards the great occipital foramen. As they enter the cranium, they communicate with the nerves of the ninth and tenth pairs; and afterwards they join those of the eighth pair, with which they return out of the cranium.

§ 8. *Blood-vessels of the brain and medulla spinalis.*

Arteries. THE arteries which supply the cerebrum, cerebellum, and medulla oblongata, come partly from the carotids which enter the cranium through the canals in the apophyses petrosæ of the ossa temporum, and partly from the vertebrales which enter by the great occipital foramen, and send off the arteriæ spinales into the canal of the spine for the medulla lodged there.

All these arteries are divided into several branches, which send out a great number of ramifications distributed through both substances of the brain, and thro' the whole extent of the pia mater. The dura mater, both of the cerebrum and cerebellum, has arteries peculiar to it, which have been already described.

The internal carotid on each side enters the cranium by the great canalis petrosus, in an angular or winding course, as was observed in the description of the skeleton. The inner surface of this canal is lined by a production

duction common to the dura mater and inferior pericranium; to which the artery adheres only by a loose filamentary substance, in which the plexiform filaments run that belong to the great sympathetic nerve, commonly called the *intercostal*.

Having passed through the bony canal, it immediately bends upward toward a notch in the sphenoidal bone, and through that notch it enters the cranium. Immediately after this, it penetrates the cavernous sinus on the side of the fella sphenoidalis; where having formed a third curvature, it goes out from it, from below, upwards; and is bent a fourth time round the anterior clinoid apophysis, from before backward. By this course it is in a manner bathed in the blood of the cavernous sinus, together with the third, fourth, fifth, and sixth pairs of nerves.

After this fourth curvature, the internal carotid having now reached the side of the infundibulum, and consequently being very near its fellow, these two arteries communicate sometimes by a very short transverse arterial production. At this place each of them, "after sending a branch through the foramen opticum to the eye," divides into two principal branches, one anterior, the other posterior; and sometimes into three, in which case there is a middle branch between the two former.

The anterior branch runs, first of all, forward under the basis of the cerebrum, separating a little from the same branch of the other carotid. They approach each other again under the interspace between the two olfactory nerves, communicating by a very short anastomosis, and sending small twigs to that pair of nerves. They afterwards separate, being each divided into two or three rami.

The first ramus of the anterior branch goes to the anterior lobe of the cerebrum. The second, which is sometimes double, is inverted on the corpus callosum, to which it gives ramifications, as also to the falx of the
dura

dura mater and middle lobe of the cerebrum. The third, which is sometimes a distinct branch, sometimes only an additional ramus to the second, goes to the posterior lobe of the cerebrum. This third ramus is sometimes so considerable as to deserve to be reckoned the middle branch of the three principal ones.

The posterior branch communicates first of all with the vertebral artery of the same side, and then is divided into several rami on the superficial circumvolutions of the cerebrum, and between these circumvolutions all the way to their bottom. The anterior and middle branches, when there are three, distribute the same kind of ramifications to the circumvolutions, and to their interstices.

All these different ramifications run on the duplicature of the pia mater, from which they receive a kind of additional coats; and the capillaries being distributed upon it in a reticular manner, do afterwards penetrate the cortical and medullary substance; in which last they terminate insensibly.

The vertebral arteries enter through the great occipital foramen, having first pierced on each side the elongations of the dura mater at the same place where the sub-occipital nerves, or those of the tenth pair, pierce it as they go out; the arteries in this place lying above the nerves.

At their entry into the cranium they send each several ramifications to the cauda of the medulla oblongata, and to the corpora olivaria and pyramidalia: which ramifications are distributed on the sides of the fourth ventricle; produce the plexus choroides; are spread on the whole surface of the cerebellum; insinuate themselves between the strata, always invested by the duplicature of the pia mater; and are at length lost in both substances of the cerebellum.

Afterwards the two vertebral arteries turn toward each other, for the most part immediately under the posterior edge of the great transverse or semi-annular

protuberance of the medulla oblongata, where they unite and form one common trunk. This trunk passes directly from behind forward, under the middle of the great protuberance, and partly in the middle groove of the convex surface of that protuberance, at the anterior edge of which it terminates.

In its passage through the groove, this trunk sends off several small branches on each side, which surround transversely the lateral portions of the protuberance, being partly lodged in the small lateral grooves of these portions. These lateral branches are afterwards distributed to the neighbouring parts of the cerebrum, cerebellum, and medulla oblongata.

This common or middle trunk of the vertebral arteries having reached the edge of the great protuberance, is divided again into small branches; each of which soon communicates with the trunk of the internal carotid on the same side. Instead of this bifurcation, the two last or most anterior lateral branches send each sometimes a small branch forward, which form the anastomoses with the internal carotids.

The principal arteries of the medulla spinalis, called commonly *arteriæ spinales*, are two in number, one anterior and one posterior, lodged in the grooves by which the medulla is divided into lateral portions on both sides. They arise from the vertebral arteries, a little above the great occipital foramen, where these arteries send each a small ramus downward, as soon as they enter the cranium; and having got under the extremity of the medulla oblongata, they send off two other branches backward.

The first two branches uniting soon after their origin, form the *arteria spinalis anterior*, which runs down within the canal of the vertebræ along the anterior groove of the medulla. The other two small branches are inverted on the sides of the medulla oblongata, and from thence running backward, they unite much in the same manner with the first two, and form the *arteria spinalis*

spinalis posterior, which runs down along the posterior groove of the medulla spinalis.

The two spinal arteries, in their course downward along the medulla, send off on each side lateral ramifications, by which they frequently communicate with each other, and likewise with the vertebral arteries of the neck, with the intercostals, and sometimes they are in a manner split for a little way, and then unite again.

The veins of the cerebrum and cerebellum, &c. may in general be looked upon as not only forming the longitudinal sinus of the dura mater, and the two great lateral sinuses, but also all the inferior sinuses of that membrane; in all which sinuses the veins terminate by different trunks, in the manner already said in the description of the great superior sinus. Their principal ramifications accompany all the cortical circumvolutions of the cerebrum, and directions of the strata of the cerebellum, running always in the duplicature of the pia mater. The veins of the plexus choroides, in general, are of the number of those already mentioned.

The veins of the medulla spinalis terminate partly in the superior extremities of the two vertebral veins, partly in the two venal ropes termed *sinus venosi*, which run down both ways laterally on the anterior convex side of the production of the dura mater, and form at different distances reciprocal communications, by semi-annular arches, as by so many subordinate sinuses. The two longitudinal sinuses communicate likewise in their passage with the vertebral veins, in the same manner as the neighbouring arteries.

§ 9. *Uses of the Brain, and of its appendages in general.*

WE are obliged to the great Malpighi for the first and best instructions concerning the manner of examining the structure of the brain, especially that of the

two substances of which it is made up, and for putting us in a condition to be able to conjecture something about its uses. The experiments and observations of that illustrious and faithful searcher into nature, having been repeated by several excellent philosophers, and confirmed by comparative anatomy, leave us no room to doubt that the brain is a secretory organ, or, as it is called by anatomists, *a gland*.

It is to no purpose to dispute about words, when we are agreed as to things themselves. Anatomists have, for many years past, understood by the word *gland*, an organ fitted to separate some particular fluid from the mass of blood, as universally as they mean by the word *muscle* all sorts of fleshy fibres capable of contraction; and this last term might be cavilled at and rejected as justly as the other.

The whole matter of secretions must be owned to be very obscure; but it is to be hoped that the brain and liver will some time or other lead us so far from the knowledge of it, as at least to be able to distinguish truth from falsehood.

The greyish or ash colour of the cortical substance is not the effect of a particular mixture of red and white; at least we have no experiment to prove it. The blood indeed gives this substance a slight reddish cast; but the ash-colour, which seems to be the characteristic of the structure of these secretory organs, is not owing to that.

We learn from M. Ruysch's anatomical injections, that the cortical substance is chiefly composed of vessels; that, by making these vessels swim in a clear pellucid liquor, their extremities represent an infinite number of fine brushes or vascular tufts; and that his injection fills even the smallest filaments of these tufts. He tells us likewise, that in these last filaments the structure is altered; and that by the mechanism of this change, the functions attributed to glands may be performed.

But still these injections and preparations do not unravel

reveal the mystery : neither is the existence of these pencils or tufts sufficiently demonstrated ; for they are only the last extremities of the small arteries macerated in water, or some other liquor, after being injected, and then artfully separated from the other essential parts of the organ.

In the first place, they are separated from the venal extremities which must answer to these tufts, in what manner soever that be brought about. Secondly, they are separated from the membranous filaments of the pia mater, which in the natural state tie these arterial extremities to each other, and give them a different disposition from that of tufts or pencils. Thirdly, by this separation, the arterial extremities are separated from their connections with the medullary substance ; which both experiments and comparative anatomy show to be fibrous.

It is nowise surprising, that these capillary extremities, thus stripped, should float loosely and freely when moved in a fluid, and that they should put on the appearance of pencils or tufts, being in this state only the truncated extremities of small vessels. When we consider these circumstances attentively, we find ourselves obliged to return to the small glandular bodies and folliculi, &c. of Malpighi ; of which in another place ; and at the same time we must acknowledge, that Ruysch's fine injections have discovered these minute bodies to be of a vascular substance, the structure of which we are still ignorant of.

In a word, Malpighi has discovered the glandular tubercles and folliculi, without destroying their natural connections. Ruysch has discovered a considerable part of their structure by destroying their connections. We are therefore very much beholden to both these illustrious anatomists ; and it is only by joining their observations to each other that we can ever be able to form an idea of the secretory organs, which will answer

all the phænomena concerning the different secretions in the human body.

The infinite number of these small secretory clusters, strain or filter the mass of blood carried to them by the numerous ramifications already mentioned, and separate from it an excessively fine fluid; the remaining blood being conveyed back by the same number of venal extremities into the sinuses of the dura mater, and from thence into the jugular and vertebral veins.

This subtle fluid, called commonly *animal spirit*, *nervous juice*, or *liquor of the nerves*, is continually forced into the medullary fibres of the white portion of the cerebrum, cerebellum, medulla oblongata, and medulla spinalis; and, by the intervention of these fibres, supplies and fills the nerves, which are a continuation of them.

All the nervous ropes, as they pass through the foramina of the cranium and vertebræ, are accompanied by particular elongations of the pia and dura mater. Those of the dura mater serve them for vaginæ in their passage through the bony openings. Those of the pia mater not only accompany and invest each nervous rope, but also form internal septa between all the filaments of which each rope consists. It is known from many experiments, that the nerves are the primitive or original organs of all muscular motion and of all animal sensation; and that these two functions depend in general on the brain: but we are ignorant of the nature of this dependence, and of the particular uses of the medullary fibres of the nervous fluid, and of the membranous productions which accompany the fibres and nerves.

Neither is there any thing certain in what has been said concerning the design or particular uses of the superficial conformation of the cerebrum and cerebellum, or of the different configuration of their turnings, circumvolutions, eminences, depressions, expansions, and various folds. It may be affirmed in general, that by
this

this structure the extent of the secretory organ of the nervous fluid is increased very considerably, and the particular functions of each nervous rope distinguished, and likewise their general and reciprocal correspondence, both in regard to the exquisiteness of the organs of sensation, and the activity of the organs of motion.

The falk of the dura mater hinders one portion of the cerebrum from pressing on the other, when we lie on one side. The transverse septum serves for a tent to the cerebellum, and defends it from a mortal compression, which it must otherwise be liable to from the cerebrum, especially when we walk or jump.

The septum and productions of the pia-mater connect and strengthen all the circumvolutions, divisions, and ridges, of the cerebrum, cerebellum, &c. and sustain, in a general and almost incomprehensible manner, all the branches and ramifications of the blood-vessels, all the medullary filaments, and all the elongations and ropes that depend on these.

§ 10. *A Dissertation on the Anatomy of the Brain, by M. STENO, read in the Assembly held at M. THEVENOT's House in the year 1668.*

GENTLEMEN,

Instead of promising that I shall satisfy your curiosity in what relates to the anatomy of the brain, I begin by publicly and frankly owning that I know nothing of the matter. I wish I were the only person under a necessity of talking in this manner, because I might in time become acquainted with what others know; and it would be a great blessing to mankind, if this most delicate part, and which is liable to so many dangerous diseases, were as well understood as the generality of anatomists and philosophers imagine it to be. In this, few imitate the sincerity of Silvius, who never talks positively concerning the brain, though he has been at more pains about it than any man that I know. The num-

ber of those who think every thing easy, is infinitely the greatest; and they give us the history of the brain, and disposition of its parts, with the same confidence and assurance, as if they had been present at the formation of this surprising machine, and had been let into all the designs of the great Architect. Though the number of these positive gentlemen may be very great, and though I cannot pretend to answer for the sentiments of all the rest, I am nevertheless very much convinced, that they who search for solid knowledge, will find nothing satisfactory in all that has been written about the brain. It is very certain that it is the principal organ of the soul, and the instrument by which it works very wonderful effects. The soul, which imagines it can penetrate into every thing without it, and that nothing in the world can set bounds to its knowledge, is nevertheless utterly at a loss to describe its own habitation, and is no where more to seek than at home. We need only view a dissection of that large mass the brain, to have ground to bewail our ignorance. On the very surface you see varieties which deserve your admiration: but when you would look into its inner substance, you are utterly in the dark, being able to say nothing more, than that there are two substances, one greyish, the other white, which last is continuous with the nerves distributed all over the body; that the greyish substance serves in some places for a cortex to the white, and that in other places it separates the white filaments from each other.

If we are asked what these substances are, in what manner the nerves are joined in the white substance, or how far their extremities penetrate into it? all we can do is to own our ignorance, except we be resolved to increase the number of those who prefer the applause of the public to sincerity and truth. For to say that the white substance is only an uniform body like wax, without any art concealed in it, would be to think too meanly of this great masterpiece of nature. We are
sure,

sure, that wherever there are fibres in the body, they always observe a certain regular order, more or less complex in proportion to the functions for which they are appointed. If this substance is every where fibrous, as it appears in many places to be, you must own that these fibres are disposed in the most artful manner; since all the diversity of our sensations and motions depends upon them. We admire the contrivance of the fibres of every muscle, and ought still more to admire their disposition in the brain, where an infinite number of them, contained in a very small space, do each execute their particular offices without confusion or disorder.

The ventricles or cavities of the brain are no less unknown than its substance. They who place the animal spirits there, think they are as much in the right as they who make them receptacles of the excrements; but they are both equally puzzled when they are desired to explain the origin of these spirits and excrements. They may come from the vessels found in these cavities as well as from the substance of the brain; and it is equally difficult to determine how they get out.

Among those who place the animal-spirits in the ventricles, some make them pass from the anterior to the posterior ventricles, there to meet with the entries of the nerves; while others affirm, that these entries are in the anterior ventricles. Some imagine, that the excrements of the brain are contained in the ventricles, because they see something like excrements there; but they own that there is a ready passage for them from the brain down to the medulla, as into the infundibulum; and supposing they go into the infundibulum, they may be carried from thence into the sinuses of the dura mater; and there is some reason to believe that they may have an immediate passage into the eyes, nares, and mouth.

We are still more uncertain about what relates to the
animal-

animal-spirits. Are they blood, or a particular substance separated from the chyle by the glands of the mesentery? or may they not be derived from a lymphatic serum? Some compare them to spirit of wine, and it may be doubted whether they are not the matter of light. Our common dissections cannot clear up any of these difficulties.

The true manner of dissecting the brain is as little known as its substance. I need not mention the method of cutting it into slices, because it is owned by every body that nothing can be learned that way. The second method of unfolding all the plicæ is something more artful; but it only shows us the outer surface of what we want to know, and even that very imperfectly.

The third method of unfolding the plicæ, and separating the two substances, goes no further than the surface of the medulla. These three methods have been differently combined; and they may be still more diversified, according as they are executed longitudinally, transversely, &c.

As for my own part, it is my opinion, that the true method of dissection would be to trace the nervous filaments through the substance of the brain, to see which way they pass, and where they end; but this method is accompanied with so many difficulties, that I know not whether we may hope ever to see it executed without a particular manner of preparing. The substance of the brain is so soft, and the fibres so tender, that they can hardly be touched without breaking. Since, therefore, anatomy has not hitherto arrived to that degree of perfection, as to make the true dissection of the brain, let us, without flattering ourselves any longer, freely acknowledge our ignorance, that we may not first deceive ourselves, and others afterwards, by promising to show them the true structure of this organ.

I should tire your patience instead of entertaining you,
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were I to mention particularly all the disputes that have arisen about the brain : books are but too full of them ; and therefore I shall only relate the principal mistakes that still subsist among anatomists, and which may be corrected by anatomy ; and they may be reduced to these heads. Some pretend to show parts in the brain as separate, which are only a continuance of the same substance ; and others would persuade us, that the parts touch each other without any connection, though they are visibly joined together by filaments or vessels. Some situate the parts in the manner which is most agreeable to the systems they have framed, without considering that they are quite otherwise situated by nature. They show you the pia mater, for instance, in places where it never was ; and do not see the dura mater in places where it is very visible ; and, in case of need, they will make the very substance of the brain pass for a membrane.

I have too good an opinion of men of learning in general, to believe that they do this with a design to deceive others ; but the principles which they have established, and the method of dissection to which they have accustomed themselves, oblige them to it. All anatomists would demonstrate the parts the same way, if they made use of the same method ; and therefore we ought not to be surpris'd if their systems are very ill founded.

The ancients were so far prepossessed about the ventricles as to take the anterior for the seat of common sense, the posterior for the seat of memory ; that the judgment, which they said was lodged in the middle, might more easily reflect on the ideas which came from either ventricles. I would only ask those who are still of the same opinion, to give us the reason why we should believe them, for there is nothing satisfactory in all that has been hitherto said in favour of it ; and as that fine arched cavity of the third ventricle where they placed the throne of judgment does not so much as exist, we may easily

easily see what judgment is to be pronounced on the rest of this system.

Willis is the author of a very singular hypothesis. He lodges common sense in the corpora striata, the imagination in the corpus callosum, and the memory in the cortical substance: but without being at pains to enter into the detail of his whole hypothesis, we need only make the following remarks upon it. He describes the corpus striatum as having two sorts of striæ, one ascending, the other descending; and yet, if you separate the cortical from the white substance, you will perceive that these striæ are all of the same nature, that is, that they are part of the substance of the corpus callosum, which runs toward the medulla spinalis, parted into different lamellæ by the intervention of the ash-coloured substance.

How can he, then, be sure that these three operations are performed in the three bodies which he pitches upon? Who is able to tell us whether the nervous fibres begin in the corpora striata, or if they pass through the corpus callosum all the way to the cortical substance? We know so little of the true structure of the corpus callosum, that a man of tolerable genius may say about it whatever he pleases.

M. Descartes knew too well how imperfect an history we have of the human body to attempt an exposition of its true structure; and accordingly in his *Tractatus de Homine*, his design is only to explain a machine capable of performing all the functions done by man. Some of his friends have indeed expressed themselves on this subject differently from him; but it is evident from the beginning of that work, that he intended no more than what I have said; and in this sense it may justly be said that M. Descartes has gone beyond all the other philosophers... He is the only person who has explained mechanically all the human actions, and especially those of the brain. The other philosophers describe to us the human body itself. M. Descartes speaks only of a machine

chine; but in such a manner as to convince us of the insufficiency of all that has been said before him, and to teach us a method of inquiring into the uses of the parts with the same evidence with which he demonstrates the parts of his machine called a *man*, which none had done before him.

We must not therefore condemn M. Descartes tho' his system of the brain should not be found altogether agreeable to experience: his excellent genius, which shines nowhere more than in his *Tractatus de Homine*, casts a veil over the mistakes of his hypothesis, especially since even Vesalius himself and other anatomists of the first rank are not altogether free from such mistakes. And since we can forgive these great men their errors, who passed the greatest part of their lives in dissecting, why should not Descartes meet with the same indulgence, who has happily employed his time in other speculations?

The respect which I and all the world owe to such superior geniuses, would have inclined me to continue only to admire this treatise as containing the description of a fine machine invented by the author, if I had not met with several persons who would make us believe that it is a faithful relation of the most secret springs of the real human body. Since these persons are not convinced by Silvius's repeated demonstrations, that M. Descartes's descriptions do not agree with what appears in dissecting the human body, I find myself obliged to point out some parts of his system, without relating the whole, in which they must see, if they have a mind to be instructed, the vast difference there is between Descartes's imaginary machine and the real machine of the human body.

The glandula pinealis has lately been the subject of the greatest disputes touching the anatomy of the brain; but before I enter upon that matter, or endeavour to determine the place where it lies, I must first give Descartes's own opinion in his own words, contained in

in the following passages, to which I have added several others taken from the same treatise, at the end of this discourse.

“ The surface of the glandula pinealis has a relation
“ to the inner surface of the brain.

“ In the concavity of the brain, the pores are directly
“ opposite to those of the small gland.

“ The spirits run from all sides of the gland into the
“ concavities of the brain.

“ The gland may perform its functions, though it
“ be inclined sometimes to one side, sometimes to the
“ other.

“ The small tubes on the surface of the concavities
“ are always turned to the gland, and may easily be
“ turned toward the different points of this gland.”

From all these passages, it is certain that he believed the glandula pinealis to lie entirely in the cavities of the brain. And though, in some other places, he says, that it is situated at the entry of these cavities, yet we are not to think that this is contrary to what he advances in the passages here quoted; for as it is but a very small body, it may lie either at the entry, or in any other place of the cavities, and yet still be within them; which he declares to be his opinion in many other places.

We are now to examine whether this opinion be not contrary to experience. It is very certain, that the basis of this gland reaches immediately from the passage of the third ventricle to the fourth; but the posterior part, that is, one half of the gland, may evidently be perceived to be altogether without the cavities, by only removing the cerebellum, and one or both of the tubercles of the third pair, with dexterity and care; upon which the posterior part of the gland will be brought into view, and yet no passage will appear, by which the air or any other fluid can pass into the ventricles.

To prove that the anterior part of the gland is not in the lateral cavities, we need only look upon them after they

they have been opened, either in Silvius's way, or in that of the ancients ; for the substance of the brain will always be found to lie between these lateral cavities and the gland. The same thing may be demonstrated without cutting the substance of the brain, by separating from its basis the part which contains these cavities ; for the gland will then appear to be so far out of the cavities, that it can have no manner of relation to them, being hindered by the insertions by which this part is fixed to the basis. The ancients knew very well that the fornix is not continuous with the basis of the brain, but that it forms a third cavity on its under side, and by forcing in air through the fissure between the tubercles of the second pair, we raise the fornix, and thus, by breaking the filaments which connect it to the basis, a large cavity is formed ; from whence some have imagined that when the spirits swell the cavities, the fornix rises, and that all sides of the surface of the gland are turned toward the cavities.

I say some have imagined this ; because, though the fornix be raised in the manner already said, only the anterior surface of the gland can be turned towards the lateral cavities ; but no preparation whatever can turn the posterior surface toward the posterior ventricles. But if the brain has suffered no violence, either in opening the cranium, forcing in air, or by any other method, the cavity of this third ventricle will be found very narrow at the middle, and to contain nothing but the great vein which forms the fourth sinus, and the glandular bodies which accompany this vein.

I own, that behind this fissure, and immediately below its posterior opening, there is a cavity lined on the fore and lateral parts by that part of the plexus choroides which runs up toward the fourth sinus, and at the back-part closed by the glandula pinealis, the anterior portion of which is perfectly continuous ; and when the fornix is removed, this cavity remains entire under the first, in the shape of a kind of inverted horn.

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What Descartes says, that the glandula pinealis may perform its functions, though it inclines sometimes to one side, sometimes to another, experience shows to be groundless; because it is so hedged in between all the parts of the brain, and so fixed to them on all sides, that it cannot be moved in the least without violence, and without breaking the fibres by which it is connected. It is easy to show likewise that M. Descartes has not represented it in its true situation; which is neither perpendicular, as he represents it, nor inclined forward, as other very great anatomists believe; but its point is always turned toward the cerebellum, and makes nearly half a right angle with the basis.

The supposed connection of this gland with the brain by means of arteries, is likewise groundless; for the whole basis of the gland adheres to the brain, or rather the substance of the gland is continuous with that of the brain, though the contrary be affirmed by Descartes.

The hypothesis of arteries meeting round the gland, and from thence running up to the great *euripus*, as it is called, is of great moment in Descartes's system, because the separation and motion of the spirits depend upon it. But if we can believe our eyes, this is no more than a collection of veins from the corpus callosum, from the anterior substance of the brain, from the plexus choroides, from different places of the basis of the brain, and from the gland itself; the office of which veins is to carry back the blood from the brain to the heart, and not to bring it from the heart to the brain. Some have thought that M. Descartes designed to carry the nerves to the gland; but he never had any such intention.

Such of M. Descartes's friends who look upon his man only as a machine, will be so good as to believe that I do not here speak against his machine, the contrivance of which I have always admired; but as for those who pretend to demonstrate that M. Descartes's
man

man is made like other men, anatomical observations may easily convince them that this is a fruitless attempt. And if they should plead the same experience on their side, we may readily answer, that there nothing more common than not to perceive the mistakes we commit in dissecting the brain, as will evidently appear in the sequel of this dissertation.

I designed to have mentioned the other systems of the brain by which the animal actions have been accounted for, and the origin and composition of the fluids contained in the brain been explained; but I considered afterwards, that this undertaking requires more application and leisure than my journey will allow me.

Dissections or preparations being liable to so many mistakes, and anatomists having hitherto too readily formed systems, and moulded these soft parts in the manner that was most agreeable to each, we cannot be surprised to find so little exactness in their figures. But this want of accuracy in the figures is not owing to bad dissections only. The ignorance of drawers has contributed very much; and the difficulty of expressing the several eminences and depressions of the parts, and of understanding what the anatomists chiefly insist upon, furnishes them with a never-failing excuse. The best figures of the brain are those of Willis; but even these contain a great number of important mistakes, and they want many things to perfect them. In the third figure he represents the superior or pineal gland like a round ball; and consequently, according to this figure, the apex of that gland cannot be said to be turned either forward or backward. Besides, we see here nothing of the substance of the brain on the fore-side of the gland, and which goes from one side to the other; all which the figure would make us believe to be annihilated. Behind the gland, a space appears on the basis of the brain between the two tubercles of the third pair, which, in the natural state, has a quite different appearance. The

thin expansion of the white substance of the cerebrum, which is continued to the middle of the cerebellum, where it is very thick, is quite wanting; as also the origin of the *nervi pathetici*, which go out from this expansion. He likewise represents the second pair of tubercles as distinct, which commonly adhere to each other. The under side of the fornix appears to be uniform, which is of an uneven and very elegant structure. When we cut the corpus striatum transversely, we see radii very different from what they are exhibited in Willis's eighth figure. The white radii appear there to be continuous with the fore-part of the corpus striatum, which, nevertheless, is of an ash-coloured substance; and as it runs in between the white radii, does not appear, in that method of dissecting, to adhere to any other body whatever.

In the third figure, the *infundibulum* has no resemblance to nature. The *nervi motores oculorum* are straight, and not oblique as they ought to be; neither do we see the true origin of the filaments, of which these nerves are composed, from the basis of the brain. The pons Varolii might have been better and more distinctly expressed; and the anterior roots of the fornix are not separated as in the seventh and eighth figures, but touch each other at the upper part, and form an acute angle. The line marked G. G. G. in the seventh figure appears to be a continued line, though the part between the roots of the fornix which is represented has no connection with the extremities; and in the same figure the *glandula pinealis* is connected to the substance of the brain by two funiculi. I need say nothing of the figures of Vesalius, Casserius, &c. for since these, which are the latest and best, are so very imperfect, we may easily imagine how little regard is to be paid to the others.

I have seen but three figures of Varolius, which express in a wretched manner the best observations that have ever been published on the brain. I do not know whether

whether the figures of the first edition at Padua in 1573 may not be better than those which I have seen published at Frankfort in 1591, and again in Bauhinus's anatomy. Among Bartholinus's figures, there are three which represent the brain dissected after Silvius's method; but the author himself owns that they are faulty. But, to pass over many other mistakes in all these figures, there is not one amongst them which represents truly the situation of the glandula pinealis; the duct of the third ventricle; the plexus choroides; the ramifications of the veins contained in the lateral cavities; the distribution of the arteries; the concurrence of the veins which forms the fourth sinus; or the numerous glandular bodies lodged there.

From all this you see how the brain has been hitherto dissected, how little knowledge has been gained from these methods of dissection, and how falsely the figures represent the parts for which they are designed. It is easy to conclude from hence how little regard is to be paid to the systems built on these bad foundations, in framing of which the authors, by an unaccountable sort of misfortune common to this with all other arts, have employed obscure terms, metaphors, and comparisons, all of them so ill chosen, as to be equally puzzling to those who have made some progress in this science and those who begin to learn it. Besides, the greatest number of these terms are so low, and so unworthy of the most noble part of the body of man, that I am at a loss whether I ought most to wonder at the bad turn of thought of those who first made use of them, or at the indolence of their successors, who continue still to retain them. What necessity could there be to employ the words *nates*, *testes*, *anus*, *vulva*, and *penis*, which in their common signification have no relation at all to the parts expressed by them in the anatomy of the brain? And, accordingly, what one author calls *nates*, another calls *testes*, &c.

The *third ventricle* is a very equivocal term. The an-

cients understood by this word, a cavity under the fornix, which they believed to be separated from the basis of the brain : and they have represented it with three legs, that it might support the brain, which lies upon it. M. Silvius calls the third ventricle a *canal*, founded in the substance of the basis of the brain, between the infundibulum and the passage which goes under the two posterior pairs of the tubercles of the brain, towards the fourth ventricle. Some anatomists having separated the bodies of this second pair of tubercles, take the space between them, which is owing to their manner of dissection, for the third ventricle, which is consequently sometimes the fissure above and sometimes the canal below ; and some will have it to be the space between the fissure and canal, which is likewise owing to the rupture of the parts already mentioned. We have therefore three *third ventricles*, the second of which alone is the true one ; the first and third arising entirely from the methods of preparing the parts. To these a fourth *third ventricle* might be added, if the small fissure under the fornix could be looked upon as a passage between the two anterior ventricles and the fourth. But it is so small, and so full of the vessels and glands of the plexus choroides, that I doubt very much whether there can be any communication that way, between the anterior and posterior ventricles, especially since Silvius's third ventricle is sufficient for that purpose, and likewise answers the design so perfectly well, that whatever goes from the lateral to the posterior ventricle, must first of all fill the infundibulum and this canal.

Two glands are reckoned to belong to the brain, though we know not if either of them resembles glands in any thing more than in the figure ; and even that, when well examined, will be found to be different from what it is in the rest. The superior or pineal gland is not like a pine-apple, either in brutes or in man ; and it is not known whether the inferior or pituitary gland acts in any respect on the pituita.

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The plexus choroides represents a vascular texture, in which the veins are seen very distinct from the arteries; and the distribution of each may be traced separately. The name of *fornix* gives the idea of an arched or vaulted part, which, however, is not to be found when looked for in a proper manner. The corpus callosum, in the common signification, means the white substance of the brain which comes into view when the two lateral parts are separated; but as it entirely resembles the rest of the substance of the brain, there can be no reason for giving a particular name to one part of this substance.

There are but two ways of coming at the knowledge of a machine; either to be taught the whole contrivance by the maker; or to take it quite to pieces, and to examine each by itself, and as it stands in relation to the rest. These are the only true ways of learning the contrivance of any machine; but the generality of inquirers have thought that they had better guess at it, than be at pains to examine it thoroughly. They have satisfied themselves with observing its motions; and on these observations they have built systems which they believed to be true, because, by their help, they imagined they could explain all the effects which they knew. They never considered, that the same thing may be explained in different manners; and that the senses alone are capable of informing us whether our ideas be conformable to nature. As the brain is a machine, we must not flatter ourselves that we can discover the contrivance of it by any other means than are made use of for knowing other machines; and we have no way left but to take it to pieces, and to consider what every part is capable of in a separated and in an united state. In this search, we may truly say that few anatomists have discovered any great degree of curiosity. Chemistry has in all ages found both private men and princes very ready to erect laboratories; but few have pursued anatomy with equal ardour. This neglect is not owing to princes, among whom many have had cu-

riosity enough for such an important part of knowledge, to build magnificent anatomical theatres, which they have often honoured with their presence. But the dissectors being always willing to appear complete masters of this science, never have had the sincerity to own that any thing still remained to be known; and, to conceal their ignorance, have contented themselves with demonstrating what is to be found in the writings of the ancients.

Anatomists might have reason to blame me, if I did not show by a farther explanation, that they are not so much in the wrong as I seem to insinuate, by saying, that they do not apply themselves sufficiently to anatomical inquiries. They that study anatomy are generally either physicians or surgeons, who being both obliged to visit their patients, have too little time left for study, after they have attained to a tolerable degree of reputation. But they ought not to undertake the cure of a body, the make of which they do not know; that is, they ought not to endeavour to rectify a machine, till they are previously acquainted with its nature. Others who do not visit sick persons, and have no other business than that of teaching anatomy in public schools, do not look upon themselves as more obliged to pursue anatomical inquiries than the practising physicians and surgeons. The design of their profession is to teach to those who are to practise physic and surgery, the descriptions left us by the ancients of the structure of the human body; and when they have clearly demonstrated all that is contained in the works of the ancients, and their hearers have as distinctly understood them, they both imagine that they have done their duty. The bounds of these different professions of teaching and practising have been so very ill settled, that the true knowledge of the human machine, tho' the most necessary branch, is neglected, as belonging neither to the anatomist, physician, nor surgeon.

To make the necessary inquiries for the discovery of truth, a man's whole time must be taken up; and
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professors of anatomy, who are obliged to make public demonstrations, which employ a great deal of time and labour, cannot be proper for this study, for the reasons already given, and for the following, which are no less evident.

1. There is so much time and application required to examine each part as it ought, that every thing else must be laid aside, and we must mind nothing but that. Physicians and surgeons cannot comply with this, because of their practice; nor professors, because of their public demonstrations. Whole years may sometimes be necessary to discover what may afterwards be demonstrated to others in the space of an hour. I do not question but that Pecquet was a great while in carrying the chyle from the mesentery to the subclavian vein; and perhaps I should not be believed, were I to mention what difficulties I found before I could show the true insertion of Pecquet's duct, of which Bilsius had given us a figure; whereas at present they may be both prepared and demonstrated in half an hour.

2. Though anatomists open a thousand bodies in the schools, it is by mere accident if every they discover any thing new. They are obliged to demonstrate the parts as described by the ancients, and in doing this, it is necessary they should follow a certain method; whereas, inquiries admit of no settled method, but must be pursued in every manner that can be thought of. In the schools, every thing must be removed that lies in the way of the part which they want to show: but in particular searches, no part must be cut off till we have first examined it; and if any such thing were attempted in public dissections, the demonstrator would be looked upon as ignorant, and the spectators would be often in the right to complain of loss of time, because he would not always be sure to find what he proposed to show them.

It is evident from these considerations, that professors have not hitherto been obliged to make inquiries in anatomy, and even that it is impossible for them to do it,

were they ever so willing ; so that it is not their fault that greater progress has not been made in that science.

Anatomy in general has, we see, been managed hitherto with very little success ; and the inquiries into the brain have succeeded less than any others, because they have not been made with that care and diligence which the difficulty of the subject requires. Let us now consider the true method, and examine if any person has hitherto found it out.

Bilsius applied himself to anatomy, without having studied the writings of the ancients ; and I make no question but that he would have made a greater progress, if, after having learned all that is good in these writings, he had employed his time and application in making new discoveries. We must own, that the works of our predecessors contain very fine experiments, which we might still have been ignorant of, if they had not handed them down. And they have sometimes told us truths, which their successors, for want of sufficient application, have not been able to see. It must, however, be owned, that all that both ancients and moderns have told us about the brain is so uncertain, that the books which contain the anatomy of this organ may be said to be chiefly a collection of doubts, disputes, and controversies ; but still a great advantage may be made of their labour, and even of their mistakes. I here speak of the authors who have dissected ; for as for those who only copy the works of others, the best that can be said of them is, that it may sometimes be proper to read their books by way of diversion. But they would have deserved a great deal more commendation, and been more useful to those who dissect, if they had given us only an exact relation of all that anatomists have wrote about the brain ; if they had explained, according to the laws of a true analysis, all the different ways of accounting for the animal-actions mechanically ; or if they had made an exact list of all the propositions found in these writings, distinguishing those
which

which are founded on facts and experience, from those which contain reasonings and conclusions drawn from the former. None of these methods have hitherto been pursued by the compilers, and therefore we must confine ourselves mostly to the original authors.

The first thing to be considered is the history of the parts; and in this we ought precisely to determine what is true and certain, that we may be able to distinguish that from what is false or uncertain. Neither is it sufficient that we ourselves are satisfied about any thing; the evidence of our demonstrations ought to be so clear, as to oblige every body else to assent to them; for otherwise the number of disputes would rather increase than diminish. Every anatomist who dissects the brain, demonstrates from experience what he advances. This soft and pliable substance so readily yields to every motion of his hand, that the parts are imperceptibly formed in the same manner as he had conceived them before dissection; while the spectator, who often sees two contrary experiments made on the same part, is either puzzled very much to know which he ought to embrace, or obliged to reject both to make himself easy. Therefore, to prevent this inconvenience, it is absolutely necessary to carry dissections the length of a convincing certainty; which, though very difficult, is very far from being impossible. For I would not have you imagine, from what I have said, that I believe there is nothing certain in anatomy; or that all who follow that study, make the parts appear as they have a mind, without any danger of being discovered. You may indeed justly doubt, if parts which are shown you separated, were ever united; but it would be impossible to show them united together, if they were not naturally so. To clear up any doubt that might arise on this subject, and to be certain whether the parts which are shown you were naturally joined or not, you need only examine them in their natural state, without using
any

any kind of violence, but allow those whom you have a mind to convince, to do all that is in their power to show that they are united. We may come at the same degree of certainty in other circumstances, and particularly when we inquire into the situation of parts, provided we touch nothing without having first examined it, and set down every moment what we touch. In order to this, we must not only be very attentive to the part which we examine, but also reflect on all that we did before we reached it, to see if these operations may have changed it from its natural state in any respect. For by often handling more exterior parts, we may easily affect those that lie within them; and when these come in sight, we are apt to imagine that they are naturally such as they then appear, without considering how far we may have altered their situation and connection with other parts. The most famous anatomical dispute which this age has produced, may serve for an example of what I say. They who deny the continuation of the glandula pinealis with the substance of the brain, and the adhesion of the fornix to the basis of the brain, would not talk so positively concerning a matter of fact, if they did not believe it to be proved by incontestible experiments and observations. But in making these experiments, they must necessarily have forgot the changes which happen in separating the exterior parts, and that they destroy all the connections by which the dura mater adheres to the cranium; and I have often observed, that, in raising the superior part of the cranium, the middle of the dura mater continued still to adhere to it, even after I had opened it sufficiently, to thrust in three fingers between the separated parts of the cranium. Now, how can the dura mater be thus raised, without making the interior parts to which it is fixed suffer violence? The glandula pinealis adheres to the fourth sinus, which is connected with the falx; so that the dura mater cannot be raised at that place without affecting the gland. This falx receives

ceives likewise all the veins which pass between the fornix and the basis of the brain, and by which these two parts are connected. There is a pretty strong connection between the upper part of the brain and the dura mater; and when that membrane is raised, the brain must follow it; and the fourth sinus being carried upward, breaks the connection between the fornix and the basis. I have many times been deceived about this when I first began to dissect the brain; and I used to wonder why these connections were not always sensible. But observing afterwards, in horses, sheep, cats, &c. where that part of the dura mater which separates the cerebrum from the cerebellum is ossified, that I destroyed a great many of the inner parts in extracting this bone, I began to perceive the cause of this mistake, and that it was not an easy matter to separate the cranium as it ought. The common way is to divide the cranium by a circular section, to remove the upper segment; but if this segment were again divided by a section perpendicular to the former, it would be much more easily removed, without doing any violence to the brain; for scissars, saws, and forceps, cannot be handled without shaking and disordering the parts. A small circular saw might be contrived which would not shake the parts very much, especially if it were turned upon a proper axis placed between two pointed pillars. This saw might likewise be employed for several other purposes in separating the cranium; but if any liquor could be discovered to dissolve or soften the bones in a small space of time, this would be by far the best way of separating the cranium.

It is not sufficient to be continually attentive; we must likewise make use of different methods of dissection, which are so many different proofs of the truth of our operations, in order to satisfy ourselves, and to convince others.

This will appear a very strange doctrine to those who believe that there are stated laws for the dissection of every

every part, and that the anatomical administrations taught us by the ancients, ought to be inviolably observed, without any change or addition. I own that the ancients might have given us unalterable rules for the dissection of each part, had they been sufficiently acquainted with them themselves; but as they certainly knew less about many parts than we do, they were at least as unfit as we are to prescribe rules, which can never be fixed or constant till more discoveries have been made. It will here be objected, that some method must be followed in dissecting the parts already known. This I readily grant, and also that the method of the ancients is to be made use of till a better is found out; but I would not have that method looked upon as perfect or unalterable. The principal reason why a great many anatomists have remained in their mistakes, and why they have gone no greater a length than the ancients in dissection, is, because they believe that every thing has been already taken notice of, and that there is nothing left for the moderns to do; and as they have looked upon the ancient laws as inviolable rules in dissection, they spent their whole lives in demonstrating the same parts in the same manner; whereas anatomy ought to be confined by no rules, every new dissection requiring a different method. The advantage of proceeding in this manner is, that if we miss of new discoveries, we at least are put in a condition to find out any mistakes that may have happened in former dissections, especially in controverted points; in which the spectators ought to have the liberty of prescribing the rules of dissection.

This method of dissection makes indeed but a very small shew, and a man cannot well display his learning at the same time that he acknowledges his ignorance; but as for my own part, I much rather choose to own what I do not know, than to impose upon my hearers ancient opinions, which will some time or other be demonstrated to be false. We have seen great anatomists exposed

exposed to this mortification ; and we still see many who believe that more regard will be paid to their stiffness and positiveness in opinion, than to ocular demonstration. I wish these gentlemen much joy of their self-conceit, while I endeavour to follow the laws of philosophy, by which we are taught to search after truth in so cautious a manner, as never to believe we have found it till it brings demonstration along with it.

I cannot prove to you the necessity of often changing the methods of dissection better than by the two following examples. It is a confirmed experiment, that by blowing into the beginning of the fissure under the fornx, the fornx is separated from the basis, and a considerable cavity left between them ; and the same thing happens when we separate the cranium with violence, as I have already said. This is so evident, that both the dissector and the spectators are fully convinced of it ; but if any person should still be in doubt, there is no other way to clear it up, but to endeavour to demonstrate this cavity in another manner. For if it be natural, we must always find it the same, in whatever manner we look for it ; but if, by any other method, you find that it is wanting, and that the parts between which it ought to lie, are connected together without leaving any void space between them, you ought from that moment to be convinced of the falsity of the former demonstration, and that it was the force of the air to which the appearance of a cavity was owing.

If the brain is dissected according to the method of Varolius or Willis, after having taken it out of the cranium, you will commonly see the second pair of tubercles separated at the middle of that white substance which lies before the glandula pinealis, and which is very often broken. When we make the dissection, leaving the brain in the cranium, we see both the tubercles and the white substance entire ; and then we see plainly, that the cause of the first mistake was owing to the

the weight of the lateral parts which break those in the middle.

Having made a true and exact plan of the parts of the brain, having discovered the mistakes and the causes of these mistakes, and having settled the true method of demonstrating these parts, with all the necessary precautions ; the next step is to express, by good figures, all that we have discovered : for we had better be without figures than not have them true and faithful. When we cannot have recourse to the originals, the representation serves to keep us in mind of them ; and many persons never have an opportunity of seeing the parts in any other way, their aversion for blood hindering them from satisfying their curiosity by examining dead bodies ; and therefore, if the figures are not true, they give false ideas to those who would learn anatomy by their help, and puzzle others who make use of them only to refresh their memory.

We ought therefore to leave nothing undone to procure exact figures ; in order to which a good drawer is as necessary as a good anatomist. We must likewise apply ourselves very particularly to see in what manner we ought to dissect and dispose the parts, so as to exhibit all that is to be seen in the brain, there being difficulties peculiar to this organ. The other parts require only a preparation to complete the figures we design ; whereas the brain, never so well prepared, subsides before the figure can be taken ; and we must have several fresh subjects before one figure can be finished. To this, perhaps, it is owing, that no anatomical figures are so imperfect as those of the brain.

I have hitherto said nothing of the uses of the parts, nor of the animal-actions, as they are called ; because it is impossible to explain the movements of a machine till we know the contrivance of its parts. A reasonable man must, in his own mind, laugh at these positive anatomists, who having made a long harangue about the use of parts, the structure of which is altogether

ther unknown to them, give this as the only reason of all they advance, that God and nature do nothing in vain. They deceive themselves in the application of this general maxim ; and the part which they rashly judge to have been made by God for one end, is afterwards discovered to have been made for another. We had therefore much better own our ignorance, be more reserved in our decisions, and not undertake, upon such slight conjectures, to explain matters which are in their own nature so difficult.

All that I have hitherto mentioned is but a very small part of what ought to be done in order to acquire the knowledge of the brain. We ought moreover to examine the heads of all animals, and in all the different states of each animal. In the foetus of animals, we see how the brain is gradually formed ; and what could not be seen in a sound healthy brain, may perhaps be discovered in one that is diseased.

In living animals, we ought to consider every thing that may cause the least alteration in the actions of the brain ; whether the causes be external, as from liquors, wounds, medicines, &c. or internal, as a great number of diseases reckoned up by physicians. There is likewise this advantage attending the dissection of the brains of animals, that we may manage them as we please. We may learn to trepan or to perform any other chirurgical operation upon them : we may examine whether the brain has any motion in these operations ; and whether the application of any medicines to the dura mater, or to the substance or ventricles of the brain, may not produce some particular effects.

We might likewise make different trials without opening the cranium, by applying medicines exteriorly, by mixing them with the food, and by injections into the vessels, in order to discover what disturbs the animal-actions, and what is most proper to restore them when disordered.

The brain is different in different animals ; and this
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is another reason why we should examine them all. The brains of birds and fishes are not at all like that of man; and even in animals where there is the greatest likeness to the human brain, I have always found a very great variety. Whatever this difference be, it may always afford us some new light, and teach us what it is absolutely necessary we should know. In some animals, the fibres are more easily seen than in men; and the parts which in the human brain are mixed and joined together, are sometimes distinct and separate in animals; and we often meet with the substance more or less solid, and the size and situation different.

I need not insist any longer on this subject, because I believe we are all convinced that we are indebted to the dissection of animals for almost all the new discoveries of this age; and that there are many parts which would never have been found in the human brain, if they had not first been observed in animals.

What I have hitherto said concerning the insufficiency of all the systems of the brain, concerning the want of a true method in dissecting it, concerning the infinite number of inquiries that ought to be made about it in man and in brutes in all their different states, concerning the barrenness of all the writers on this subject, and concerning the precautions that must be used in handling these tender parts, ought certainly to undeceive those who satisfy themselves with what they find in the books of the ancients. We must always remain in ignorance if we sit down with what the ancients have taught us, and if men capable of making such inquiries do not contribute their labour, industry, and study, in order to arrive at the knowledge of truth, which is the principal aim of all who search for it sincerely.

The passages from Descartes referred to in this dissertation, are these.

Pag. 11. For we must know that the other vessels which bring the blood from the heart, having been divided into an infinite number of small branches disposed in a reticular manner, and which are spread like a thin web in all the cavities of the brain, are collected round a certain small gland situated almost in the middle of the substance of the brain at the entry of the cavities, and have in this place a great number of small holes, through which the most subtle parts of the blood which they contain may be conveyed to the gland, because they are too small to allow the grosser parts to pass. These arteries do not terminate here; but several of them being united into one, run up in a straight course to that great vessel, which like an euripus supplies all the exterior surface of the brain:

Pag. 12. This gland is to be looked upon as a rich source from which the finest and most agitated parts of the blood run on all hands into the cavities of the brain.

Pag. 63. Imagine the surface which is turned toward the cavities to be a piece of close net-work or plexus, all the meshes of which are so many small holes thro' which the animal spirits may pass; and being turned toward the gland from which all these spirits proceed, they can easily be directed toward all the different points of this gland.

Pag. 65. The spirits do not stop any where; but in proportion as they enter the cavities of the brain by the holes of the small gland, they run directly toward those of the small tubes which are over against them.

Pag. 72. In explaining how figures are marked in the spirits on the surface of the gland, he determines plainly enough the relation which he supposes to be

between the inner surface of the brain and that of the gland.

Pag. 77. It ought likewise to be considered, that the gland is composed of a soft matter, and that it is not all united to the substance of the brain, but only connected to small arteries (the coats of which are very loose and pliable), and supported in its situation by the force of the blood in these arteries; so that a very small matter may incline it to either side, and, by so doing, dispose the spirits which it contains, to run toward one part of the brain rather than to another If the spirits were of equal force, the gland would always be kept in an immoveable erect posture in the centre of the head.

Pag. 77. As the spirits flow out more readily from one part of the brain than from another, they may have force enough to turn the small tubes in the inner surface of the brain into which they run, towards the place from whence they flow out, if they do not find them in that direction.

SECT. II. *The EYE.*

§ 1. *The Eye in general.*

Situation and composition. THE eyes are commonly two in number, situated at the lower part of the forehead, one at each side of the root of the nose; and they are made up of hard and soft parts. The hard parts are the bones of the cranium and face; which form two pyramidal or conical cavities, like funnels, to which we give the name of *orbits*. The soft parts are of several kinds.

The principal and most essential soft part in each organ is the globe or ball of the eye; the others are partly external and partly internal. The external parts are the

the *supercilia* or eye-brows, the *palpebræ* or eye-lids, the *caruncula lachrymalis*, and the *puncta lachrymalia*; and the internal parts are the muscles, fat, lachrymal gland, nerves, and blood-vessels.

The orbits. Seven bones are concerned in the composition of each orbit, viz. the *os frontis*, *os sphenoidale*, *os ethmoides*, *os maxillare*, *os malæ*, *os unguis*, and *os palati*. In each orbit we are to consider the edge, sides, and bottom. The edge is formed by the *os frontis*, *os maxillare*, and *os malæ*; the bottom by the *os sphenoides* and *os palati*; and all these bones except the *os palati*, contribute to form the sides. The bottom is perforated by the *foramen opticum* of the *os sphenoides*; and the external side near this foramen, by two orbital fissures, one superior, called *sphenoidalis*, the other inferior, called *spheno-maxillaris*, as has been already said in the description of the skeleton.

All the cavity of the orbit is lined by a membrane, which is an elongation or production of the *dura mater*; and it comes partly through the *foramen opticum* of the *os sphenoides*, and partly through the *sphenoidal* or *superior orbital fissure*. This membrane, which may be looked upon as the *periosteum* of the orbit, communicates with the *periosteum* of the *basis cranii*, by the *inferior orbital fissure*, and with the *periosteum* of the face at the edge of the orbit. At the upper part of the edge of the orbits, the two *periosteæ* form a kind of broad ligament, and a narrow one at the lower part of this edge, which I shall call *ligaments of the palpebræ*.

The particular situation of the orbits represents nearly two funnels, placed laterally at a small distance from each other, in such a manner as that their apices are almost joined, their nearest sides almost parallel, and the other sides turned obliquely backward; and for this reason the middle of the great circumference or edge of each orbit, is at a much greater distance from the *septum narium*, than the bottom or apex; and the edge

or great circumference is very oblique, the temporal or external angle of the orbit lying more backward than the nasal or internal angle.

§ 2. *The Globe or Ball of the Eye.*

Composition. THE globe of the eye being the most essential of all the soft parts belonging to the organ of sight, and being likewise a part which we are obliged to mention as often as we speak of the other soft parts, must be first described. It is made up of several proper parts, some of which being more or less solid, represent a kind of shell formed by the union of several membranous strata called the *coats of the globe of the eye*; and the other parts being more or less fluid, and contained in particular membranous capsulæ, or in the interstices between the coats, are termed *the humours of the globe of the eye*. These capsules are likewise termed *coats*.

The coats of the globe of the eye are of three kinds. Some form chiefly the shell of the globe; some are additional, being fixed only to a part of the globe; and some are capsular, which contain the humours. "The coats which form the globe of the eye are, The sclerotic, to which the convexity of the globe is owing; the cornea, which forms the anterior part of the globe; the iris, choroides, and retina." The additional coats are two; one called *tendinosa* or *albuginea*, which forms the white of the eye; and the other, *conjunctiva*. The capsular tunicae are likewise two, the vitrea and crystallina.

The globe of the eye thus formed, sends out backward a pretty large pedicle, which is the continuation of the optic nerve. It is situated about the middle of the orbit in the manner which we shall afterwards see; and it is tied to it by the optic nerve, by six muscles, by the tunica conjunctiva, and by the palpebrae. The back-part of the globe, the optic nerve, and muscles, are surrounded by a soft fatty substance, which fills the rest of the bottom of the orbit.

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The humours are three in number; the aqueous, vitreous, and crystalline. The first may properly enough be called an *humour*, and is contained in a space formed in the interstices of the anterior portion of the coats. The second or vitreous humour is contained in a particular membranous capsula, and fills above three-fourths of the shell or cavity of the globe of the eye. It has been named *vitreous*, from its supposed resemblance to melted glass; but it is really more like the white of a new-laid egg.

The crystalline humour is so called from its resemblance to crystal, and is often named simply the *crystalline*. It is rather a gummy mass than an humour, of a lenticular form, more convex on the back than on the fore-side, and contained in a fine membrane called *membrana* or *capsula crystallina*. What I have here said is sufficient to give a general idea of the three humours of the globe of the eye.

§ 3. *The Coats of the Eye in particular.*

“THE most external, the thickest, and strongest coats of the eye, are the sclerotica and cornea. They invest all the other parts of which the globe is composed—The sclerotic is made up of many fibres closely connected; and is of a firm texture, resembling parchment.” About the middle of its posterior convex portion, where it sustains the optic nerve, it is in a manner perforated, and thicker than any where else, its thickness diminishing gradually toward the opposite side, and its substance is penetrated obliquely in several places by small blood-vessels. The course of the nervous filaments thro’ this coat is very singular: they enter the convex side at some distance from the optic nerve; and running from thence through its substance, they pierce the concave side near the cornea.

The cornea is made up of several strata or laminæ closely united, and of a different texture from the former

mer. When macerated in cold water, it swells; and then its strata may be separated from each other.

This portion is something more convex than the sclerotica, so that it represents the segment of a small sphere added to the segment of a greater; but this difference is not equally great in all persons. The circumference of the convex side is not circular as that of the concave side, but transversely oval; for the superior and inferior portions of the circumference terminate obliquely; but this obliquity is more apparent in oxen and sheep than in man.

The cornea is perforated by a great number of imperceptible pores, through which a very fine fluid is continually discharged, which soon afterwards evaporates; but we discover it evidently by pressing the eye soon after death, having first wiped it very clean; for we then see a gradual collection of a very subtle liquor, which forms itself into little drops; and this experiment may be several times repeated on the same subject. It is this dew that forms a kind of pellicle on the eyes of dying persons, which sometimes cracks soon after, as is observed in the *Memoirs of the Academy for 1721*.

Tunica choroides. The next coat of the globe of the eye is the choroides, which is of a blackish colour, more or less inclined to red; and adheres, by means of a great number of small vessels, to the sclerotica, from the insertion of the optic nerve all the way to the cornea, where it leaves the circumference of the globe; "and turns inward, to form a number of little processes termed *ciliary*, which are situated at the edge of the crystalline lens."

The external lamina of the choroides is stronger than the internal, and both appear blackish because of their transparency. At a very small distance from the cornea this lamina is most closely united to the sclerotica. Round this adhesion it changes colour, and forms a whitish ring of the same breadth with the adhesion; and
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near the edge of the sclerotica this ring is stronger and of a different texture from what it is any where else. It adheres so closely to the sclerotica, that if we blow through a small hole made therein without touching the choroides, the air will penetrate every where between the two coats, but cannot destroy this adhesion, or pass to the cornea. This adhesion has been improperly named *ligamentum ciliare*. On the inner surface of this lamina we discover a great number of flat lines in a vortical disposition, which are the vessels named by Stenon *vasa vorticosa*, or *vortices vasculosi*, of which hereafter.

The internal lamina of the choroides is thinner and of a darker colour than the external; and its surface, together with the corresponding surface of the other lamina, is covered by a blackish substance with some mixture of red, which easily separates when touched, and immediately tinges the water in which the choroides is dipped. The origin of this substance has not as yet been observed; but, after a nice anatomical injection, I have observed a great number of vascular stars on the inner surface of this lamina. In Mr Ruysch's works, it is termed *membrana Ruyschiana*.

“ At the anterior edge of the choroides we find the iris composed of two laminæ, the posterior of which was called *uvea* by the antients. In the middle of the iris there is a hole termed *pupil*: this in a foetus is covered with a membrane called *pupillaris*, which generally disappears about the seventh month.” Between the two laminæ of the iris we find two very thin planes of fibres which appear to be fleshy; the fibres of one plane being orbicular, and lying round the circumference of the papilla; and those of the other being radiated, one extremity of which is fixed to the orbicular plane, the other to the great edge of the iris.

The plicæ or processus ciliares are small radiated and prominent duplicatures of the anterior edge of the choroid coat; and their circumference answers partly to that of the white ring of the external lamina. They

are oblong thin plates ; their external extremities, or those next the choroides, being very fine and pointed ; the internal are broad, prominent, and ending in acute angles. In the duplicature of each ciliary fold we find a fine reticular texture of vessels ; and some pretend to have seen fleshy fibres in the same place, lying in small grooves of the membrana vitrea, as we shall see hereafter.

The space between the cornea and iris, contains the greatest part of the aqueous humour, and communicates by the pupilla with a very narrow space behind the iris, or between that and the crystalline. These two spaces have been termed *the two chambers of the aqueous humour*, one anterior, the other posterior, as I shall observe in describing this humour in particular.

Retina. The last coat proper to the eye is of a very different texture from that of the other two coats. It is white, soft, and tender, and, in a manner, medullary, or like a kind of paste spread upon a fine reticular web. It reaches from the insertion of the optic nerve to near the edge of the crystalline lens." At the place which answers to the insertion of the optic nerve, we observe a small depression, in which lies a sort of medullary button, terminating in a point ; and from this depression blood-vessels go out, which are ramified on all sides through the substance of the retina.

It is commonly said, that the retina is a production or expansion of the medullary substance of the optic nerve ; the sclerotica, of the dura mater ; and the choroides, of the pia mater, which accompanies this nerve. But this opinion is not altogether agreeable to what we observe in examining the optic nerve, and its insertion in the globe of the eye. If we take a very sharp instrument, and divide this nerve through its whole length, between where it enters the orbit and where it enters the globe, into two equal lateral parts, and then continue this section through the middle or centre of its insertion, the following phenomena will appear.

That

That the nerve contracts a little at its insertion into the globe; that its outer covering is a true continuation of the dura mater; that this vagina is very different from the sclerotica both in thickness and texture, the sclerotica being thicker than the vagina, and of another structure; that the vagina from the pia mater forms, through the whole medullary substance of the nerve, several very fine cellular septa; and that where it enters the globe of the eye, the pia mater does not directly answer to the choroides.

Lastly, that as the medullary substance of the nerve enters the globe, it is very much contracted, and seems to terminate only in the small tubercle or button already mentioned; but if we examine accurately, we shall find that the retina is really a continuation of the fibres which compose the medullary part of the nerve.

The insertion of the optic nerve in the globe of the eye is not directly opposite to the pupilla, so that the distance between these two parts is not the same when measured on all parts of the globe. The greatest distance is on the side next the temples; and the smallest, next the nose. I have observed an inequality of the same kind in the breadth of the uvea, which in many subjects is less near the nose than near the temples; so that the centre of the pupilla is not the same with that of the great circumference of the iris; and I have seen the same difference in the breadth of the corona ciliaris.

§ 4. *The Humours of the Eye and their Capsula.*

The vitreous humour. The vitreous humour is a clear and very liquid gelatinous fluid contained in a fine transparent capsula, called *tunica vitrea*, together with which it forms a mass nearly of the consistence of the white of an egg. It fills the greatest part of the globe of the eye, that is, almost all that space which answers to the extent of the retina, except a small portion behind

hind the uvea, where it forms a fossula, in which the crystalline lens is lodged. This humour being dexterously taken out of the globe, preserves its consistence for some time in the capsula, almost like the white of an egg; and then runs off by little and little, till it quite disappears.

The tunica vitrea is composed exteriorly of two laminæ very closely connected, which quite surround the mass of humour, and are immediately applied to the retina all the way to the great circumference of the corona ciliaris; but from thence to the circular edge of the fossula of the crystalline, this coat is full of radiated sulci, which contain the processus ciliares of the uvea. At the edge of the fossula the two laminæ separate, and form a particular capsula, which belongs to the crystalline; as we shall see hereafter.

The internal lamina of the tunica vitrea gives off, through the whole substance of this humour, a great number of cellular elongations or septa so extremely fine, as not at all to be visible in the natural state, the whole mass appearing then to be uniform and equally transparent through its whole substance; but they are discovered by putting the whole soon after it is taken out of the body into some acedent and gently coagulating liquor.

The radiated sulci of the tunica vitrea, which may be termed *sulci ciliares*, are perfectly black, when the coat is taken out of the body. This proceeds from the black substance with which the laminæ or processus ciliares are naturally covered, as well as all the rest of the choroides, and which remains in the bottom of the sulci after the laminæ have been taken out. We observe very fine vessels in this humour, which shall be described afterwards.

The crystalline humour. The crystalline lens is a small lenticular body of a pretty firm consistence, and transparent like crystal. It is contained in a transparent membranous capsula, and lodged in the anterior fossula
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of the vitreous humour, as has been already said. It is very improperly called *an humour*, because it may be handled and moulded into different shapes by the fingers, and sometimes almost dissolved by different reiterated compressions, especially when taken out of the capsula.

The figure of the crystalline is lenticular; but its posterior side is more convex than the anterior, the convexity of both sides being very rarely equal. The internal structure of this mass has not been hitherto sufficiently discovered, to be described with certainty, especially in man, where I could never find that contorted disposition of crystalline tubes which some pretend to have seen in the eyes of large animals.

The colour and consistence of the crystalline varies in different ages, as was discovered by M. Petit the physician, and demonstrated by him in the Academy of Sciences from a great number of human eyes; and his observations are inserted in the Memoirs for 1726. Till the age of 30 it is very transparent, and almost without any colour. It afterwards becomes yellowish, and that yellowness gradually increases. The consistence varies almost in the same manner, being of an uniform softness till the age of 20, and afterwards growing gradually more solid in the middle of the mass; but in this there are varieties, explained in the Memoirs for 1727.

The crystalline capsula or coat is formed by a duplication of the tunica vitrea, as I have already said. The external lamina covers the anterior side of the crystalline mass; the internal lamina covers the back-side, and likewise the fossula vitrea, in which the crystalline is lodged. The anterior portion of the crystalline capsula is thicker than the posterior, and, in a manner, elastic; and both its thickness and elasticity may be discovered in dissection, without any other artifice.

The anterior portion swells when macerated in water,

ter, and then appears to be made up of two pelliculæ, united by a fine spongy substance. I demonstrated this duplicature very plainly in the eye of an horse by the knife alone; and I even carried the separation of the two laminæ as far as the vitreous coat. Having made a small hole in the middle of the capsula, and blown into it through a pipe, some part of the air remained between the edge of the crystalline mass and that of the capsula in form of a transparent circle. This experiment was made with an ox's eye above ten years ago.

The aqueous humour is a very limpid fluid, resembling a kind of lymph or serum, with a very small degree of viscosity; and it has no particular capsula like the crystalline and vitreous humours. It fills the space between the cornea and iris, that between the iris and the crystalline, and the hole of the pupilla. These two spaces are called the *chambers of the aqueous humour*, and they are distinguished into the anterior and posterior.

The two chambers are not of the same extent. The anterior, which is visible to every body between the cornea and iris, is the largest; the other between the iris and crystalline is very narrow, especially near the pupilla, where the iris almost touches the crystalline. This proportion between the two chambers has been sufficiently proved, contrary to the opinion of many ancient writers, by M. Heister, Morgagni, and several members of the royal academy; but none has treated these matters at so great a length as M. Petit the physician, as appears by the printed Memoirs of that Society.

§ 5. *The Tunica Albuginea, and Muscles of the Globe of the Eye.*

THE tunica albuginea, called commonly the *white of the eye*, and which appears on all the anterior convex side of the globe, from the cornea to the beginning of the
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the posterior side, is formed chiefly by the tendinous expansion of four muscles in the manner presently to be described. This expansion adheres very close to the sclerotica, and makes it appear very white and shining, whereas the rest of it is of a dull whitish colour. It is very thin near the edge of the cornea; in which it seems to be lost, terminating very uniformly,

There are commonly six muscles inserted in the globe of the human eye; and they are divided, on account of their direction, into four recti and two obliqui. The recti are again divided, from their situation, into superior, inferior, internal, and external; and, from their functions, into a levator, depressor, adductor, and abductor. The two oblique muscles are denominated from their situation and size, one being named *obliquus superior* or *major*, the other *obliquus inferior* or *minor*. The *obliquus major* is likewise called *trochlearis*, because it passes through a small cartilaginous ring, as over a trochlea or pulley.

The musculi recti do not altogether answer to that name; for in their natural situation they do not at all lie in a straight direction, as they are commonly represented in an eye taken out of the body. To understand this, we ought to have a just idea of the situation of the globe in the orbit, and at the same time to remember the obliquity of the orbits, as already explained. The globe is naturally placed in such a manner, as that, during the inaction or equilibrium of all the muscles, the pupilla is turned directly forward; the inner edge of the orbit is opposite to the middle of the inside of the globe; the outer edge of the orbit, because of its obliquity, is behind the middle of the outside of the globe; and lastly, the great circumference of the convexity of the globe between the pupilla and the optic nerve, runs directly inwards and outwards, upwards and downwards.

In this situation, the internal rectus alone is in a straight direction, the other three being oblique; and the

the external rectus is the longest, the internal the shortest, and the superior and inferior of the same middle length between the two former. The external rectus is likewise bent round the outer convex side of the globe; the superior and inferior are also incurvated, but in a less degree; whereas the whole internus is almost streight: notwithstanding all this, I shall still continue to give them all the common name of *musculi oculi recti*.

These muscles are fixed by their posterior extremities at the bottom of the orbit near the foramen opticum in the elongation of the dura mater, by short narrow tendons, in the same order in which I have already named them. From thence they run wholly fleshy, toward the great circumference of the convexity of the globe, between the optic nerve and cornea, where they are expanded into flat broad tendons which touch each other, and afterwards unite. These tendons are fixed first of all by a particular insertion in the circumference just mentioned, and afterwards continue their adhesion all the way to the cornea, forming the tunica albuginea, as has been already said.

The superior oblique muscle is fixed to the bottom of the orbit, by a narrow tendon, in the same manner as the recti, between the rectus superior and internus. From thence it runs on the orbit opposite to the interstice between these two muscles, toward the internal angular apophysis of the os frontis, where it terminates in a thin tendon, which having passed thro' a kind of ring as over a pulley, runs afterwards in a vagina obliquely backward under the rectus superior, that is, between that muscle and the globe; and increasing in breadth it is inserted posteriorly and laterally in the globe, near the rectus externus.

The ring through which the muscle passes, is partly cartilaginous and partly ligamentous. The cartilaginous portion is flat, of a considerable breadth, and like half a ring. The ligamentous portion adheres strongly to the

the two ends of the cartilage, and is fixed in the small fossula which lies in the orbit on the angular apophysis of the os frontis. By means of this ligament, the ring is in some measure moveable, and yields to the motions of the muscle. To the anterior edge of the ring, a ligamentous vagina is fixed, which invests the tendon all the way to its insertion in the globe.

The obliquus inferior is situated obliquely at the lower side of the orbit, under the rectus inferior, which consequently lies between this muscle and the globe. It is fixed by one extremity a little tendinous, to the root of the nasal process of the os maxillare, near the edge of the orbit between the opening of the lacrymal duct, and the inferior orbitary fissure.

From thence it passes obliquely, and a little transversely backward, under the rectus inferior; and is fixed to the posterior lateral part of the globe by a flat tendon opposite to and at a small distance from the tendon of the obliquus superior; so that these two muscles do in some measure surround the outer posterior part of the globe.

Uses of these muscles. The rectus superior moves the anterior portion of the globe upward when we lift up the eyes; the rectus inferior carries this portion downward; the internus toward the nose, and the externus toward the temples.

When two neighbouring recti act at the same time, they carry the anterior portion of the globe obliquely toward that side which answers to the distance between these two muscles: and when all the four muscles act successively, they turn the globe of the eye round, which is what is called *rolling the eyes*.

It is to be observed, that all these motions of the globe of the eye are made round its centre; so that in moving the anterior portion, all the other parts are likewise in motion. Thus, when the pupilla is turned toward the nose or upward, the insertion of the optic nerve is at the same time turned toward the temple, or downward.

The use of the oblique muscles is chiefly to counterbalance the action of the recti, and to support the globe in all the motions already mentioned. This is evident from their insertions, which are in a contrary direction to those of the recti, their fixed points with relation to the motions of the globe being placed forward, and those of the recti backward, at the bottom of the orbit. The soft fat which lies behind the globe is altogether insufficient to support it : neither is the optic nerve more fit for this purpose ; for I have shewn that this nerve follows all the motions of the globe, which would be impossible, were not the fat very pliable and without resistance. And to this we must add, that the optic nerve at its insertion in the globe has a particular curvature, which allows it to be elongated, and consequently prevents it from suffering any violence in the different motions of the eyes.

The obliquity of these two muscles does not hinder them from doing the office of a fulcrum ; because this is not a fulcrum distinct from the part moved, or on which the globe of the eye slides like the head of one bone in the articular cavity of another ; but being fixed to the part, it easily accommodates itself to all the degrees of motion thereof. Had these muscles lain in a straight direction, they would have incommoded the recti ; but their obliquity may be said to be in some measure rectified by the inner surface of the orbit, and the rectus externus.

The inner surface of the orbit serves for a kind of collateral fulcrum, which hinders the globe from falling too far inward ; as the joint action of the two obliqui prevents it in part from falling too far outward. The rectus externus, by being bent on the globe, not only hinders it from being carried outward, but also prevents the indirect motions of the obliqui from thrusting it out of the orbit toward the temples. The other uses attributed to these muscles seem to be without foundation, from the consideration of their insertions,
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and of the structure of the parts with which they are concerned ; both which reasons are explained in the Memoirs of the Academy for 1721.

§ 6. *The Supercilia, and Musculi frontales, occipitales, and superciliares.*

Supercilia. THE supercilia or eye-brows are the two hairy arches situated at the lower part of the forehead, between the top of the nose and temples, in the same direction with the bony arches which form the superior edges of the orbits, and are peculiar to the human species. The skin in which they are fixed does not seem to be much thicker than that of the rest of the forehead ; but the membrana adiposa is thicker than on the neighbouring parts. The colour of the eye-brows is different in different persons ; and often, in the same person, different from that of the hair on the head : neither is the size of them always alike. The hairs of which they consist are strong and pretty stiff ; and they lie obliquely, their roots being turned to the nose, and their points to the temples.

The supercilia have motions common to them with those of the skin of the forehead, and of the hairy scalp. By these motions the eye-brows are lifted up ; the skin of the forehead is wrinkled more or less regularly and transversely ; and the hair and almost the whole scalp is moved, but not in the same degree in all persons ; for some by this motion alone can move their hat, and even throw it off from their head. The eye-brows have likewise particular motions which contract the skin above the nose ; and all these different motions are performed by the following muscles.

Musculi frontales. The frontal muscles are two thin, broad, fleshy planes, of unequal lengths, lying immediately behind the skin and membrana adiposa, on the anterior parts of the forehead, which parts they cover from the root of the nose, and through about two-thirds of the arch of the eye-brows on each side, all the

way to the lateral parts of the hair on the forehead. At the root of the nose they touch each other as if they were but one muscle; and at this place their fibres are short and longitudinal, or vertical.

The next fibres on each side become gradually longer and more oblique; the most anterior being always the shortest and straightest; and the lateral, the longest, and turned most obliquely toward the temples at their upper extremities. By this disposition an angular interstice is formed between the place where the two muscles join, and the hair on the middle of the forehead; but this disposition is not the same in all subjects, no more than the wrinkles and bounds of the hair on the forehead.

These muscles are fixed by their inferior extremities immediately in the skin, running through the *membrana adiposa*. They cover the *musculi superciliares*, and adhere closely to them by a kind of intertexture. By the same fibres they seem to be inserted in the angular apophyses of the *os frontis*, and to be blended a little with the muscles of the *palpebræ* and nose. Their upper extremities are fixed to a tendinous expansion which runs over the head to be inserted to the occipital muscles. Each of their lateral portions covers a portion of the temporal muscle on the same side, and adheres very closely to it. The superior and inferior insertions are graduated.

Musculi occipitales. The occipital muscles are two small, thin, broad, and very short fleshy planes, situated on the lateral parts of the occiput, at some distance from each other. They are inserted by the inferior extremities of their fleshy fibres in the superior transverse line of the *os occipitis*, and also a little above it. From thence they run up obliquely from behind forward, and are fixed to the tendon mentioned above.

The breadth of these muscles reaches from the posterior middle part of the occiput toward the mastoid apophysis, and they diminish unequally in length as they ap-

approach these apophyses. From this inequality in length, each of them appears as if it were double in some subjects; and in others they are so thin and pale, that they seem to be wanting. They are sometimes covered by an aponeurotic expansion of the trapezii.

The occipital and frontal muscles appear to be true digastrici, both in regard to their insertions and action. The fixed insertions of the occipitales at the lower part of the occiput, and the moveable insertions of the frontales in the skin of the forehead and of the supercilia, being well considered, together with their reciprocal insertions in the same aponeurosis, seem to be a very convincing proof that they are digastric muscles.

These four muscles seem always to act in concert, the occipitales being only auxiliaries or assistants to the frontales, the office of which is to raise the supercilia, by wrinkling the skin of the forehead; these wrinkles following the direction of the eye-brows pretty regularly in some subjects, and very irregularly in others.

To be convinced of the co-operation of these four muscles, we need only hold the hand on the occipitales, while we raise the eye-brows and wrinkle the forehead several times; and we will perceive the occipitales to move each time, though not in the same degree in all subjects. In some persons the occipitales seem to be relaxed, while the frontales being in contraction move the whole scalp and pericranium forward, and then contract to bring them back to their natural situation.

Musculi superciliares. The musculi superciliares are fleshy fasciculi situated behind the supercilia, and behind the inferior portion of the musculi frontales from the root of the nose to above one half of each superciliary arch. They are strongly inserted, partly in the synarthrosis of the ossa nasi with the os frontis, where they come very near the proper muscles of the nose, and partly in a small neighbouring portion of the orbit. From thence they first run up a little, and afterwards more or less in the direction of the eye-brows. They are made up of several small fasciculi of oblique fibres,

all fixed by one end in the manner already said, and by the other partly in the lower extremity of the muscles by which they are covered, and partly in the skin of the supercilia. This last portion is easily confounded with a portion of the musculus orbicularis palpebrarum.

The action of these muscles is to depress the eyebrows. to bring them close together, and to contract the skin of the forehead immediately above the nose into longitudinal and oblique wrinkles, and the skin which covers the root of the nose into irregular transverse wrinkles. This action, as well as that of the frontales, and of the muscles of the nose and lips, is not always arbitrary, but sometimes mechanical and involuntary. These muscles may perhaps likewise serve to keep the muscoli frontales in equilibrio during their inaction, they being moveable by both extremities.

§ 7. *The Palpebræ and Membrana conjunctiva.*

Palpebræ. THE palpebræ are a kind of veils or curtains placed transversely above and below the anterior portion of the globe of the eye; and accordingly there are two eye-lids to each eye, one superior, the other inferior. The superior is the largest and most moveable in man. They both unite at each side of the globe; and the places of their union are termed *angles*, one large and internal which is next the nose, the other small or external which is next the temples.

Structure of the palpebræ. The palpebræ are made up of common and proper parts. The common parts are the skin, epidermis, and membrana adiposa. The proper parts are the muscles, the tarfi, the puncta or foramina lacrymalis, the membrana conjunctiva, the glandula lacrymalia, and the particular ligaments which sustain the tarfi. The tarfi and their ligaments are in some measure the basis of all these parts.

Tarfi

Tarfi. The tarfi are thin cartilages, forming the principal part of the edge of each palpebra; and they are broader at the middle than at the extremities. Those of the superior palpebræ are something more than a quarter of an inch in breadth; but in the lower palpebræ they are not above the sixth part of an inch; and their extremities next the temples are more slender than those next the nose.

These cartilages are suited to the borders and curvature of the eye-lids. The lower edge of the superior cartilage, and the upper edge of the inferior, terminate equally, and both may be termed the *ciliary edges*. The opposite edge of the upper tarsus is something semicircular between its two extremities; but that of the inferior tarsus is more uniform, and both are thinner than the ciliary edges. Their inner sides, or those next the globe are grooved by several small transverse channels, of which hereafter; and the extremities of both cartilages are connected by a kind of small ligaments.

Ligamenta tarforum lata. The broad ligaments of the tarfi are membranous elongations formed by the union of the periosteum of the orbits and pericranium along both edges of each orbit. The superior ligament is broader than the inferior, and fixed to the superior edge of the upper cartilage, as the inferior is to the lower edge of the lower cartilage; so that these ligaments and the tarfi, taken alone or without the other parts, represent palpebræ. This discovery I first communicated in my private courses.

Membrana conjunctiva. The membrana conjunctiva is generally described among the coats of the globe of the eye; and I also mentioned it there, but have referred the description of it to that of the palpebræ. It is a thin membrane, one portion of which lines the inner surface of the palpebræ, that is, of the tarfi and their broad ligaments. At the edge of the orbit it has a fold, and is continued from hence on the anterior half of the globe of the eye, adhering to the tunica albuginea; so

that the palpebræ and the fore part of the globe of the eye are covered by one and the same membrane, which does not appear to be a continuation of the pericranium, but has some connection with the broad ligaments of the tarfi.

The name of *conjunctiva* is commonly given only to that part which covers the globe, the other being called simply *the internal membrane of the palpebræ*; but we may very well name the one *membrana oculi conjunctiva*, and the other *membrana palpebrarum conjunctiva*. That of the palpebræ is a very fine membrane adhering very close, and full of small capillary blood-vessels. It is perforated by numerous imperceptible pores, thro' which a kind of serum is continually discharged; and it has several very evident folds which shall be spoken to hereafter.

The conjunctiva of the eye adheres by the intervention of a cellular substance; and is consequently loose, and as it were moveable; and it may be taken hold of, and separated in several places from the tendinous coat. It is of a whitish colour; and being transparent, the albuginea makes it appear perfectly white: these two coats together forming what is called *the white of the eye*. The greatest part of the numerous vessels which run upon it contain naturally only the serous part of the blood, and consequently are not discoverable, except by anatomical injections, inflammations, obstructions, &c. With the point of a good knife we continue the separation of this membrane over the cornea.

Glandula lacrymalis. The lacrymal gland is yellowish, and of the number of those called *conglomerate glands*. It lies under that depression observable in the arch of the orbit near the temples mentioned in the description of the skeleton, and laterally above the globe of the eye. It is a little flattened, and divided as it were into two lobes; one of which lies toward the insertion of the musculus rectus superior, the other toward the rectus externus. It adheres very closely to the

the fat which surrounds the muscles and posterior convexity of the eye, and it was formerly named *glandula innominata*.

From this gland several small ducts go out, which run down almost parallel to each other, thro' the substance of the tunica interna or conjunctiva of the superior palpebra, and afterwards pierce it inwardly near the superior edge of the tarsus.

The borders of each palpebra taken together are formed by the edge of the tarsus, and by the union of the internal membrane with the skin and epidermis. This border is flat, and of some sensible breadth from within about a quarter of an inch of the internal angle, all the way to the external angle, near which the breadth diminishes. This breadth is owing only to the thickness of the palpebræ, which at this place have their edges oblique or slanting, in such a manner as when the two palpebræ touch each other slightly, a triangular space or canal is formed between them and the globe of the eye.

Cilia. The flat edge of each palpebra is adorned with a row of hairs called *cilia*, or the *eye-lashes*. Those belonging to the superior palpebra are bent upward, and longer than those of the lower palpebra which are bent downward. These rows are placed next the skin; and are not single, but irregularly double or triple. The hairs are longer near the middle of the palpebræ than toward the extremities; and for about a quarter of an inch from the inner angle, they are quite wanting.

Glandulæ ciliares. Along the same border of the palpebræ near the internal membrane, or toward the eye, we see a row of small holes, which may be named *foramina* or *puncta ciliaria*. They are the orifices of the same number of small oblong glands which lie in the sulci, channels, or grooves on the inner surface of the tarsus. These little glands are of a whitish colour; and, when examined through a single microscope, they

appear like bunches of grapes, those of each bunch communicating together; and when they are squeezed between two nails, a sebaceous matter like soft wax, is discharged through the *puncta ciliaria*.

Puncta lacrymalia. Near the great or internal angle of the palpebræ, the flat portions of their edges terminate in another, which is rounder and thinner. By the union of these two edges an angle is formed; which is not perfectly pointed like a true angle, but rounded; and yet it ought not to be termed *an obtuse angle*, because that expression in the mathematical style means something different. For the same reason the name of *great angle* is improper; and we had better call it *the internal or nasal angle*.

At this place, the extremity of the flat portion is distinguished from the round portion by a small protuberance or papilla, which is obliquely perforated by a small hole in the edge of each palpebra. These two small holes are very visible, and often more so in living than in dead bodies; and they are commonly named *puncta lacrymalia*, being the orifices of two small ducts which open beyond the angle of the eye into a particular reservoir, termed *sacculus lacrymalis*, which shall be described in the article of the *Nose*.

The *puncta lacrymalia* are opposite to each other, so that they meet when the eye is shut. Round the orifice of each of these points, we observe a whitish circle, which seems to be a cartilaginous appendix of the tarsus, and which keeps the orifice always open. These two oblique circles are so disposed, that when the eye is but slightly shut, they touch each other only toward the skin, and not toward the globe of the eye. The fine membrane which covers these circles, and passes through the *puncta* into the ducts, seem sometimes to run into gathers when it is touched with a stileet. This observation was first made by the late M. Saint Yves a Parisian oculist.

Caruncula lacrymalis. The *caruncula lacrymalis* is a small

small reddish, granulated, oblong body, situated precisely between the internal angle of the palpebræ and globe of the eye, but it is not fleshy as its name would insinuate. The substance of it seems to be wholly glandular; and it appears through a single microscope, in the same manner as the other conglomerate glands. We discover upon it a great number of fine hairs covered by an oily, yellowish matter; and on the globe of the eye, near this glandular body, we see a semilunar fold formed by the conjunctiva, the concave side of which is turned to the uvea, and the convex side to the nose.

This fold, which has the name of *membrana semilunaris*, appears most when the eye is turned toward the nose; "it is shaped like a crescent, the two points of which answer to the puncta lacrymalia, and conduct the tears into the puncta."

§ 8. *The Muscles of the Palpebra.*

THE muscles of the palpebræ are commonly reckoned to be two; one peculiar to the upper eye-lid, named *levator palpebræ superioris*; the other common to both, called *musculus orbicularis palpebrarum*, which has been subdivided in different manners, as we shall see presently.

Levator proprius. The levator palpebræ superioris is a very thin muscle, situated in the orbit above and along the rectus superior oculi. It is fixed to the bottom of the orbit, by a small narrow tendon, near the foramen opticum between the posterior insertions of the rectus superior and obliquus superior. From thence its fleshy fibres run forward on the rectus, increasing gradually in breadth, and terminate by a very broad aponeurosis, in the tarsus of the superior palpebra.

Orbicularis palpebrarum. By the musculus palpebrarum obliquus, we understand all that extent of fleshy fibres which, by a thin stratum, surrounds the edge of each orbit, and from thence, without any interruption,

tion, covers the two palpebræ all the way to the cilia. The fibres which run upon the edge of the orbit are nearly orbicular; but most of those which cover the palpebræ are transversely oval.

Almost all of them have a common tendon situated transversely between the internal angle of the eye and the nasal apophysis of the os maxillare. This is a slender ligamentous tendon, strongest where it is fixed in the bone, and diminishing gradually as it approaches the angle of the palpebræ, where it terminates at the union of the points, or at the extremities of the two tarfi. The fleshy fibres are fixed to it anteriorly; so that at the first sight it appears to be no more than a *linea alba*.

From thence one portion of the fibres is turned upward, the other downward; and both meet again at the external angle, being united by a particular kind of intertexture very difficult to be explained. When, having inverted this portion of the muscle, we examine its posterior surface, we observe a small thin tendinous rope, which runs through the fleshy fibres, and divides them all the way from the union of the two tarfi to the temporal edge of the orbit, where it disappears; the fibres which lie beyond it appearing to continue the main circuit of the muscle.

I divide this muscle into four portions; whereof the first is that which surrounds the orbit, and which does not appear to be interrupted toward the temples, the upper part of it lying between the supercilia and the lower part of the muscoli frontales. The second portion is that which lies between the upper edge of the orbit and the globe of the eye, and which covers the inferior edge of the orbit below, some of its fibres being fixed to both edges of the orbit. Riolan divided this into two semicircular portions, one superior, the other inferior; the first lying between the musculus superciliaris and the lower part of the musculus frontalis, to both which it adheres very much.

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The third portion seems to belong more particularly to the palpebræ, and the greatest part of it is spent in the palpebra superior. The fibres of this portion meet at the two angles of the eye, where they appear to make very acute inflexions without any discontinuation; but when examined on the other side next the globe of the eye, they have in some subjects appeared to me to be distinguished into superior and inferior. The greatest part of these fibres form a transversely oval circumference; the shortest diameter of which is longer when the eyes are open than when shut.

The fourth portion is an appendix to the third; from which it differs chiefly in this, that its fibres do not reach to the angles, and form only small arches; the extremities of which terminate in each palpebra. This portion is really divided into two; one for the edge of the upper eye-lid, the other for that of the lower. Riolan names this portion *musculus ciliaris*.

All these different portions of the orbicular muscle adhere to the skin, which covers it from the upper part of the nose to the temples, and from the supercilium to the upper part of the cheek. When they contract, several wrinkles are formed in the skin, which vary according to the different direction of the fibres; those under the lower palpebra are very numerous, and run down very obliquely from before backward.

The skin of the superior palpebra is folded archwise, almost in a parallel direction to that of the semioval fibres; the plicæ intersecting the levator, whereas the other folds only intersect the orbicularis. The radiated and oblique plicæ seldom appear in young persons, except when the first and second portions of the orbicularis are in action; but in aged persons the marks thereof are visible at all times.

In man, the superior palpebra has much more motion than the inferior. The small simple motions, called *twinkling*, which frequently happen, though not equally often in all subjects, are performed “by the alternate

ternate contraction of the levator palpebræ and orbicularis."

These slight motions, especially those of the upper palpebra, are not very easy to be explained according to the true structure of the part. The motions which wrinkle the palpebræ, and which are commonly performed to keep one eye very close-shut, while we look stedfastly with the other, are explicable by the simple contraction of all the portions of the orbicularis. These motions likewise depress the supercilia, which consequently may be moved in three different manners, upwards by the musculi frontales, downward by the orbiculares, and forward by the superciliares. I shall take another occasion to explain the difficulties here mentioned.

§ 9. *The Vessels of the Eye and of its Appendages.*

THE external carotid artery, by means of the arteria maxillaris externa, and the temporal and frontal arteries, give several ramifications to the integuments which surround the eye, and to all the portions of the musculus orbicularis; and these ramifications communicate with those which are distributed to the membrana conjunctiva palpebrarum, and to the caruncula. "Some small branches also come in through the spheno-maxillary future, to be distributed chiefly on the periosteum and fat of the eye. The internal carotid artery having entered the cranium, sends off a considerable branch called *ocular*, which accompanies the optic nerve, to be distributed to the muscles and globe of the eye, to the levator palpebræ, to the fat, glandula lacrymalis, membrana conjunctiva, caruncula lacrymalis, &c. It likewise communicates with the external carotid, and sends one or two very small branches to the nose. The branches which supply the globe of the eye perforate the back part of the tunica sclerotica
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in five or six places, after having run a little way thro' its substance."

They next perforate the external lamina of the choroïdes in the same number of places, and form between that and the internal lamina the *vasa vorticosa* of Steno, and the vascular *stellæ* mentioned in the description of this internal lamina. Some small vascular filaments from these ramifications are likewise observed to adhere very closely to the tunica vitrea; and before they form the *vasa vorticosa*, they send small arteries in a direct course to the circumference of the uvea, where they form a vascular circle, which sends out capillaries as far as the *membrana crystallina*, which are very easily injected in new-born children.

The veins of all these parts answer nearly to the arteries. The internal veins unload themselves, partly into the internal jugular vein, by the *sinus orbitarii*, *cavernosi*, and *petrosi*; and partly into the external jugular vein, by the *vena angularis*, or *maxillaris externa*, the *maxillaris interna*, *temporalis*, &c.

Besides the capillary vessels, easily distinguishable by the red colour of the blood, there are great numbers of those which admit nothing but the serous and lymphatic parts of the blood, and consequently do not appear in the natural state. They become visible in some places by inflammations and injections, as on the *membrana conjunctiva* of the eye; but these contrivances do not discover them every where in aged persons. In a foetus, and in new-born children, a fine injection has succeeded so well as to discover the vessels of the *membrana crystallina* and *vitrea*; and in a foetus of about six months, the injected liquor seemed to me to have penetrated a part of the crystalline and vitreous humour.

§ 10. *The Nerves of the Eye and of its Appendages.*

I SHALL in this paragraph repeat and illustrate what has been already said in the description of the nerves, concerning those of the eye. Besides the optic nerve already described, the globe of the eye receives several small ones, which run on each side along and about the optic nerve, from its entry into the orbit to its insertion in the globe. These filaments come chiefly from a small lenticular ganglion, formed by very short rami of the orbitary or ophthalmic branch of the fifth pair, and by a branch of the third pair, or *motores oculi*.

These nervous filaments of the lenticular ganglion having reached the globe of the eye, are divided into five or six fasciculi; which having surrounded the optic nerve, and penetrated and perforated the sclerotica, run at distances more or less equal between the sclerotica and choroides towards the iris. There each of them is divided into several short filaments, which terminate in the substance of the iris. These small nerves, which run from behind forward between the sclerotica and the choroides, have formerly been taken for particular ligaments by very great anatomists.

The nerves which go to the other parts belonging to the eye, come from the third, fourth, sixth, and first two branches of the fifth pair of nerves of the medulla oblongata, and likewise from the portia dura of the seventh pair. The third, fourth, and sixth pairs give nerves to the muscles of the globe of the eye. The two branches of the fifth pair, and the portio dura of the seventh, give nerves not only to the other parts which surround the globe, but also to the muscoli frontales and internal parts of the nose.

The trunk of the third pair, or *motores oculi*, having entered the orbit through the superior orbitary fissure, “or foramen lacerum of the sphenoid bone,”

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produces four branches. The first runs upward, and divides into two; one for the *musculus rectus superior*, and the other for the *levator palpebræ superioris*. The trunk continuing its course, gives off the second short branch to the *rectus inferior*. The third branch is long, and goes to the *obliquus inferior*, contributing likewise to the formation of the lenticular ganglion already mentioned. The fourth branch is large, and supplies the *rectus internus*.

The first branch of the fifth pair, commonly termed *nervus ophthalmicus*, divides into three rami, as it enters the orbit; and sometimes only into two, one of which is afterwards subdivided. Of these three branches one is superior, which I term *nervus superciliaris*; one internal, termed *nasalis*; and one external, to which the name of *temporalis* agrees better than that of *lacrymalis*, which may occasion a mistake.

The superior or superciliary ramus runs along the whole periosteum of the orbit; and having passed thro' the superciliary notch or foramen of the *os frontis*, is distributed to the *musculus frontalis*, *superciliaris*, and superior portion of the *orbicularis palpebrarum*; and it communicates with a small branch of the *portio dura* of the seventh pair.

The internal or nasal branch passes under the ramification of the nerve of the third pair; and running toward the nose, is distributed thereto, and to the neighbouring parts of the *orbicularis*, the *caruncula*, &c. This branch sends off a filament, which, passing thro' the internal anterior orbitary hole, enters the cranium, and presently returns again through one of the ethmoidal holes to the internal parts of the nose. I have sometimes observed this nasal ramus to communicate with the ramus *superciliaris* by a particular arch, before it enters the orbitary hole.

The external or temporal ramus, which is sometimes a subdivision of the *superciliaris*, is distributed to the
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glandula lacrymalis, and sends off a filament which pierces the orbital apophysis of the os malæ.

The second branch of the fifth pair, called *nervus maxillaris superior*, sends off a ramus through the bony canal of the lower part of the orbit; which going out at the anterior inferior orbital hole, is distributed to the neighbouring portion of the musculus orbicularis, and communicates with a ramus of the portio dura. I shall here say nothing of the other distributions of this branch of the maxillaris superior.

The portio dura of the seventh pair, or auditory nerve, which I call *nervus sympathicus minor*, gives branches to the superior, inferior, and external lateral parts of the orbicularis palpebrarum; one of which communicates with the nervus superciliaris; and another with the sub-orbitarius, as I observed in the description of the nerves.

§ 11. *The Uses of the Eye and of its Appendages in general.*

EVERY body knows that the eye is the organ of vision. The transparent parts of the globe modify the rays of light, by different refractions; the retina and choroides receive the different impressions of these rays; and the optic nerve carries these impressions to the brain. When objects are at a great distance or obscure, the pupilla is dilated; and it is contracted when objects are near, or placed in a great light. The muscles of the globe of the eye and of the palpebræ perform the motions already described.

The glandula lacrymalis continually moistens the forepart of the globe of the eye; and the lacrymal serum is equally spread over that globe by the motions of the superior palpebra, the inner surface of which is in a small measure villous. The union of the two palpebræ directs this serum towards the puncta lacrymalia; and the unctuous matter discharged through the foramina ciliaria hinders it from running out between the pal-

palpebræ. The large size and viscid surface of the caruncula prevents it from running beyond the puncta; and thus forces it into them: "but when from any particular cause this fine fluid is poured out through the excretory ducts of the lacrymal gland faster than it can be carried off through the puncta, it trickles down the cheek, and forms what is properly called *tears*."

The supercilia may hinder sweat from falling on the eyes. The superior cilia, which are longer than the inferior may have the same use; and they both serve to prevent dust, insects, &c. from entering the eyes when they are only a little open.

SECT. III. *The Nose.*

THE parts of which the nose is composed, may be divided in two different ways, viz. from their situation, into internal and external parts; and, from their structure, into hard and soft parts.

The external parts are the root of the nose, the arch, the back or spine of the nose, the sides of the nose or of the arch, the tip of the nose, the alæ, the external nares, and the part under the septum.

The internal parts are the internal nares, the septum narium, the circumvolutions, the conchæ superiores, or ossa spongiosa superiora, conchæ inferiores, the posterior openings of the internal nares, the sinus frontales, sinus maxillares, sinus sphenoidales, the ductus lacrymales, and ductus palatini.

The firm or hard parts are mostly bony, and the rest cartilaginous, viz. the os frontis, os ethmoides, os sphenoides, ossa maxillaria, ossa nasi, ossa unguis, ossa palati, vomer, conchæ inferiores, and the cartilages. To these we may add the periolteum and perichondrium, as parts belonging to the bones and cartilages.

The soft parts are the integuments, muscles, sacculus

his lacrymalis, membrana pituitaria, vessels, nerves, and hairs of the nares. The bony parts have been all explained in the description of the skeleton; and therefore I need only in this place set down the distribution and disposition thereof, for the formation of some of the principal parts. The septum is formed by the descending lamina of the os ethmoides, and by the vomer; and it is placed in the groove framed by the cristæ of the ossa maxillaria, and rising edges of the ossa palati. The back of the nose is formed by the ossa nasi; and the sides, by the superior apophyses of the ossa maxillaria.

The internal nares, or the two cavities of the nose, comprehend the whole space between the external nares and posterior openings, immediately above the arch of the palate, from whence these cavities reach upwards as far as the lamina cribrosa of the os ethmoides, where they communicate forward with the sinus frontales, and backward with the sinus sphenoidales. Laterally, these cavities are bounded on the inside by the septum narium, and on the outside or that next the cheek by the conchæ, between which they communicate with the sinus maxillaris.

The particular situation of these cavities deserves our attention. The bottom of them runs directly backward, so that a straight and pretty large stilett may easily be passed from the external nares, under the great apophysis of the occipital bone. The openings of the maxillary sinuses are nearly opposite to the upper edge of the ossa malarum. The openings of the frontal sinuses are more or less opposite to and between the pulleys or rings of the muscoli trochleares; and by these marks the situation of all the other parts may be determined.

The inferior portion of the external nose is composed of several cartilages, which are commonly five in number, and of a pretty regular figure. The rest are only additional, smaller, more irregular, and the number of them more uncertain. Of the five ordinary cartilages, one is situated in the middle, the other four laterally.

rally. The middle cartilage is the most considerable, and supports the rest, being connected immediately to the bony parts; but the other four are connected to the middle cartilage, and to each other, by means of ligaments.

The principal cartilage of the nose consists of three parts, one middle and two lateral. The middle portion is a broad cartilaginous lamina, joined, by a kind of symphysis, to the anterior edge of the middle lamina of the os ethmoides; to the anterior edge of the vomer, and to the anterior part of the groove formed by the ossa maxillaria, as far as the nasal spines of these bones. This lamina completes the septum narium, and indeed forms the principal part thereof.

The lateral portions are oblique and narrow, suited to the corresponding parts of the bony arch. Where they join the middle lamina, a superficial groove is observable; which makes them sometimes appear like two distinct pieces, separated from the lamina, though they are really continuous. This shallow groove terminates below by a small crista.

The lateral cartilages are two, on each side of the inferior part of the lamina; one anterior, the other posterior. The two anterior cartilages are very much bent forward, and form what is called the *tip of the nose*; the space between their incurvated extremities being commonly filled with a kind of fatty substance. The two posterior cartilages form the alæ of the nares, being pretty broad, and of an irregular figure.

The spaces left between some portions of the anterior and posterior cartilages, those between the posterior cartilages and the neighbouring parts of the ossa maxillaria, and lastly those between these four lateral cartilages and the principal lamina, vary in different subjects; and are filled by small additional cartilages, the number, size, and figure of which are as various as the interstices in which they lie.

The sub-septum, or portion under the septum narium,

rium, is a pillar of fat applied to the inferior edge of the cartilaginous partition, in form of a soft moveable appendix. The thickness of the *alæ narium*, and especially that of their lower edges, is not owing to the cartilages, which are very thin, but to the same kind of solid fat with which these cartilages are covered. The great cartilage is immoveable by reason of its firm connection to the bony parts of the nose; but the lateral cartilages are moveable, because of their ligamentous connections, and they are moved in different manners by the muscles belonging to them.

The external nose is covered by the common integuments, the skin, epidermis, and fat. Those which cover the tip of the nose and *alæ narium*, are a great number of glandular bodies, called *glandulæ sebaceæ* by M. Morgagni, the contents of which may easily be squeezed out by the fingers. All these bony and cartilaginous parts have likewise the common periosteum or *perichondrium*.

Muscles of the nose. Six muscles are commonly reckoned to belong to the nose; "two levatores, two depressores, and two compressores." In very muscular bodies, there are likewise some supernumerary muscles, or small *accessorii*. The nose may also be moved in some measure by the neighbouring muscles, which in many cases become assistants to the proper muscles of this organ.

The *musculus levator alæ nasi* on each side, is inserted by one extremity, in the synarthrosis of the *os frontis* and *os nasi*, where its fleshy fibres mix with those of the *musculi frontales* and *superciliares*. It is very flat, and runs down on the side of the nose, increasing gradually in breadth, and terminating by an *aponeurosis*, which represents the basis of a pyramid, and is inserted in the moveable cartilage which forms the *ala* of the nares.

"The depressor muscle is a thin, fleshy plane, arising from the *os maxillare superius*, opposite to the roots of the

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the two dentes incisivi and dens caninus. From thence it runs up toward the ala narium, and is inserted in the moveable cartilage at the side of the nose, being covered partly by a portion of the former muscle.

“The compressor muscle is fixed by one end to the cartilage at the side of the nose, and by the other to the fore-part of the os nasi, and nasal process of the superior maxillary bone, where it meets with the under and middle part of the frontal muscle.”

The first pair of these muscles raises and dilates the ala of the nares, when they act. They likewise wrinkle the skin on the sides of the nose. “The second pair have the contrary effect; and the third pair compress the sides of the nose to the septum, as in smelling.”

Membrana pituitaria. The membrana pituitaria is that which lines the whole internal nares, the ossa spongiosa, the sides of the septum narium, and, by an uninterrupted continuation, the inner surface of the sinus frontales and maxillares, and of the ductus lacrymales, palatini, and sphenoidales. It is likewise continued down from the nares to the pharynx, septum palati, &c. as we shall show hereafter.

It is termed *pituitaria*, because, through the greatest part of its large extent, it serves to separate from the arterial blood a mucilaginous lymph, called *pituita* by the ancients, which in the natural state is pretty liquid; but it is subject to very great changes, becoming sometimes glutinous or snotty, sometimes limpid, &c. neither is it separated in equal quantities thro’ the whole membrane.

When we carefully examine this membrane, it appears to be of a different structure in different parts. Near the edge of the external nares it is very thin, appearing to be the skin and epidermis in a degenerated state. All the other parts of it in general are spongy, and of different thicknesses. The thickest parts are those on the septum narium, on the whole lower portion of the internal nares, and on the conchæ; and if

we make a small hole in it at any of these places, and then blow thro' a pipe, we discover a very large cellular substance. In the sinuses it appears to be of a more slender texture.

On the side next the periosteum and perichondrium, it is plentifully stored with small glands, the excretory ducts of which are very long near the septum narium, and their orifices very visible; and by applying a pipe to any of these orifices, the ducts may be blown up almost through their whole extent; but, in order to this, the parts must first be very well cleaned and washed in lukewarm water.

In these places especially, we likewise discover a very fine villous substance, when the parts are examined in clear water, in the manner which I have described in another place.

Sinus. The frontal, maxillary, and sphenoidal sinuses open into the internal nares, but in different manners. The frontal sinuses open from above downward, answering to the infundibula of the os ethmoides described in the history of the skeleton. The sphenoidales open forwards, opposite to the posterior orifices of the nares; and the maxillares open a little higher, between the two conchæ or ossa spongiosa. Therefore the sinus frontales discharge themselves most readily when we stand or sit; and the sphenoidales, when the head is inclined forward.

The sinus maxillares cannot be emptied wholly or both at the same time in any one situation. Their opening, which in some subjects is single, in others double, &c. lies exactly between the two ossa spongiosa of the same side, about the middle of their depth: so that when the head is held straight, or inclined forward or backward, they can only be half emptied; but when we lie on one side, the sinus of the opposite side may be wholly emptied, the other remaining full.

It is proper here to observe the whole extent of the maxillary sinus. Below, there is but a very thin partition

tion between it and the dentes molares, the roots of which do, in some subjects, perforate that septum. Above, there is only a very thin transparent lamina between the orbit and the sinus. Backward, above the tuberosity of the os maxillare, the sides of the sinus are very thin, especially at the place which lies before the root of the apophysis pterygoïdes, thro' which the inferior maxillary nerve sends down a ramus to the foramen palatinum posterius, commonly called *gustatorium*. Inward, or toward the conchæ narium, the bony part of the sinus is likewise very thin.

Sacculus lacrymalis. The lacrymal sacculus is an oblong membranous bag, into which the serous fluid is discharged from the eye through the puncta lacrymalia, already described, and from which the same fluid passes to the lower part of the internal nares. It is situated in a bony groove and canal, formed partly by the apophysis nasalis of the os maxillare and os unguis, partly by the same os maxillare and lower part of the os unguis, and partly by this lower portion of the os unguis and a small superior portion of the concha narium inferior. This groove and canal are the bony lacrymal duct, about which I would advise beginners to consult what was said in the description of the skeleton.

I have an observation or two to add in this place concerning the situation of this bony duct. It runs down for a little way obliquely backward, toward the lower and lateral part of the internal nares on each side, where its lower extremity opens on one side of the sinus maxillaris under the os spongiosum inferius, nearly at the place from which a perpendicular line would fall in the interstice between the second and third dentes molares. The upper part of this duct is only an half canal or groove; the lower is a complete canal, narrower than the former.

The sacculus lacrymalis may be divided into a superior or orbitary portion, and an inferior or nasal portion.

The orbitary portion fills the whole bony groove, being situated immediately behind the middle tendon of the *musculus orbicularis*. About one fourth of its length is above this tendon, and the rest below. The nasal portion lies in the bony canal of the nose, being narrower and shorter than the former.

The orbitary portion is disposed at its upper extremity much in the manner of an *intestinum cæcum*, and at the lower extremity is continued with the *portio nasalis*. Towards the internal angle of the eye, behind the tendon of the orbicular muscle, it is perforated by a small short canal formed by the union of the lacrymal ducts.

The nasal portion having reached the lower part of the bony duct under the inferior concha, terminates in a small, flat, membranous bag, the bottom of which is perforated by a round opening, as I have always found it upon a careful examination, but which at first sight appears oblong.

I used to attribute this difference to the force which I was obliged to use in separating the concha inferior, in order to see this opening, which I have often found more backward than the middle of the bag at the extremity of this portion; and therefore, when I would either see or show this opening in its natural state, I do not separate the inferior concha, but cut it gently with a sharp knife, or with scissars. If a transverse line be drawn between the lower part of the nose and *os malæ*, and another line be drawn directly upward, opposite to the third *dens molaris*, or opposite to the second and third, these two lines will intersect each other nearly at the lower extremity of this sacculus.

I have sometimes found the upper extremity of this bag divided into an anterior and posterior part, by a kind of *valvula connivens* lying in the anterior portion, a little lower than the tendon of the *musculus orbicularis*. The small common canal of the two lacrymal ducts opens in the posterior portion, and consequently behind the valve.

The substance of this sacculus is something spongy or cellulous, and pretty thick, being strongly united by its convex side to the periosteum of the bony canal, which may be very distinctly shown. This substance seems to be made up of two laminæ, joined together by a spongy membrane, the outermost of which is that which I have mentioned; the other appears to be glandular, and is in some subjects loose and pliable, which I look upon as a disease.

Ductus incisorii. The ductus incisorii, or naso-palatini of Steno, are two canals which go from the bottom of the internal nares cross the arch of the palate, and open behind the first or largest dentes incisorii. Their two orifices may be distinctly seen in the skeleton at the lower part of the nasal fossæ, on the anterior and lateral sides of the cristæ maxillares; and we may likewise perceive their oblique passage through the maxillary bones, and lastly their inferior orifices in a small cavity or fossula called *foramen palatinum. anterius*. In fresh subjects they are not so apparent, especially in human subjects; but in sheep and oxen they are easily discoverable.

Santorini, in his Anatomical Observations, has described those of the human body in a very pretty manner; and has given us his method of discovering them, which is nearly the same with that which I have always made use of in my private courses, to show at one view all the external parts which belong to the nose.

By cutting the nose longitudinally at a little distance from the septum, I show on that side from which all the septa have been sawed off, the ossa spongiosa entire, their convex sides, the particular thickness of the membrana pituitaria on their lower edges, the orifice or orifices of the sinus maxillaris, the situation of the orifice of the sinus sphenoidalis, the communicating ducts that go between the sinus frontales and the ethmoidal cells, and interstices between the two ossa spongiosa and the structure of the posterior openings of the nares. I
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can show likewise at the same time the orifice of the Eustachian tube behind the posterior opening of the nares, and the communication of the nose with the mouth.

On the same side, I afterwards separate gradually with a very sharp knife, or with narrow sharp-pointed scissars, the superior spongy bone, without doing any violence to the neighbouring parts; and then I can show on the parts covered by that concha, a little oblong or oval fossula, which runs down obliquely from before backward; at the posterior and lower extremity of which, there is an orifice of about a quarter of an inch in-diameter, which opens into the maxillary sinus; and another at the anterior or superior extremity, which opens into the frontal sinus.

Immediately behind this fossula there are two openings, one into the sinus frontales, the other into the ethmoidal cellulæ of the os frontis. I show likewise in the posterior part of the os ethmoides, at least two openings, by which the cells of that bone communicate with each other. All this is very different from what we see in the skeleton, or even when these parts are deprived of their membranes, &c. Neither is the structure always the same in fresh subjects; for in some I have observed, a little before and above the opening of the maxillary sinus, two small grooves, which united in their passage to the frontal sinuses, the uppermost groove being a little contorted.

In the next place, I remove the concha inferior, or maxillaris, in the same manner, and with the same precautions; and then I observe, at the distance of about a quarter of an inch from the anterior extremity of this concha, or spongy bone, a small opening, the diameter of which is not above the twelfth part of an inch, and it is turned obliquely backward. It seems to be the extremity of a duct of the same diameter; but when it is slit with sharp-pointed scissars, we discover a flat oval cavity, the diameter of which is a quarter of an inch in length,

length, and lies in the same direction with the septum narium.

This oval cavity is the lower extremity of the sacculus lacrymalis, which consequently is only contracted between this inferior cavity and the orbitary portion. Within this narrow or contracted portion we see likewise the opening of a blind duct, which runs obliquely backward and upward for about a quarter of an inch; but I do not know precisely where it terminates, or for what it is designed.

Arteries and veins. The arteries of all these parts come chiefly from the external carotid. Those of the external parts of the nose are chiefly branches and rami of the arteria maxillaris externa or angularis, and of the temporalis; and the arteries of the internal parts are branches and ramifications of the maxillaris interna. The veins are, almost in the same manner, branches and ramifications of the external jugular; and they communicate with the orbitary sinus, and, by that means, with the sinuses of the dura mater, and with the internal jugulars.

Nerves. The principal nerves belonging to the nose are filaments of the nervi olfactorii, which run down through the holes of the transverse lamina of the os ethmoides, and are distributed to the common membrane of the internal nares, especially to the villous portions thereof. The inner ramus of the orbitary or ophthalmic sends a filament through the internal anterior orbitary hole into the cranium, which comes out again in company with one of the filaments of the olfactory nerve through the ethmoidal lamina.

This internal ramus advances afterwards toward the os unguis; and is distributed partly to the sacculus lacrymalis, partly to the upper portion of the musculus levator alæ nasi, and of the integuments of the nose. The suborbitary nerve, which is a branch of the maxillaris superior, having passed through the inferior orbitary hole, sends filaments to the lateral external parts
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of the nose. Another ramus of the superior maxillary nerve goes to the posterior opening of the nares, being spent on the conchæ and other internal parts of the nose.

Uses. The nose is the organ of smelling, by means of the villous portion of the internal membrane, to which the olfactory nerves are chiefly distributed. It is likewise of use in respiration; and the mucilaginous fluid spread over the whole pituitary membrane, prevents the air from drying that membrane, and so rendering it incapable of being affected. The nose serves likewise to regulate and modify the voice, and to this the sinuses likewise contribute. The sacculus lacrymalis receives the serum from the eyes, and discharges it upon the palate, from whence the greatest part of it runs to the pharynx.

SECT. IV. *The EAR.*

The ear in general. EVERY one knows that the ears are two in number, that they are situated in the lateral parts of the head, and that they are the organs of hearing. Anatomists commonly divide or distinguish the ear into external and internal. By the external ear they mean all that lies without the external orifice of the meatus auditorius in the os temporis; and by the internal ear, all that lies within the cavities of that bone, and also the parts that bear any relation thereto.

The greatest part of the external ear consists of a large cartilage very artificially framed, which is the basis of all the other parts of which this portion of the ear is made up. The internal ear consists chiefly of several bony pieces, partly formed in the substance of the ossa temporum, and especially in that portion of it called *apophysis petrosa*; and partly separated from, but contained in a particular cavity of, that bone. All these
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bony pieces have been explained in the description of the skeleton, to which I must therefore refer, desiring those who have a mind to understand what I am now to say about the other parts of this organ, carefully to revise the explication there given.

The external ear. The external ear, taken all together, resembles in some degree the shell of a muscle, with its broad end turned upward, the small end downward, the convex side next the head, and the concave side outward. Two portions are distinguished in the external ear taken all together; one large and solid, called *pinna*, which is the superior, and by much the greatest part; the other small and soft, called the *lobe*, which makes the lower part. We may likewise consider two sides in the outward ear; one turned obliquely forward, and irregularly concave; the other turned obliquely backward, and unequally convex; for all ears which have not been disordered by binding the head too tight in childhood, are naturally bent forward.

The foreside is divided into eminences and cavities. The eminences are four in number, called *helix*, *antihelix*, *tragus*, and *antitragus*. The helix is the large folded border or circumference of the great portion of the ear. The antihelix is the large oblong eminence or rising surrounded by the helix. The tragus is the small anterior protuberance below the anterior extremity of the helix, which in an advanced age is covered with hairs. The antitragus is the posterior tubercle, below the inferior extremity of the antihelix.

The cavities on the foreside are four in number: the hollow of the helix; the depression at the superior extremity of the antihelix, called *fossa navicularis*; the concha, or great double cavity that lies under the rising termed *antihelix*, the upper bottom of which is distinguished from the lower by a continuation of the helix in form of a transverse crista; and lastly, the meatus of the external ear, situated at the lower part of the bottom of the concha.

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The backside of the external ear shows only one considerable eminence, which is a portion of the convex side of the concha, the other portion being hid by the adhesion of the ear to the os temporis. This adhesion hinders us likewise from seeing the hollow answering to the crista, by which the cavity of the concha is divided.

I have already said, that the external ear consists chiefly of a cartilage, which is the basis of all the other parts. These other parts are ligaments, muscles, integuments, sebaceous and ceruminous glands, vessels, and nerves : but I do not reckon among them a large gland, called by the Greeks *parotis*, altho' it lies very near the ear ; the description of this must be referred to that of the salivary glands, of which it is a very considerable one.

The cartilage of the outward ear is nearly of the same extent and figure with the large solid portion thereof already mentioned ; but it is not of the same thickness, being covered by integuments on both sides. In the lobe or soft lower portion of the ear, this cartilage is wanting. On the back-side, it shows all the eminences and cavities on the fore-side in an opposite situation with respect to each other, except the fold of the great circumference ; and it consists only of one piece from that circumference all the way to the meatus externus, except at the two extremities of the folded part of the helix, where there are two small separate portions connected to the great cartilage only by the integuments.

The cartilaginous portion of the external meatus auditorius does not make a complete circle ; but rather a short tube, in one side of which there is a break, and which terminates in an oblique border fixed to the edge of the bony canal by several small inequalities, as by a kind of ingrailing ; and from this obliquity it is, that the cartilaginous border terminates downward in a kind of apex or point. The lateral break in this cartilage is
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between the upper and back part of its circumference; and on each side thereof the cartilaginous edges are rounded. There are likewise two or three other small incisures in this circumference, which, in regard to the meatus, represent obliquely transverse fissures. The anterior fissure is in a manner quadrangular; neither are the intermediate parts always opposite to each other, for the uppermost is a little further from the os temporis than the posterior.

The external ear is fixed to the cranium, not only by the cartilaginous portion of the meatus already mentioned, but also by ligaments which are two in number, one anterior, the other posterior. The anterior ligament is fixed by one extremity to the root of the apophysis zygomatica of the os temporis, at the anterior and a little toward the superior part of the meatus ossis, close to the corner of the glenoid cavity; and by the other extremity, to the anterior and superior part of the cartilaginous meatus.

The posterior ligament is fixed by one end to the root of the mastoid apophysis, and by the other to the posterior part of the convexity of the concha; so that it is opposite to the anterior ligament. There is likewise a kind of superior ligament, which seems to be only a continuation of the aponeurosis of the frontal and occipital muscles.

Of the muscles of the external ear, some go between the cartilages and the os temporis, others are confined to the cartilages alone. Both kinds vary in different subjects, and are sometimes so very thin as to look more like ligaments than muscles. The muscles of the first kind are generally three in number, one superior, one posterior, and one anterior; and they are all very thin. The superior muscle is fixed in the convexity of the fossa navicularis, and of the superior portion of the concha; from whence it runs up to the squamous portion of the os temporis, expanding in a radiated manner, though not in the same degrees in all subjects, and

and is inserted principally in the “aponeurosis of the occipital and frontal muscles; and has the name of *attollens aurem*.”

The anterior muscle is small, more or less inverted, and like an appendix to the superior. It is fixed by one extremity above the root of the zygomatic apophysis; and by the other, in the anterior part of the convexity of the concha; and is called *anterior auris*.

The posterior muscle is almost transverse, and of a considerable breadth, being fixed by one end to the posterior part of the convexity of the concha, and by the other in the root of the mastoid apophysis. It covers the posterior ligament; “and is divided into two or three very distinct portions, which get the name of *posteriores auris*.”

The small muscles which are confined to the cartilages, are only small strata of fibres found on both sides of the cartilages. In many subjects they are of so pale a colour as not to look at all like muscular fibres. Of this number are those which Valsalva discovered in the different cavities on the backside of the cartilage; and those found by Santorini on the tragus, and along the convex part of the anterior portion of the helix. They are described in the treatise on the muscles.

The skin of the external ear is in general a continuation of that which covers the neighbouring parts of the temporal region. The skin on the foreside of the ear is accompanied by a very small quantity of cellular substance; and therefore we find all the eminences and cavities of that side distinctly marked upon it, as far as the bottom of the external meatus auditorius. In what I have said of the skin, the epidermis is likewise comprehended.

The backside is covered by the skin continued from the foreside; but as the folds are there very close, it only passes over them, except that portion of the concha which surrounds the entry of the meatus auditorius, and which is joined to the os temporis by means of the cellular

lular substance. The hollow of that common fold which lies between the antihelix and concha does not appear on the backside ; for as it is filled with cellular substance, the skin passes over it.

The lobe of the ear, or that soft portion which lies under the tragus, antitragus, and meatus auditorius, is made up of nothing but skin and cellular substance. The meatus auditorius is partly bony and partly cartilaginous. The bony portion is the longest, and forms the bottom of the canal, as may be seen in the description of the skeleton. The cartilaginous portion is the shortest ; and, in adults, forms the external opening or orifice of the canal, as has been already said.

These two portions joined endwise to each other, form a canal of a considerable length, of different wideness in its different parts, and a little contorted. It is lined on the inside by the skin and cellular membrane, through its whole length ; and thus these integuments make up for the breaks in the cartilaginous portions, and form a kind of cutaneous tube in the other portion. The cellular membrane is confounded with the perichondrium and periosteum of the meatus.

The skin which covers both sides of the cartilage contains a great number of small glands, which continually discharge an oily, whitish humour, collected chiefly near the adhesions of the ear to the head, and under the fold of the helix ; and these glands are of the sebaceous kind. The skin, which lines the meatus auditorius, contains another kind of glands, of a yellowish colour, and which may be plainly seen on the convex side of the cutaneous tube already mentioned.

These glands are disposed in such a manner as to leave reticular spaces between them, and they penetrate a little way into the substance of the skin. They are called *glandulae ceruminosae*, because they discharge that matter which is named *cerumen* or the *wax* of the ear.

The inner surface of the cutaneous tube is full of fine hairs, between which lie the orifices of the ceruminous

glands. The first place in which we meet with these glands is on that part of the convex side of the cutaneous tube, which supplies the breaks of the cartilaginous meatus.

The arteries of the external ear come anteriorly from the arteria temporalis, and posteriorly from the occipitalis, all of which are branches of the external carotid. It is proper to observe here, that the occipital artery communicates with the vertebralis, and thereby with the internal carotid. The veins are rami of the jugularis externa; and the occipital vein, one of these rami, communicates, not only with the vena vertebralis, but with the neighbouring lateral sinus of the dura mater.

The portio dura of the auditory nerve having passed out of the cranium through the foramen stylo-mastoid, in the manner that shall be afterwards described, gives off a ramus, which runs up behind the ear, to the backside of which it sends several filaments; and the trunk of this ramus sends likewise filaments to the meatus and foreside of the ear. The second vertebral pair sends also a ramus to the ear, the ramifications of which communicate with those of the other ramus from the portio dura.

“After having described the external parts of the ear, we next proceed to examine its internal bony parts; and here we shall consider them at some length, as they are purposely omitted in the osteological part of this work.

“The bony part of the organ of hearing may be divided into four general parts: 1. The meatus auditorius externus; 2. The tympanum; 3. The labyrinth; 4. The meatus auditorius internus. It may likewise be divided into immoveable or containing parts, which take in all the four already mentioned; and moveable or contained parts, which are four little bones lodged in the tympanum, called *incus*, *malleus*, *stapes*, and *os orbiculare* or *lenticulare*.

“The

“The meatus externus at its outer end has its edges rough and prominent ; but its back part is considerably depressed. The passage itself is somewhat more than half an inch in length, running obliquely from behind forward in a curved direction. Its cavity is almost oval, but wider at each end than in the middle. It terminates inwardly by an even circular edge, lying in a plane very much inclined, the upper part of it being turned outward, and the inner part inward ; so that the canal is longer on the lower than upper side. The circular edge is grooved quite round for the attachment of the membrana tympani.

“In children, this bony canal is wanting, as well as the mastoid process ; and the inner circular edge is a distinct ring, which, in an advanced age, unites entirely, and becomes one piece with the rest. It is termed the bony circle in infants ; and indeed it is very easily separated from all the other parts.

“It would seem, therefore, that the whole bony canal in adults is only a prolongation of the bony circle in children ; because even in a more advanced age, the whole canal may without much difficulty be taken out. The circular groove lies between the mastoid process and the articular fissure mentioned in the description of the other parts of the temporal bone.

“*Tympanum.* The tympanum, or drum of the ear, is a cavity somewhat spherical, the bottom of which is turned inward, and the mouth joined to the circular groove already mentioned.

“The remarkable eminences are three in number : A large tuberosity, lying in the very bottom of the barrel, a little toward the back part ; and a small irregular pyramid, situated above the tuberosity, and a little more backward, the apex of which is perforated by a small hole : on one side of the basis two small bony filaments are often found in a parallel situation ; and indeed I believe they are seldom wanting, though their tender structure exposes them to be often broken. In the third

eminence is a cavity situated at the upper and a little toward the anterior part of the bottom of the tympanum. This cavity is part of a half canal, which in a natural state has one of the muscles of the malleus lodged in it.

“ The principal cavities in the tympanum, are, The opening of the mastoid cells; the opening of the Eustachian tube; the bony half canal; the fenestra ovalis and rotunda; and to these may be added the small hole in the pyramid.

“ The opening of the mastoid cells is at the posterior and upper part of the edge of the tympanum. The cells themselves which end there are hollowed out in the substance of the mastoid process, being very irregular and full of windings and turnings.

“ The opening of the Eustachian tube is at the anterior and upper part of the edge of the tympanum. It runs from the tympanum toward the posterior openings of the nostrils and arch of the palate. The bony portion thereof, of which alone I here speak, is hollowed out in the pars petrosa, and is afterward lengthened out by the spinal process of the os sphenoides.

“ The mastoid cells, and the Eustachian tube, from their situation, may be looked upon in some measure as prolongations of the tympanum.

“ The bony half canal lies immediately above the Eustachian tube, toward the upper side of the pars petrosa. In the recent subject, one of the muscles of the malleus is lodged in it.

“ The fenestra ovalis is a hole of communication between the tympanum and labyrinth. It lies immediately above the tuberosity; the upper side of it being a little rounded, the lower a little flattened, and has its longest diameter from before backwards. Toward the labyrinth, this opening has a little border round it, which renders it narrower at that place than any where else.

The fenestra rotunda is something less than the ovalis

lis, and situated above it toward the lower and posterior part of a large tuberosity; the opening of it, which is the orifice of a particular duct in the labyrinth, lying obliquely backward and outward.

“ The hole in the apex of the pyramid is the orifice of a cavity, which may be named the *sinus* of this pyramid.

“ *Officula auditus.* The tympanum contains several little bones, called the *bones of the ear*. They are generally four in number, demonstrated from something to which they are said to bear a resemblance, *viz.* incus, malleus, stapes, and os orbiculare or lenticulare.

“ *Incus.* The incus, or anvil, resembles, in some measure, one of the anterior dentes molares, with its roots at a great distance from each other. It may be divided into a body, and two branches or legs; one of the legs is long, the other short. The body is turned forward, the short leg backward, and the long leg downward.

“ The body of the incus is broader than it is thick. It has two eminences, and two cavities between them, much in the same manner as we see in the crown of the first dentes molares.

“ The short leg is thick at its origin; and from thence decreasing gradually, it ends in a point. It is situated horizontally, its point being turned backward, and joined to the edge of the mastoid opening of the tympanum.

“ The long leg viewed through the external auditory passage appears to be situated vertically; but if we look upon it either on the fore or back side, we see it is inclined, the extremity of it being turned much more inward than the root or origin. The point of the extremity is a little flattened, bent inward like a hook, and sometimes a little hollowed like a kind of ear-picker. By this we may distinguish the incus of one ear from that of the other, when out of their places: for turn-

ing the short leg backward, and the long leg downward, if the curvature of this long leg be toward the left hand, the bone belongs to the right ear; if toward the right, it belongs to the left ear.

“ *Malleus*. The malleus, or hammer, is a long bone with a large head, a small neck, an handle, and two processes; one in the neck, the other in the handle.

“ The top of the head is considerably rounded; and from thence it contracts all the way to the neck. Both head and neck are in an inclined situation; and the eminences and cavities of it answer to those in the body of the incus. The handle is looked upon by some as one of the processes of the malleus; and in that case it is the greatest of the three. It forms an angle with the neck and head; near which it is something broad and flat, and decreases gradually toward its extremity.

“ The process of the handle, termed by others the *small* or *short process* of the malleus, terminates in the angle already mentioned, being extended toward the neck, and lying in a straight line with that side or border of the handle which is next it. The process of the neck, called also *processus gracilis*, is, in a natural state, very long; but so slender, that it is very easily broken, especially when dry; which is the reason why the true length of it was for a long time unknown. It arises from the neck, and sometimes appears much longer than it really is, by the addition of a small dried tendon sticking to it.

“ When the malleus is in its true situation, the head and neck are turned upward and inward; the handle downward, parallel to the long leg of the incus, but more forward; the process of the handle upward and outward, near the superior portion of the edge of the tympanum, near the centre of which is the extremity of the handle; and the *processus gracilis* forward, reaching all the way to the articular fissure in the os temporis.

temporis. It is easy, after what has been said, to distinguish the malleus of the right side from that of the left.

“ *Stapes.* The stapes is a small bone, very well denominated from the resemblance it bears to a stirrup. It is divided into the head, legs, and basis. The head is placed upon a short flattened neck; the top of which is also sometimes flat, sometimes a little hollow.

“ The two legs, taken together, form an arch like that of a stirrup; in the concave side of which is a groove which runs through their whole length. One leg is longer, more bent, and a little broader, than the other. The basis resembles that of a stirrup both in its oval shape and union with the legs, but it is not perforated. Round its circumference, next the legs, is a little border, which makes that side of the basis appear a little hollow. The other side is pretty smooth; and one half of the circumference is more curved than the other.

“ The subject being in an erect posture, the stapes is to be considered as lying on its side, with the head turned outward, near the extremity of the leg of the incus; the basis being fixed in the fenestra ovalis; the longest leg backward, and both legs in the same plane. By this situation, it is easy to know the stapes belonging to each ear.

“ *Os orbiculare.* The os orbiculare, or lenticular bone, is the smallest bone in the body. It lies between the head of the stapes and extremity of the long leg of the incus, being articulated with each of these.

“ In dry bones it is found very closely connected, sometimes to the stapes, sometimes to the incus; and might, in that state, be easily mistaken for an epiphysis of either of these bones.

“ *Labyrinth.* The labyrinth is divided into three parts; the anterior, middle, and posterior. The middle portion is termed *vestibulum*, the anterior *cochlea*, and the posterior

posterior *labyrinth in particular*; which comprehends the three semicircular canals.

“The cochlea lies forward and inward toward the extremity of the pars petrosa; the semicircular canals backward and outward toward the basis of the process; and the vestibulum between the other two.

“*Vestibulum.* The vestibulum is an irregular round cavity, less than the tympanum, and situated more inward, and a little more forward. These two cavities are in a manner set back to back, with a common partition between them, perforated in the middle by the fenestra ovalis, by which the cavities communicate with each other. The cavity of the vestibulum is likewise perforated by several other holes; on the back side by the five orifices of the semicircular canals; on the lower part of the fore side by a hole, which is one of the passages of the cochlea; and on the fore side, toward the meatus auditorius, opposite to the fenestra ovalis, by a number of very small holes, for the passage of the nerves; on the upper side there are only small pores.

“*Semicircular canals.* The semicircular canals are only three in number; one vertical, one oblique, and one horizontal. The vertical canal is situated transversely with respect to the pars petrosa, the convex side of it being turned upward. The oblique canal lies farther back than the former, and runs parallel to the length of the process, the convex side being turned backward, with one extremity upward, the other downward: the superior extremity of this canal meets and loses itself in the internal extremity of the former.

“The curvature and extremities of the horizontal canal are almost on a level; the curvature lying obliquely backward; and the extremities forward, and under those of the vertical canal, but a little nearer each other, the inner being almost in the middle space between the extremities of the oblique canal.

“The horizontal canal is generally the least of the three;

three ; the oblique is often, and the vertical sometimes, the greatest ; and sometimes these two are equal. All the three canals are larger than a semicircle, forming nearly three-fourths of one ; they are broader at the orifices than in the middle. These orifices open into the back-side of the vestibulum, and are but five in number, because two of them open into each other ; so that in the posterior part of the vestibulum, two appear toward the inside, and three toward the outside.

“ In children, the substance of these canals is compact, while that which surrounds them is spongy. Hence they may be easily separated from the rest of the pars petrosa. In adults, all the parts of the bone are so solid, that these canals appear only like passages formed in a piece of ivory. From this description, it is easy to distinguish the right labyrinth from the left.

“ *Cochlea*. The cochlea is a sort of spiral body with two ducts, formed in the anterior part of the pars petrosa, somewhat resembling the shell of a snail. The parts to be distinguished in it, in its true situation, are, The basis ; the apex ; the spiral lamina, or half septum, by which its cavity is divided into two half canals ; the modiolus, round which the cochlea turns ; and, lastly, the orifices and union of the two ducts. The basis is turned directly inward toward the internal foramen auditorium, the apex outward ; and the axis of the modiolus is nearly horizontal ; but in all of them allowance must be made for the obliquity of the pars petrosa in which they lie.

“ The basis of the cochlea is gently hollowed ; and, toward the middle, perforated by several small holes. The modiolus is a kind of short cone with a very large basis, which is the middle of the basis of the cochlea : through its whole length runs a double spiral groove, which, through a microscope, shows a great number of pores. The cochlea makes about two turns and a half from the basis to the apex ; and the two half canals being firmly united together through their whole course,

course, form a half septum, called *lamina spiralis*; which must not be confounded with the complete septum in the recent subject, as is often done. One edge of the *lamina spiralis* is strongly joined to the modiolus, being thicker there than in any other place; whereas the other edge is terminated all round by a very thin border, lying in the middle cavity of the cochlea. In the natural state, the other half of the septum is membranous, and completes the partition between the two canals. The two half canals turn jointly about the modiolus; one being situated toward the basis of the cochlea, the other toward the apex; for which reason I have always called one of them *internal*, the other *external*.

“ The spiral or volute of the cochlea begins at the lower part of the vestibule; runs from thence forward to the top, then backward down to the bottom, afterward upward and forward; and so on from the basis, which is turned inward to the apex, which is turned outward. From this description, it is easy to know to what ear any cochlea belongs when we see it prepared: it likewise teaches us, that, in the right cochlea, the direction of the turnings is the same as in garden-snails, and almost all the other common shells; but in the left cochlea, the turnings are in a contrary direction, as in one kind of shell, which is rarely met with. The two half canals communicate fully at the apex of the cochlea. Their separate openings are toward the basis; one of them being immediately into the lower part of the fore-side of the vestibulum, the other into the fenestra rotunda. These two openings are separated by a particular turning, which shall be described afterwards.

“ The meatus auditorius internus, is on the back-side of the pars petrosa, in some measure behind the vestibule and basis of the cochlea. It is a kind of blind hole, divided into two fossulae; one large, the other small. The large one lies lowest, and serves for the
portio

portio mollis of the auditory nerve or seventh pair. The small one is uppermost, and is the opening of a small duct, through which the portio dura of the same nerve passes. The inferior fossula is full of little holes, which, in the natural state, are filled with nervous filaments of the portio mollis, which go to the vestibule, to the semicircular canals, and to those of the cochlea. It is this fossula which forms the shallow cavity at the basis of the spindle of the cochlea. The passage for the portio dura of the auditory nerve runs behind the tympanum, and its external orifice is termed *foramen stylo-mastoideum*. It begins by the small fossula, and pierces from within outward the upper part of the pars petrosa, making there an angle or curvature; from thence it is inclined backward behind the small pyramid of the tympanum, and runs down to the foramen stylo-mastoideum; through which it goes out, and is distributed in the manner to be described hereafter. It communicates likewise by a hole with the sinus of the pyramid, and lower down by another hole with the tympanum. At the upper part of the pars petrosa it is covered with a bony lamina, although sometimes it has been found open above."

The soft parts of the internal ear are chiefly the membrana tympani, the periosteum of the "tympanum, and of the ossicula auditus," labyrinth, and of all its cavities, the membrana mastoidea interna, the muscles of the ossicula, the parts which complete the formation of the Eustachian tube, the arteries, veins, and nerves. I find, myself, however, under a necessity of beginning by the tuba Eustachiana, for two reasons: first, because the bony parts of that tube are but of very small use for the knowledge of its whole structure and composition; and, secondly, because we are obliged to mention it in describing the muscles.

The *ductus auris palatinus*, or Eustachian tube, as

was observed in the description of the skeleton, is a canal or duct which goes from the tympanum to the posterior openings of the nares, or nasal fossæ, and toward the arch of the palate; it is dug in the apophysis petrosa along the carotid canal, and it is lengthened out by the spinal apophysis of the os sphenoidale.

In its natural state, this duct reaches from the cavity of the barrel to the root or superior part of the internal ala of the apophysis pterygoides; and through this whole course it is made up of two portions, one entirely bony, and the other partly bony, partly cartilaginous, and partly membranous.

The bony portion lies through its whole length immediately above the fissure of the glenoid or articular cavity of the os temporis, and terminates at the meeting of the spinal apophysis of the os sphenoides with the pars petrosa of the os temporis.

The other or mixed portion reaches in the same direction from this place to the internal ala of the apophysis pterygoides, or to the posterior and outer edge of the nares. But to form a more exact idea of it, it will be proper to consider it as divided into four parts, two superior and two inferior.

The two upper parts or quarters are bony; and of these the innermost is formed by the side of the apophysis petrosa, the outermost by the side of the apophysis spinalis of the os sphenoides. Of the two inferior parts, the internal or that next the os sphenoides, is cartilaginous; and the external, or that next the pars petrosa, membranous.

The Eustachian tube thus formed, is very narrow next the ear, but grows gradually wider, especially near the posterior nares, where the inner cartilaginous side terminates by a prominent edge, and the outer side joins that of the neighbouring nostril. The cavity of the tube is lined by a membrane like that of the internal

ternal nares, of which it appears to be a continuation; and on the prominent edge, this membrane is considerably increased in thickness, representing a kind of half pad.

The situation of the two tubes is oblique, their posterior extremities at the ears being at a greater distance than the anterior at the nares; and the convex sides of the prominent edges are turned toward each other. The openings of the tubes are oval at this place; as is likewise their whole cavity, especially that of the mixed portion.

The membrana tympani is a thin, transparent, flattish pellicle; the edge of which is round, and strongly fixed in the orbicular groove which divides the bony meatus of the external ear from the tympanum or barrel. This membrane is very much stretched or very tense, and yet not perfectly flat: for on the side next the meatus externus it has a small hollowness, which is pointed on the middle; and on the side next the tympanum, it is gently convex, and also pointed in the middle.

This membrane is situated obliquely, the upper part of its circumference being turned outward, and the lower part inward, suitably to the direction of the bony groove already mentioned. It is made up of several very fine laminæ, closely united together. The external lamina is in some measure a production of the skin and cuticula of the external meatus; for they may be pulled at the same time like the finger of a glove. The internal lamina is a continuation of the periosteum of the tympanum; and when the membrane has been first macerated in water, each of these laminæ may be subdivided into several others, which I have sometimes made to amount in all to six. In very young children, this membrane is covered on the outside by a thick mucilaginous web.

The depression in the middle of the membrana tympani, is caused by the adhesion of the malleus; the handle

handle of which is closely joined to the inside of the membrane, from the upper part of the circumference all the way to the centre, to which the end of the handle is fixed. This handle seems to lie in a very fine membranous duplicature; by means of which it is tied to the membrana tympani, and which serves it for a perio-steum.

The periosteum of the tympanum, or barrel of the ear, produces that of the small bones; and it may be made visible by means of anatomical injections, which discover capillary vessels very distinctly ramified on the surface of the ossicula. It is likewise continued over the two fenestræ, and enters the Eustachian tube, where it is lost in the inner membrane of that duct.

The cellulæ mastoidæi are very irregular cavities in the substance of the mastoid apophysis, which communicate with each other, and have a common opening towards the inside, and a little above the posterior edge of the orbicular groove. These cells are lined by a fine membrane; which is partly a continuation of the periosteum of the tympanum, and partly seems to be of a glandular structure like a kind of membrana pituitaria. The mastoid opening is opposite to the small opening of the Eustachian tube, but a little higher.

The ligaments of the ossicula come next in order. The incus is tied by a strong short ligament fixed in the point of the short leg to the edge of the mastoid opening. Between the incus and malleus we find a small thin cartilage. The malleus is connected thro' the whole length of its handle to the inside of the membrana tympani, in the manner already said. I need only add here, that by help of a microscope we discover round the point of the handle, in the substance of the membrane, a small orbicular plane of a whitish colour, a little inclined to red.

The malleus has two distinct little muscles, one anterior, and one internal; and the stapes has one muscle.

The

The anterior muscle of the malleus, called, from its use, *laxator tympani*, is fleshy, long, and thin. It runs along the outside of the Eustachian tube; to which it adheres very closely through its whole length. Its anterior extremity is fixed in that side of the tube just before the sphenoidal spine; and the posterior extremity ends in a long thin tendon, which runs in the articular or glenoid fissure of the os temporis, through a small oblique notch; in which fissure it enters the tympanum, and is inserted in the long thin apophysis of the malleus. It is partly accompanied by a nerve, which forms what is called the *chorda tympani*, as we shall see hereafter.

The internal muscle of the malleus, called *tensor tympani*, is very fleshy and distinct. It lies along the inside of the Eustachian tube, partly on the cartilaginous, and partly on the bony portion, being fixed by one extremity in the apophysis petrosa. Afterwards it runs along the cavity of the bony half canal of the tympanum; within which cavity it is invested by a portion of a membranous or ligamentary vagina, which being fixed to the edges of the half canal, forms an entire tube therewith, and this vagina must be cut open before we can see the muscle.

At the posterior extremity of this bony half canal, this muscle ends in a tendon, which is bent round the transverse bony or ligamentary ridge in the last-named cavity, as over a pulley; and is inserted in the neck of the malleus above the small apophysis, advancing likewise as far as the handle. A third muscle has by some been described under the name of *external* or *superior muscle of the malleus*; but this is much less distinct than those already mentioned.

The muscle of the stapes is short and thick, and lies concealed within the small bony pyramid at the bottom of the tympanum. The cavity which it fills, touches very nearly the bony canal of the portio dura of the auditory nerve; and it terminates in a small tendon

don which goes out of the cavity thro' the small hole in the apex of the pyramid. As it goes thro' the hole it turns forward, and is inserted in the neck of the stapes on the side of the longest and most crooked leg of that bone.

The three parts of the labyrinth, that is, the vestibulum, femicircular canals, and cochlea, are lined by a fine periostrum, which is continued over all the sides of their cavities, and shuts the two fenestræ of the tympanum.

In all the subjects which I ever examined, I have found the femicircular canals simply lined by a periostrum adhering to their inner surfaces without any particular membranous bands. The two half-canals of the cochlea are lined in this manner; the periostrum of the two sides of the bony spiral lamina advances beyond the edge of that lamina, and forms a membranous duplicature, which extending to the opposite side completes the spiral septum.

The septum separates the two half-canals from the basis to the apex; but there it leaves a small opening, by which the small extremities of the half-canals communicate with each other. The large extremity of the external half-canal ends by an oblique turn in the fenestra rotunda, which is shut by a continuation of the periostrum of that canal. The large extremity of the other half-canal opens into the vestibulum; and these two extremities are entirely separated by a continuation of the periostrum.

“ The whole internal cavity of the labyrinth is filled with a watery fluid secreted from the vessels which are dispersed upon the periostrum. This fluid transmits to the nerves the vibrations it receives from the membrane situated between the tympanum and labyrinth.

“ The superfluous part of this fluid is supposed to pass off through two small canals called the *aquæducts of Cotunnus*, from the discoverer, an ingenious physician at Naples.

Naples. One of these ducts is sent off from the cochlea, the other from the vestibule; and after running through the pars petrosa, they are said to open into the cavity of the cranium, where the fluid that passes thro' them is absorbed: but future experience must determine this more fully."

All the periosteum of the internal ear, especially that of the ossicula and tympanum, is in children no more than a mucilage; and in them likewise the membrana tympani is thick, opaque, and covered with a whitish, slimy matter.

Through the whole extent of the periosteum of the internal ear, especially on that of the ossicula, semicircular canals, and half-canals of the cochlea, we discover a vast number of blood-vessels, not only by anatomical injections, but in inflammations, and even without the help of a microscope; for I have often shown them to the naked eye in the semicircular canals and half-canals of the cochlea. The arteries come partly from the internal carotid, and partly from the arteria basilaris, which is a continuation of the vertebralis, the small capillary ramifications of which may be observed to accompany the auditory nerve through the internal foramen auditorium.

The portio mollis of the auditory nerve ends, by its trunk, at the great fossula of the internal auditory hole, from whence the filaments pass through several small holes in the basis of the cochlea, "to be distributed thro' the cochlea, the vestibule, and the semicircular canals."

The portio dura, which I name *nervus sympatheticus minor*, runs first of all into the small fossula of the foramen auditorium internum, then passes through the whole bony duct called *aquæductus Fallopii*, and comes out again through the stylo-mastoide hole of the os temporis. In this course it communicates with the dura mater on the upper or anterior side of the apophy-

sis petrosa, at the place where the bony duct is interrupted.

Having reached behind the small pyramid in the bottom of the tympanum, this nerve sends a small filament to the muscle of the stapes; and a little before it goes out by the stylo-mastoide hole, it gives off another more considerable filament, which enters the tympanum from behind forward, passes between the long leg of the incus and handle of the malleus, and afterwards runs cross the whole breadth of the tympanum a little obliquely, and goes out at the same place at which the tendon of the anterior muscle of the malleus enters.

This small nerve is generally called *chorda tympani*, because in its passage thro' the tympanum it has been compared to the chord of a drum. Having left the cavity of the internal ear, it advances toward one side of the basis of the tongue, where having joined the small *nervus lingualis*, it is considered as a kind of recurrent; but the remaining part of its course must be referred to the description of the tongue.

The *portio dura* of the auditory nerve having passed through the *foramen stylo-mastoidæum*, is distributed in the manner to be afterwards mentioned in the description of the nerves; and we ought very carefully to observe its different communications with the branches and rami of the nerves of the fifth pair, with the *sympatheticus medius* or eighth pair, with the second pair of cervical nerves, and with the *nervi suboccipitales* or tenth pair of the *medulla oblongata*, &c.

The ear is the organ of which we can most distinctly unfold the structure, and demonstrate the greatest number of parts, that is, of small machines of which it is made up. We know likewise in general that it is the organ of hearing: but when we endeavour to discover the uses of each of these parts, that is, how each contributes to the great design of the whole; after having thoroughly examined them, we must be obliged to own, that

that the greatest part of what the most able philosophers have said upon this subject, is without any real foundation.

It is certain that the cavity of the external ear collects sound or noise, and concentrates it towards the bottom of the concha, all the way to the external meatus auditorius. This we learn from experience, by enlarging this cavity with the hand. It may likewise be affirmed with certainty, that in proportion as the membrana tympani is more or less stretched, sounds become more or less sensible. This experience teaches us; for when this membrane is wetted by any liquor, our hearing is imperfect, but is restored again when the membrane is dry. By the muscles of the ossicula, we can demonstrate that this membrane is capable of being stretched and relaxed, as occasion requires; but the prosecution of this curious subject must be referred to another occasion.

SECT. V. *The Mouth.*

Introduction. THE word *mouth* may have two significations: for, first, it means the transverse slit between the nose and chin, formed by the lips; and, secondly, it expresses the internal cavity, of which this transverse slit is the external opening. For this reason the mouth may be distinguished into external and internal; and the parts of which it consists may likewise come under the same two general heads. The bony parts are the ossa maxillaria, ossa palati, maxilla inferior, and the teeth: to these we may add the os hyoides, and the upper vertebræ of the neck.

The external parts of the mouth are, The two lips, one upper, the other under; the borders or red parts of the lips; the corners or commissures of the lips; the fossula of the upper lip, the basis of the under lip; the chin,

the basis of the chin; the skin; the beard; and even the cheeks, as being the lateral parts of the mouth in general, and of the lips in particular.

The internal parts of the mouth are, The gums, palate; septum palati, uvula, amygdalæ, the tongue, the membrane which lines the whole cavity of the mouth, the salival ducts and glands, and the bottom of the mouth. We might likewise reckon among the internal parts of the mouth, all the muscles that have any relation to it, as those of the lips, of the tongue, of the uvula, of the septum palati, &c. and to these might be added the muscles of the lower jaw, and of the os hyoides, which have been already described.

The parts of the neck to be described here, are only the larynx, pharynx, and glandulæ thyroideæ; and therefore, instead of making a particular section for so small a number of parts, I choose to bring them in under the description of the head; especially since the larynx and pharynx have so near a relation to the internal parts of the mouth, that I find myself under a necessity of describing them before I proceed to the mouth in particular.

§ 1. *The Larynx.*

THE larynx forms the protuberance in the upper and anterior part of the neck, called commonly *pomum Adami*. Anatomists term it the *head of the trachea arteria*, as I shall explain particularly in the description of the thorax. This is larger and more prominent in men than in women.

It is chiefly made up of five cartilages, the names of which are these: Cartilago-thyroides, which is the anterior and largest; cricoides, the inferior, and basis of the rest; two arytenoides, the posterior and smallest; and the epiglottis, which is above all the rest. These cartilages are connected together by ligaments, and they

they have likewise muscles, glands, membranes, &c. belonging to them.

Cartilago thyroïdæa. The cartilago thyroïdæa is large and broad, and folded in such a manner as to have a longitudinal convexity on the fore-side, and two lateral portions which may be termed *alæ*. The upper part of its anterior middle portion is formed into an angular notch; the upper edge of each *ala* makes an arch; and, together with the middle notch, these two edges resemble the upper part of an ace of hearts in playing cards.

The lower edge of each *ala* is more even, and the posterior edges of both are very smooth, being lengthened out both above and below by apophyses, which I name the *cornua of the thyroïde cartilage*. The superior apophyses are longer than the inferior, and the extremities of all the four are rounded like small heads, which in the inferior apophyses have a shining surface on the inside, resembling an articular eminence.

On the outside of each *ala* near the edge, is a prominent oblique line which runs from behind forward. The upper extremity of this line is near the superior apophysis or cornu; and both that and the lower extremity end in a small tuberosity, the lowest being often the most considerable. These tuberosities serve for the insertion of muscles and ligaments. The inside of the *alæ* and the convex side of the anterior portion are very uniform; and this cartilage ossifies gradually in old age.

Cartilago cricoides. The cricoidæ cartilage resembles a kind of thick, irregular ring, very broad on one side and narrow on the other; or it may be compared to a small portion of a thick tube, cut horizontally at one end, and very obliquely at the other. I distinguish it into a basis and top, into an anterior, posterior, and two lateral sides. The basis is almost horizontal when we stand, and to this the *aspera arteria* is connected; so that the cricoides may be looked upon as the upper extremity of the trachea.

The posterior portion of the cricoides is larger than the rest, and its posterior or convex side is divided by a longitudinal eminence, or prominent line, into two distinct surfaces, for the insertion of muscles. The top is gently sloped above this prominent line; and terminates on each side by a kind of obtuse angle, formed between it and the oblique edge of each lateral portion of this cartilage. At the upper part of each of these angles, there is a very smooth articular surface, gently convex.

The whole posterior side is distinguished into two lateral portions by two prominent lines, each of which runs down almost in a straight direction from the articular surface at the top, a little below the middle of this side, where it terminates in another articular line a little concave; and near these four articular surfaces there are small tubercles. The two superior surfaces are for the articulation of the cartilagine arytenoidæ, as we shall see presently; and the two inferior, for the articulation of the inferior cornua or appendices of the cartilago thyroïdes.

Cartilagine arytenoidæ. The cartilagine arytenoidæ are two small, equal, similar cartilages, which joined together resemble the spout of an ewer; and they are situated on the top of the cricoides. In each, we may consider the basis; cornua; two sides, one posterior and concave, the other anterior and convex; and two edges, one internal, the other external, which is very oblique. The bases are broad and thick; and have each a concave articular surface, by which they are joined to the cricoides.

The cornua are bent backward, and a little toward each other. In some subjects they are very loose, appearing like true appendices, and easily separable from the rest. Between their inner edges they form a kind of fissure, and their outer oblique edges terminate each by a thick prominent angle.

Epiglottis. The epiglottis is an elastic cartilage, nearly of the figure of a purslane leaf, narrow and thick

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at the lower part, thin and slightly rounded at the upper part, gently convex on the fore side, and concave on the back side. It is situated above the anterior or convex portion of the cartilago thyroïdes; and its lower extremity is tied by a short, pretty broad, and very strong ligament, to the middle notch in the upper edge of that cartilage. It is perforated by a great number of holes, something like those in the leaves of the hypericum or St John's wort, which are hid by the membranes that cover its two sides.

Ligaments of the larynx. The cartilago thyroïdes is connected to the cricoides by several short strong ligaments, round the articulations of the two inferior cornua with the lateral articular surfaces of the cricoides. The apices of the superior cornua are fixed to the posterior extremities of the great cornua of the os hyoides, by slender round ligaments, about a quarter of an inch in length.

In the middle of each of these ligaments, we often meet with a small cartilage of an oval figure, and much thicker than the ligaments. The thyroïdes is likewise connected to the os hyoides by a short, broad, strong ligament, one end of which is inserted in the superior notch of the cartilage, and the other in the lower edge of the basis of the bone. It has also two ligaments at the middle of the concave side which belong to the arytenoidæ.

The cricoides is tied to the lower part of the thyroïdes by a strong ligament; and by the ligaments already mentioned, to the inferior cornua of that cartilage. Its basis is fixed to the first cartilaginous ring of the trachea arteria, by a ligament exactly like those by which the other rings are connected together; and the membranous or posterior portion of the trachea is likewise fixed to the posterior part of the basis of the cricoides.

Glottis. The cartilagine arytenoidæ are connected to the cricoides by ligaments, which surround their articulations with the top of that cartilage. Anteriorly the basis

of each arytenoides is fixed to one end of a ligamentary cord, which by its other end is inserted about the middle of the concave side of the anterior portion of the thyroids. At their insertions in the thyroids, these two ligaments touch each other; but a small space is left between them, where they are fixed in the two arytenoides; and they seem likewise to have a small adhesion to the top of the cricoides. This is what is called *the glottis*.

Under these two ligamentary cords there are two others, which run likewise from behind forward. The interstice between the superior and inferior cords on each side form a transverse fissure, which is the opening of a small membranous bag, the bottom of which is turned outward, that is, toward the ala of the thyroids. These two sacculi are the ventricles mentioned by the ancients, and restored by M. Morgagni, who has given an excellent description of them. They are chiefly formed by a continuation of the internal membrane of the larynx, and the inner surface of their bottom appears sometimes to be glandular.

On the anterior surface of the arytenoid cartilages, there is a small depression between the basis and the convex upper part. This depression is filled by a glandular body, which not only covers the anterior surface of each arytenoides, but is likewise extended forward from the basis over the posterior extremity of the neighbouring ligamentary cord. They are larger and more sensible in some subjects than in others; and they are covered by the membrane which lines the neighbouring parts. These glands were discovered by M. Morgagni.

I have already described the ligaments which connect the epiglottis to the notch of the thyroids, and to the basis of the os hyoides. These two ligaments, and a third which ties the basis of the os hyoides to the notch of the thyroids, form a triangular space filled with a cellular or fatty substance, and with small glands.

The epiglottis has likewise two lateral ligaments, by which it is connected to the arytenoides all the way to their points or cornua. It has also a membranous li-
gament,

gament, which, running along the middle of its anterior or concave side, ties it to the root or basis of the tongue. This ligament is only a duplicature of the membrane which covers the epiglottis, continued to the neighbouring parts. Lastly, there are two lateral membranous ligaments belonging to it, fixed near the glandulous bodies called *amygdalæ*.

The epiglottis is not only perforated by the regular holes already mentioned, but has likewise a great number of small irregular fissures and breaks, which are so many different lacunæ situated between its two membranes, and filled with small glands, the excretory orifices of which are chiefly on the back-side of this cartilage.

Muscles of the larynx. The larynx gives insertion to a great number of muscles, which may be divided into common, proper, and collateral. The common muscles, according to the general acceptation of that term, are all those that move the whole body of the larynx, one extremity of them being inserted in other parts; and these are reckoned to be four in number, two for each side, viz. sterno-thyroidæi, thyro-hyoidæi or hyo-thyroidæi.

The proper muscles are those inserted wholly in the larynx, and which move the cartilages separately. These have been divided in various manners, but may be all reduced to the following pairs: Crico-thyroidæi; crico-arytenoidæi laterales; crico-arytenoidæi posteriores; thyro-arytenoidæi; arytenoidæi; thyro-epiglottici; aryteno-epiglottici.

By the collateral muscles, I understand those which are inserted by one portion in the larynx, without appearing to contribute any thing to the motions of it. Of this kind are the thyro-pharyngæi, crico-pharyngæi, &c.; of which hereafter.

The larynx may likewise be moved by muscles, which are not immediately inserted in it, but altogether in other parts. Such are the mylo-hyoidæi, genio-hyoidæi,

dæi, stylo-hyoidæi, omo-hyoidæi, sterno-hyoidæi, and especially the digastrici of the lower jaw, by reason of their particular adhesion to the os hyoides. It is likewise probable that those muscles of the pharynx which are inserted in the basis cranii, may, in certain circumstances, move the larynx in some small degree.

Sterno-thyroidæi. The sterno-thyroidæi are two long, flat, narrow, thin muscles, like ribands, broader above than below, and situated along that part of the neck which lies between the thyroide cartilage and the sternum. They are covered by the sterno-hyoidæi; and they cover the thyroide glands, passing immediately before them.

Each muscle is fixed by its lower extremity, partly in the superior portion of the inner or backside of the sternum, partly in the ligament and neighbouring portion of the clavícula, and partly in the cartilaginous portion of the first rib. Sometimes it runs a great way down on the first bone of the sternum, and crosses the muscle on the other side. From thence it runs up on the *aspera arteria*, close by its fellow, passes before the thyroide glands over the cricoide cartilage, and is inserted by its upper extremity in the lower part of the lateral side of the thyroide cartilage, and partly along that whole side. I have found this muscle double, one distinct portion of it being inserted in the basis, and the other laterally.

Thyro-hyoidæi. The thyro-hyoidæi, or hyo-thyroidæi, are two flat thin muscles, lying close by each other, between and above the former. Each of them is inserted by its upper extremity, partly in the basis, and partly in the neighbouring part of the great cornu of the os hyoides; and, by its lower extremity, in the lower part of the lateral side of the thyroide cartilage, immediately above the superior extremity of the sterno-thyroidæus; and both this superior extremity of the last-named muscle, and the lower extremity of the thyro-hyoidæus, are, at their place of union, confounded a little

little with the thyro-pharyngæus inferior; of which hereafter.

Crico-thyroidæi. The crico-thyroidæi are two small muscles, situated obliquely at the lower part of the thyroide cartilage. They are inserted by their lower extremities in the anterior portion of the cricoide cartilage near each other; and by their superior extremities, laterally in the lower edge of the thyroide cartilage at a distance from each other. By this oblique situation, they represent a Roman V.

Each of these small muscles is in a manner double: its upper extremity, inserted in the thyroide cartilage, being in some subjects very broad, and divided into two portions; one anterior, the other more lateral and more oblique. They may likewise be easily separated into two distinct muscles; whereof one may be called *crico-thyroidæus anterior sive internus*, the other *lateralis sive externus*.

Crico-arytenoidæi posteriores. The two musculi crico-arytenoidæi posteriores, are situated posteriorly at the large or back portion of the cricoides, filling almost the two longitudinal surfaces of that portion, and distinguished by the prominent line between these two surfaces already mentioned. Each of them runs up obliquely, and is inserted by its upper extremity in the posterior part of the basis of the arytenoide cartilage of the same side, near the angle of that basis.

Crico-arytenoidæi laterales. The two crico-arytenoidæi laterales are small, and situated more laterally than the former. Each muscle is fixed by one end to the side of the broad part of the cricoides, and by the other to the lower part of the side of the neighbouring arytenoides.

Thyro-arytenoidæi. The two thyro-arytenoidæi are very broad, each muscle being situated laterally between the thyroide and cricoides. It is fixed by a broad insertion in the inside of the ala of the thyroide cartilage; and the fibres contracting from thence run from before back.

backward, and from below upward, towards the neighbouring arytenoide cartilage, in which they are inserted, from the glottis to the angle of the basis. In some subjects, these muscles cover almost both sides of the glottis.

Arytenoidæi. The arytenoidæi are three small muscles lying on the posterior concave sides of the arytenoide cartilages: "two of these are crucial, and one transverse."

The crucial muscles run each obliquely from the basis of one arytenoide cartilage to the middle and upper part of the other, the left muscle covering the right, as is observed by M. Morgagni in his first *Adversaria*.

I look upon these muscles as superior crico-arytenoidæi, because I have always found them partly inserted in the upper neighbouring portion of the cricoides. The arytenoidæus transversalis is inserted more or less directly by both extremities in the two arytenoide cartilages; and this I look upon as the true musculus arytenoidæus.

Thyro-epiglottici. The two thyro-epiglottici cross the thyro-arytenoidæi, being inserted in the inner lateral part of the thyroides, and laterally on the epiglottis.

Aryteno-epiglottici. The aryteno-epiglottici are small fleshy fasciculi; each of which is fixed by one extremity in the head of one of the arytenoide cartilages, and by the other in the nearest edge of the epiglottis.

Uses. The larynx serves particularly to admit and let out the matter of respiration; and the solidity of the pieces of which it is composed, hinders not only external objects, but also any hard thing which we swallow, from disordering this passage. The glottis being a narrow slit, modifies the air which we breathe; and as it is very easily dilated and contracted, it forms the different tones of the voice, chiefly by means of the different muscles inserted in the cartilagine arytenoidææ, to which the other muscles of the larynx, both proper and common, are assistants.

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The whole larynx is likewise of use in deglutition, as has been already observed, by means of its connection with the os hyoides, to which the digastric muscles of the lower jaw adhere; which muscles raise the larynx together with the os hyoides every time we swallow.

The facility of varying and changing the tone of the voice depends on the flexibility of the cartilages of the larynx, and decreases in proportion as we advance in age; because these cartilages gradually harden and ossify, though not equally soon in all persons: and this change happens not only in the cartilago thyroïdes, but also to the cricoides and arytenoides.

The musculi sterno-thyroidæi serve in general to pull down the thyroïde cartilage, and the whole larynx along with it. They may likewise assist the sterno-hyoidæi in its action, and compress the thyroïde gland; of which hereafter. The thyro-hyoidæi may, as occasion requires, either draw up the larynx toward the os hyoides, or draw that bone downward toward the cartilago-thyroides.

It is difficult to determine the use of the crico-thyroidæi from their situation. They may either pull the cricoides obliquely backward, or the thyroïdes obliquely forward; and by this action the inferior cornua of the thyroïdes, and small articular surfaces of the cricoides, must slide upon each other.

Both the lateral and posterior crico-arytenoidæi may separate the arytenoid cartilages, and thereby open or dilate the glottis; but they do not both perform this action in the same manner. The lateral muscles separate these cartilages obliquely forward, and at the same time loosen or relax the sides of the glottis; but the posterior muscles separate them obliquely backward, and at the same time stretch or extend the sides of the glottis; and when both muscles act equally, they separate the cartilages directly.

The thyro-arytenoidæi acting together, draw both the arytenoid cartilages forward, and consequently
loosen

loosen the glottis, and render it capable of the smallest quaverings of the voice. They may likewise probably compress the lateral sinuses or ventricles of the larynx, and also the arytenoide glands.

The arytenoidæi bring the arytenoide cartilages close together, and press them against each other; and when the cartilages are in this situation, they may at the same time be inclined either forward by the thyro-arytenoidæi, or backward by the crico-arytenoidæi posteriores. By this means the glottis, when shut, may be either relaxed or tense; and in this last case it is entirely shut, as when we hold in our breath in straining: but of this more in another place.

The general use of the epiglottis is to cover the glottis like a pent-house, and thereby hinder any thing from falling into it when we eat or drink; and for this purpose it is depressed in the manner that shall be shown hereafter. It serves likewise to hinder the air which we inspire from rushing directly upon the glottis; but by splitting it, as it were, obliges it to enter by the sides, or in an oblique course. The muscles of the epiglottis do not appear to be absolutely necessary for that cartilage; for in deglutition it may be sufficiently depressed by the basis of the tongue, and it may raise itself again by its own elasticity. The thyro-epiglottici and aryteno-epiglottici may serve to shut any lateral openings that might remain when the epiglottis is depressed by the basis of the tongue; and the hyo-epiglottici may pull it a little forward in strong respirations, as in sighing, yawning, &c.

§ 2. *The Pharynx.*

THE pharynx is a muscular and glandular bag, the outer surface of which is closely joined to the inner surface of all that space which is at the bottom of the mouth, behind the posterior nares, uvula, and larynx, and which reaches from the cuneiform process of the

os occipitis all the way to the œsophagus, which is the continuation of the pharynx. This space is bounded posteriorly by the muscles which cover the bodies of the first vertebræ of the neck, and laterally by the superior portions of both the internal jugular veins, and of both the internal carotid arteries, by the spinal apophyses of the os sphenoides, by the extremities of the apophyses petrosæ, by the os sphenoides, immediately above the internal alæ of the apophyses pterygoides, and by the neighbouring portion of both pterygoide muscles.

From these limits and adhesions of the pharynx we may pretty nearly determine its figure. It may be compared to the wide part of a covered funnel, of which the œsophagus is the narrow part or tube; or it may be called the *broad end of the œsophagus*, that and the pharynx taken together being compared to a trumpet. The pharynx may be divided into three parts; one superior, which is the arch of the pharynx; one middle, which is the body or great cavity; and one inferior, which is the bottom, narrow portion, or sphincter. We are likewise to observe in it three openings; that of the arch, toward the nares; that of the body, toward the mouth; and that of the bottom, toward the œsophagus.

The arch is the broadest part of the pharynx; and ends on each side in angle or point, toward the jugular fossulæ of the basis cranii. Afterwards the great cavity contracts a little toward the sides, all its other dimensions continuing the same; and behind the larynx it is again enlarged on each side, a very small space being left between it and the cricoide cartilage. The extremity of the lower portion is very narrow, and joins the basis of the cartilage just named.

The pharynx is made up partly of several distinct fleshy portions, which are looked upon as so many different muscles so disposed as to form a large cavity; and partly of a membrane which lines the inner surface of
this

this whole cavity, and is a continuation of that of the nares and palate.

This membrane is wholly glandular; and it is thicker on the superior and middle portions of the pharynx, than on the bottom or lower portion. Immediately above the first vertebra it forms several longitudinal rugæ very thick, deep, and short; and we generally find therein a collection of mucus in dead bodies. In the great cavity there are no rugæ, the membrane adhering, both there and in the upper part, very closely to the muscles. At the lower part where it is thinnest, it covers likewise the posterior part of the larynx; and is very loose, and formed into irregular folds. It runs in a little on each side between the edges of the pharynx.

Muscles of the pharynx. Though almost all the muscular or fleshy portions of which the pharynx is composed, concur in the formation of one continued bag or receptacle, they are nevertheless very distinguishable from each other, not only by their different insertions, from which they have been denominated, but also by the different directions of their fibres. They may be looked upon as three digastric muscles, the middle tendons of which lie backward in one longitudinal line, which in some subjects appears plainly like a linea alba.

The *constrictores pharyngis inferiores* are inserted in the lower side of the apophysis basilaris, or cuneiform process of the os occipitis, about the middle of the posterior part. From thence they separate laterally, and sometimes join the stylo-pharyngæi. Part of the linea alba of the pharynx is formed by the middle adhesion of these muscles.

The *constrictores pharyngis medii* are fasciculi of muscular fibres very distinctly inserted by one end along the ligaments by which the superior cornua of the cartilago thyroïdes are connected to the extremities of the great cornua of the os hyoides. “ From thence they
run

run backward and upward, to meet in the linea alba, and to be fixed to the cuneiform process of the occipital bone." To be able to see them distinct from the other muscles, the pharynx must be filled with cotton, to give it a proper convexity, and to support its sides, which otherwise collapse and sink inward, and thus prevent our seeing the direction and distinction of several of the muscles belonging to it.

The *constrictores pharyngis inferiores* are very broad; and each muscle is inserted along the outside of the ala of the cartilago thyroides, between the edge of that and the oblique line in which the thyro-hyoidæ are fixed. "They are also fixed to the cricoid cartilage." From thence they run up obliquely backward; and meeting under the linea alba, they sometimes appear to be but one muscle without any middle tendon. Sometimes they have appeared to me to be distinguished into superior and inferior, because their upper portion ran upward and backward, and their lower portion more transversely.

The lowest of these muscular fibres make a complete circle backward, between the two sides of the basis of the cartilago cricoides. This circle is the beginning of the œsophagus, and has been thought by some to form a distinct muscle called *œsophagus*. "Besides the muscles which form the body of the pharynx, there are several other small ones connected with it; but of these sufficient descriptions have been already given in a former part of the work."

The particular uses of these muscles are very difficult to be determined. It is certain that those of the middle and lower portions of the pharynx serve chiefly for deglutition. Those of the upper portion, and some of those of the middle portion, may, among other functions, be useful in modifying the voice, according to the opinion of M. Santorini.

§ 3. *The Palate, Uvula, &c.*

THE palate is that arch or cavity of the mouth, surrounded anteriorly by the alveolar edge and teeth of the upper jaw, and reaching from thence to the great opening of this pharynx. The arch is partly solid and immoveable, and partly soft and moveable. The solid portion is that which is bounded by the teeth, being formed by the two ossa maxillaria and two ossa palati. The soft portion lies behind the other, and runs backward like a veil fixed to the edge of the ossa palati, being formed partly by the common membrane of the whole arch, and partly by several muscular fasciculi, &c.

The membrane that covers all this cavity is like that which lines the superior and middle portions of the pharynx. It is very thick set with small glands, the orifices of which are not so sensible as in the pharynx, and especially in the rugæ of the superior portion thereof, where M. Heister observed a considerable orifice, and a canal proportioned to that orifice, which he could easily inflate with air. This is certainly the best way of beginning these kinds of inquiries, especially if the pipe be held at first only near the part, without endeavouring to force it in. To immerge the parts in clear water in the manner already mentioned, is likewise a very good way to discover small orifices, by the help of a microscope. Small ducts of the same kind with what I have now mentioned, may be supposed to lie along the middle line or raphe of the arch of the palate, and along the alveolar edge, because of some small tubercles or points which appear there.

This membrane, together with that of the posterior nares, forms, by an uninterrupted continuation, the anterior and posterior surface of the soft portion, or septum palati; so that the muscular fasciculi of this portion lie in the duplicature of a glandulous membrane. The
muscles

muscles composed of these fasciculi shall be presently described.

The septum, which may likewise be termed *velum* or *valvula palati*, terminates below by a loose floating edge, representing an arch situated transversely above the basis or root of the tongue. The highest portion or top of this arch sustains a small, soft, and irregularly conical glandular body, fixed by its basis to the arch, and its apex hanging down without adhering to any thing, which is called *uvula*.

On each side of the uvula there are two muscular half-arches, called *columna septi palati*. They are all joined to the uvula by their upper extremities, and disposed in such a manner as that the lower extremities of the two which lie on the same side, are at a little distance from each other, and so as that one half arch is anterior, the other posterior, an oblong triangular space being left between them, the apex of which is turned toward the basis of the uvula.

The two half arches on one side, by joining the like half-arches on the other side, form the entire arch of the edge of the septum. The posterior half-arches run by their upper extremities, more directly toward the uvula than the anterior. The anterior half-arches have a continuation with the sides of the basis of the tongue, and the posterior with the sides of the pharynx. At the lower part of the space left between the lateral half-arches on the same side, two glands are situated, termed *amygdala*, which shall be described hereafter, together with the glandular structure of the uvula, among the other glands of the mouth.

The half-arches are chiefly made up of several flat fleshy portions, almost in the same manner with the body of the septum. The membrane which covers them is thinner than the other parts of it towards the palate, pharynx, and tongue. Each portion is a distinct muscle, the greatest part of which terminates by one extremity in the substance of the septum and of the

half-arches, and by the other extremity in parts different from these.

As anatomists used formerly to ascribe all these muscles, as far as they knew them, to the uvula, without any regard to the septum, they termed them in general either *ptery-staphylini*, or *peri-staphylini*. The last part of these two compound words expresses the uvula: the first part of the first word is an abridgement of *pterygoïdes*, and expresses the insertion of these muscles; but the first part of the second word signifies no more than round, or about, &c.

I might make use of the term *peri-staphylinus* as a general denomination for the muscles belonging to the septum; and then add the other terms, of which these names have been made up by modern writers. But “the reader will find it more agreeable to use the names expressed in the treatise on the muscles already described.”

Of these we find; first, the *constrictores isthmi faucium*; which are two small muscles, fixed each in the lower and lateral part of the base of the tongue; from whence they run up obliquely backward, along the anterior half-arches of the septum palati, and terminate insensibly on each side near the uvula, some of their fibres being spread through the septum. The thickness of the anterior half-arches is chiefly owing to these two muscles.

The palato-pharyngei are likewise two small muscles, each of them being fixed by one extremity to the lateral part of the *musculi constrictores pharyngis inferiores*, as if they were portions detached from these muscles. From thence they run up obliquely forward along the two posterior half-arches of the septum, and terminate in the septum above the uvula, where they meet together, and seem to form an entire arch by the union of their fibres. The thickness of the two posterior half-arches is owing to these muscles.

The thyro-staphylini are two small muscles, which
may

may be considered as making part of the former pair; they accompany the palato-pharyngei very closely thro' their whole course, except that their posterior extremities are fixed in the thyroide cartilages near the other muscles. They likewise contribute to the thickness of the posterior half-arches, and are interted in the septum in the same manner with the former.

The *tenfores palati*, are each fixed by one extremity, partly to the sphenoidal side of the bony portion of the Eustachian tube, partly to the nearest soft portion of the same tube. From thence it runs toward the external ala of the apophysis pterygoides, into which one portion of this muscle is inserted. The other portion runs to the end of the ala, and turns round to the forked extremity thereof as over a pulley, and is afterwards inserted in the septum palati near the uvula.

“The *levator palati* begin each by a tendinous and fleshy origin, from the extremity of the *pars petrosa* of the temporal bone, where it is perforated by the Eustachian tube; and also from the membranous part of the same tube. From thence it runs toward the soft part of the palate, to which it is fixed, uniting with its fellow on the other side.”

The *staphylinus*, or *azygos uvulæ*, is a small fleshy rope, fixed by one extremity in the common point of the posterior edges of the *ossa palati*; and from thence runs downward and backward along the middle of the septum, and likewise along the middle of almost the whole uvula. This muscle has been termed *azygos Morgagni*, from the discoverer.

The septum palati serves to conduct the lacrymal lymph, and that which is continually collected on the arch of the palate, into the pharynx. It serves for a valve to hinder what we swallow, and especially what we drink, from returning from the nares. The uses of the different muscles of the septum are not as yet sufficiently known, nor the different motions of which it is capable, as may be observed by looking for some time

into an healthy person's mouth opened wide. I shall endeavour to explain these things at greater length in another place.

§ 4. *The Tongue.*

EVERY one knows, that the tongue is a soft fleshy body, which fills all that part of the cavity of the mouth that is surrounded by the alveolar border and teeth of the lower jaw, and extends still farther back. All this space is therefore in a manner the mould and measure of the length and breadth of the tongue, as well as of its thickness and figure.

The tongue is divided into the basis and point; the upper and under sides; and the lateral portions, or edges. The basis is the posterior and thickest part; the point, the anterior and thinnest part. The upper side is not quite flat, but a little convex; and divided into two lateral halves, by a shallow depressed line, called *linea linguæ mediana*. The edges are thinner than the other parts, and a little rounded as well as the point. The lower side reaches only from the middle of the length of the tongue to the point.

The tongue is principally composed of very soft fleshy fibres, intermixed with a particular medullary substance, and disposed in various manners. Many of these fibres are confined to the tongue without going any farther; the rest form separate muscles which go out from it in different ways, and are inserted in other parts. All the upper side of the tongue is covered by a thick membrane of a papillary texture, upon which lies another very fine membrane like a kind of epidermis, which is likewise continued over the lower side, but without papillæ.

Three sorts of papillæ may be distinguished in the upper side of the tongue; capitatæ, semi-lenticulares, and villosæ. Those of the first kind are the largest, resembling little mushrooms with short stems, or buttons with-

without a neck. They lie on the basis of the tongue in small superficial fossulæ.

They resemble small conglomerate glands seated on a very narrow basis, and each of them has sometimes a small depression in the middle of their upper or convex side. They occupy the whole surface of the basis of the tongue, and they are situated near each other in such a manner as that the most anterior form an angle. They are glandular papillæ, or small salival or mucilaginous glands, of the same kind with those that are to be described hereafter.

We commonly observe about the middle of this part of the tongue a particular hole of different depths, the inner surface of which is entirely glandular, and filled with small papillæ, like those of the first kind. It is called *foramen cæcum Morgagnii*, as being first described by that author. Since that time M. Vaterus has discovered a kind of salival ducts belonging to it: and M. Heister found two of these ducts very distinctly, the orifices of which were in the bottom of the *foramen cæcum* near each other. He observed the ducts to run backward, divaricating a little from each other; and that one of them terminated in a small oblong vesicle, situated on the side of the small cornua of the *os hyoides*. Later anatomists, however, have observed no such ducts.

The papillæ of the second kind, or *semilenticulares*, are small orbicular eminences, only a little convex, their circular edge not being separate from the surface of the tongue. When we examine them in a sound tongue, with a good microscope, we find their convex sides full of small holes or pores, like the end of a thimble.

They lie chiefly in the middle and anterior portions of the tongue; and are sometimes most visible on the edges, where they appear to be very smooth and polished even to the naked eye, and sometimes in living subjects. They soon lose their consistence after death;

that, by rubbing them several times, they may be drawn out in form of small soft pyramids inclined to one side.

The papillæ of the third kind, or villosæ, are the smallest and most numerous. They fill the whole surface of the upper side of the tongue, and even the interstices between the other papillæ. They would be more properly named *papillæ conicæ* than *villosæ*, from the figure which they appear to have when examined thro' a microscope in clear water. They are naturally softish, but they become extremely flaccid after death; so that by handling them they may be made short and thick, whereas they are naturally long and small.

The fleshy fibres of which the tongue is composed, and which go no further than the tongue, may be termed *musculi linguæ interiores*, and they are the same which Spigelius named *musculi linguales*. The fibres these muscles consist of, are of three general kinds; longitudinal, transverse, and vertical; and each of these situations admits of different degrees of obliquity. The longitudinal fibres point to the basis and apex of the tongue; and seem partly to be expansions of the musculi stylo-glossi, hyo-glossi, genio-glossi, and lingualis. The vertical fibres seem likewise to be in part produced by these muscles.

Besides these mixed productions, there is a distinct plane of longitudinal fibres, which run near the surface of the upper side of the tongue, and a distinct transverse plane under them. All these fibres are partly interwoven, one portion of them terminating at the two edges of the tongue, and the other at the basis and point, without going to any other part; and they lie immediately above those that belong to the genio-glossi. To discover all these different fibres, and their different degrees of direction, we need only cut the tongue longitudinally, after it has been boiled, or long macerated in strong vinegar.

The musculi exteriores, are those which by one extremity make a part of the body of the tongue, and are fixed by the other in some part without the tongue. Of these

these we commonly reckon three pairs; stylo-glossi, hyo-glossi, genio-glossi.

The muscles which move the os hyoides belong likewise to the tongue; and are the principal directors of its motions. The names of these muscles may be remembered to be as follows: *Mylo-hyoidæi*, *genio-hyoidæi*, *stylo-hyoidæi*, *omo-hyoidæi*, *sterno-hyoidæi*.

The stylo-glossi are two long, small muscles, which run down from the styloide apophyses or epiphyses, and form two portions of the lateral parts of the tongue. Each muscle is fixed in the outside of the apophysis styloides by a long tendon, being the uppermost of the three muscles fixed in that apophysis, which at Paris go by the name of *Riolan's nasegay*. The stylo-hyoidæus is the lowest; and the stylo-pharyngæus is in the middle, but more backward.

As it runs down almost opposite to the inside of the angle of the lower jaw, it sends off a pretty broad and short lateral aponeurotic ligament, which, being fixed in that angle, serves for a frænum or ligamentum suspensorium to the muscle in this part of its course. From thence it passes on to the side of the basis of the tongue, where it first of all adheres closely to the lateral portion of the hyo-glossus; and then forms, together with that muscle, a large portion of the side of the tongue.

The hyo-glossi are each inserted in three parts of the os hyoides that lie near each other; in the basis, in the root of the great cornua, and in the symphysis between these two: and on this account the hyo-glossus has been divided by some into two or three distinct muscles, called *basio-glossus*, *cerato-glossus*, and *chondro-glossus*. In some subjects they may be easily separated, the three portions being simply contiguous to each other; but it is needless to burden the memory with so many useless names, and therefore I describe them all as one muscle by the name of *hyo-glossus*.

It is situated on the inside, and a little lower than the
stylo-

stylo-glossus, with which it forms the lateral part of the tongue. The portion inserted in the basis of the os hyoides lies more anteriorly, and is larger than the other two; that which is inserted in the symphysis is the least, and that inserted in the great cornua the most posterior. This muscle is partly sustained by the mylo-hyoidæus, as by a girth; and the anterior portion is distinguished from the rest by the passage of the nerves of the fifth pair, and of the arteries which accompany them.

The genio-glossi are situated close to each other, on the lower side of the tongue. Each muscle is inserted in the inner or backside of the symphysis of the lower jaw, immediately above the genio-hyoidæus. From thence it runs backward toward the os hyoides, to which the lowest fibres are connected by a ligamentary membrane; and in this course its fibres are spread through the substance of the tongue in a very singular manner.

Of these fibres, some run directly toward the os hyoides, all the way to the basis of the tongue; some are inflected forward, and go to the point of the tongue; and the rest are distributed in a radiated manner, forward, upward, and backward, in the substance of the tongue; and the middle fibres expand laterally toward the edges of the tongue.

The two genio-glossi run close to each other, as if they formed but one mass; but they are evidently divided by a very thin cellular membrane, or middle septum, which penetrates a good way between the lateral or right and left halves of the tongue, lying in the same plane with the linea mediana of the upper side of the tongue.

When we separate these two muscles from the chin, they presently contract so much, that their anterior extremities, which lay under the point of the tongue, are as far back as the middle of it. It is in this preternatural situation that we see these muscles represented in

figures given by very great anatomists, and drawn and engraved by very good artists, in which figures the whole beauty of their true mechanism is lost.

These two muscles, by their posterior straight fibres which go to the basis, can draw the tongue out of the mouth, and bring it back again by their anterior bent fibres, which go to the point. They can either successively, or all at once, make the tongue longitudinally hollow, or like a groove; and they can at the same time contract it, by the lateral expansion of the middle fibres. I pass over many other motions which these muscles are capable of performing, from whence I formerly used in my private courses to call them *musculi polychrestii*.

When either of the stylo-glossi acts, it turns the tongue toward the cheek, and forces the aliment between the upper and lower molares. When they act jointly with the lateral portions of the superior fleshy plane of the tongue, they turn the tongue obliquely upward to the teeth of the upper jaw, and near the cheeks, as when we bring down any part of the food that may have stuck there after mastication. When they act jointly with the lateral portions of the hyo-glossi, they turn the tongue downward between the lower teeth and the cheek.

When all the parts of the hyo-glossi act together, they shorten the tongue. They likewise turn the point of the tongue between the teeth and the under lip, and make it pass over that lip. The superior fleshy plane of the body of the tongue bends it upward toward the palate, and makes it pass along and lick the upper lip. The mylo-glossi serve as a frænum to one side of the basis, while the point is turned to the other side. The ligamenta suspensoria of the stylo-glossi may answer the same purpose, and even supply the want of the mylo-glossi.

Besides the membranes of the tongue already described, it is customary to mention another, called *membrana*

brana reticularis ; which is commonly demonstrated from the boiled tongues of oxen or sheep ; and some pretend to have showed it in the human tongue, which I own I have never been able to do. It is now a long time since I showed, that what they take from the tongues of oxen and sheep is not a true membrane, but a kind of clear mucilaginous substance, which lies between the papillary and external membranes, and which by boiling becomes white, and acquires solidity enough to be taken out in large portions ; and that the holes found in it are owing to the small pyramidal papillæ.

• The tongue is fixed in the mouth, not only by muscles, but also by ligaments, which are for the most part membranous. The principal ligament is that called the *frænum*, which is the prominent fold that appears first under the tongue when we raise it, with the mouth opened ; and is no more than a continuation or loose duplicature of that membrane which covers the inferior cavity of the mouth. It covers the curvature of the anterior portion of the genio-glossi from the point of the tongue, almost as high as the middle interstice between the lower dentes incisarii.

The other ligaments of the tongue are the small membranous fold which runs along the middle of the convex side of the epiglottis to the basis of the tongue, and the membranous folds which cover the inferior half-arches of the septum palati. These three folds are continuations of the membrane which covers the neighbouring parts. The aponeurotic ligaments of the styloglossus may be looked upon as true lateral ligaments of the tongue ; and they adhere a little to the lower part of the musculus pterygoideus internus or anterior.

The principal blood-vessels of the tongue are those that appear so plainly on its lower surface on each side of the frænum ; and they consist of one artery and one vein, which accompany each other, and are called *arteria et vena sublinguales* or *ranina*. The veins lie next the

the frænum, and the arteries on the other side of the veins. The arteries are rami of the second internal or anterior branch of the external carotid on each side, and communicate with the first external or posterior branch of the same carotid, &c. The veins are commonly rami of a branch of the external anterior jugular vein, described among the other veins.

We observe four nervous ropes to go very distinctly to the basis of the tongue, and to continue their course through its whole substance all the way to the point. Two of these ropes are rami of the inferior maxillary nerves, or of the third branch of the fifth pair from the medulla oblongata. The other two are the nerves of the ninth pair. The two first I have already named *linguals* or *hypo-glossi minores*, and the other two *linguales* or *hypo-glossi majores*. The majores are inferior and internal, the minores superior and external or lateral. The small portion or first branch of the nervus sympathicus medius, or of the eighth pair, sends likewise a nerve to each side of the tongue.

The great lingual nerve on each side runs forward between the musculus mylo-hyoidæus and hypo-glossus, under the genio-glossus, and is distributed to the fleshy fibres all the way to the point of the tongue, communicating by several small filaments with the lingualis minor, and with the nerve from the eighth pair. For the other distributions of it, I refer to the description of the nerves.

The small lingual nerve on each side goes off from the maxillaris inferior, sometimes at, and sometimes before, its passage between the pterygoide muscles. Afterwards, separating more and more from the trunk, it passes under the lateral part of the tongue, over the sublingual gland; of which hereafter. It supplies the nearest parts of the tongue as it passes; and then entering its substance, terminates at the point, having sent a great number of filaments to the papillary membrane. It communicates, as has been said, with the lin-

lingualis major, and with the nerve from the eighth pair.

This lingual nerve, a little after it leaves the maxillaris inferior, is accompanied by a small distinct nerve, which runs upward and backward toward the articulation of the lower jaw in company with the lateral muscle of the malleus; passes through the tympanum between the handle of the malleus and the long leg of the incus, by the name of *chorda tympani*; and afterwards, perforating the back-side of the tympanum, unites with the portio dura of the auditory nerve, as has been already said in the description of the ear.

This small nervous rope has been looked upon by anatomists as a kind of small recurrent of the nervus lingualis; but as in some subjects it appears to make simply an acute angle with the lingual nerve, and as this lingual nerve is something larger after this angle, it ought rather to be believed to come from the tympanum, and to unite with the lingual nerve, than to arise from this nerve, and run up to the tympanum. In some subjects, the union of this nerve with the lingualis is in a manner plexiform, and very difficult to be unfolded.

The lingual nerve of the eighth pair, which is its first branch, runs first of all on the inside of the digastric muscle of the lower jaw, and supplies the geniohyoidæi, the neighbouring muscles of the basis of the tongue, and those of the pharynx. Afterwards it sends out the ramifications, and forms the communications described in the history of the nerves; and lastly goes to the lower part of the tongue, where it communicates with the lingual ramus of the fifth pair, and with the lingual ramus of the ninth.

The tongue is the organ of the sense called the *taste*, by means of the papillæ, especially the villosæ or pyramidales. "The different state of the papillæ with respect to their moisture, figure, or covering, seems to produce a considerable difference in the taste, not only

in different people, but in the same person in sickness and health. By the sensation of taste we are enabled to distinguish wholesome and salutary food from that which is unhealthy: and we suppose that the degree of taste, in some animals, is in proportion to the length of these papillæ; for in the sheep and ox, where the sensation of taste is extremely acute, the papillæ are very long." It is not as yet discovered in what manner the papillæ semi-lenticulares contribute to the taste; and the capitatae ought to be looked upon as salival glands.

The tongue is likewise one of the principal instruments of speech, and of the articulation of the voice. Riolan, in his *Anthropographia*, mentions a child of five years of age, who, though he had lost his tongue by the small-pox, but not the uvula, continued still to speak almost as distinctly as before. Probably the basis of the tongue still remained. M. de Jussieu has published an observation in the *Memoirs of the Royal Academy* concerning a little girl who could speak, though she was born without a tongue; in room of which there was only a kind of small tubercle.

The tongue serves also to collect all the morsels which we chew; to turn them in different manners, and to different parts of the mouth; and to rub off whatever sticks to the palate: and it is useful in spitting, sucking, &c. It bears a great part in deglutition, being assisted by the digastric muscles; which, by contracting at the same time that the other muscles press the lower jaw against the upper, raise the os hyoides, and fix it at a convenient height; that the stylo-glossi and hyo-glossi may make the basis of the tongue bear back upon the morsel which is to be swallowed, and so force it into the pharynx; the portions of which, that are at that time immediately above the morsel, do instantly contract, and push it into the œsophagus.

§ 5. *The Cheeks, Lips, and Gums.*

THE cheeks and lips form the sides and entry of the cavity of the mouth. They are formed in general by the connection of several fleshy portions of different breadths, fixed round the convex sides of the two jaws, covered on the outside with the skin and fat, and lined on the inside by a glandulous membrane. Besides all this, the lips seem likewise to have a soft spongy substance in their composition, which swells and subsides on certain occasions, independently of the action of the muscles belonging to them, and is mixed with fat.

The substance which forms the red border of the lips is very different from the rest of the skin, being a collection of very fine, long, villous papillæ, closely connected together, and covered by a fine membrane, which seems to be both a continuation of the epidermis, and of that pellicle which covers the glandulous membrane of the cavity of the mouth. This substance is extremely sensible, and very painful when the outer membrane is by any accident destroyed. The internal membrane of the upper lip forms a small middle frenum above the first dentes incisorii.

The gums are that reddish substance like leather, which covers the two sides of the whole alveolar border of both jaws, insinuates itself between all the teeth, surrounds the collar of each tooth in particular, and adheres very strongly to them. Therefore the outer and inner gums are continuous, and both together form just as many openings as there are teeth.

The substance of the gums is of a very singular structure, resembling, in some measure, the texture of a hat, supposed to be very compact and elastic. It is not immediately fixed to the bones of the jaws, but by the intervention of the periosteum, with which it is perfectly united; and it is covered by a fine strong even mem-

membrane, which sticks very close to the substance of the gums; and seems to be a continuation of that thin membrane which goes to the lips and cheeks, and of that which goes to the tongue.

The arteries which go to the lips, cheeks, and gums, are ramifications of the external carotid, and chiefly of those branches called *maxillares externæ et internæ*. The veins are ramifications of the external anterior jugular.

The nerves of these parts come from the maxillaris superior and inferior, which are branches of the fifth pair; and also from the portio dura of the auditory nerve, or sympathicus minimus; the ramifications of which are spread in great numbers on all these parts, and communicate in a pretty singular manner with the nerves of the fifth pair in several places, as may be seen in the description of the nerves.

There is so much variety to be met with in the muscles of the lips in different subjects, that it is not at all surprising to find the descriptions given of them by anatomists very unlike one another. In some subjects, portions of these muscles are wanting; in some they can scarcely be distinguished, because of the paleness and attenuation of the fibres; and in others, there are really some particular fasciculi which are not generally to be found. About fifteen years ago I dissected an old woman; in which subject alone I observed a great many singular things which I have not met with in great numbers of other subjects more proper for dissection. In this subject, the muscles of the face in general were very much multiplied, and very distinct.

The muscles of the lips are commonly divided into common and proper. The common muscles are those which end at the angles or commissures of the two lips; and those are proper which are fixed in one lip only; which are again subdivided into the proper muscles of the upper lip, and proper muscles of the under lip.

All these muscles have particular names ; some of which are taken from something in the conformation of the muscles, some from the insertions or situation, and some from the uses attributed to them.

The muscles to which I confine myself may be enumerated in the following order. *Musculi communes* : Semi-orbiculares, supra-semi-orbiculares, buccinatores, zygomatici majores. *Musculi proprii labii superioris* : Zygomatici minores, canini, incisorii laterales, incisorii medii. *Musculi proprii labii inferioris* : Triangulares, triangularium collaterales, quadratus, incisorii inferiores, cutanei *.

The upper lip is sometimes moved by the action of the muscles of the nose, especially of the pyramidales ; and both lips, either jointly or separately, are moved by suction, without the assistance of the muscles belonging to them.

The semi-orbiculares are commonly looked upon as one muscle surrounding both lips ; from whence it is called *orbicularis* : but when we examine carefully the angles of the lips, we find that the fibres of the upper lip intersect those of the under lip ; and we easily distinguish the muscular arch of one lip from that of the other : and for this reason I divide this muscle into two, and I call them by the common name of *semi-orbicularis*, or I call one of them *semi-orbicularis superior*, and the other *semi-orbicularis inferior* ; but the name of *semioiales* would be still more proper.

The superior semi-orbicular muscle is oftentimes broader than the inferior ; and it has this peculiarity likewise, that all its fibres do not go to the corner of the mouth, but terminate by degrees between the middle and extremities of this arch, nearly like the semi-oval fibres of the upper palpebra. The inferior semi-orbicular muscle is commonly more uniform in the disposition of its fibres.

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* For the other names of these muscles, see Vol. I. part ii. chap. 6.

The buccinatores are two in number ; each of them situated transversely between the posterior part of the two jaws and the corner of the mouth. They are broad backward and narrower forward, in the shape of a triangle or trapezium ; and they form a considerable portion of the cheeks, and for that reason are sometimes called the *muscles of the cheeks*. To have a just idea of these muscles, we must be made acquainted with a ligament on each side of the face, which I call *ligamentum inter-maxillare*, because it connects the two jaws, and also gives insertion to the posterior fibres of the buccinator.

This ligament is strong and pretty broad. It is fixed by one end to the outside of the upper jaw above the last dens molaris, and at the side of the apophyses pterygoïdes, where it adheres very closely to the musculus pterygoïdæus internus. By the other end it is fixed in the posterior or superior extremity of the oblique prominent line on the outside of the lower jaw, below the last dens molaris. It serves likewise as a frænum to check and limit the depression of the lower jaw in opening the mouth, and we may feel it ourselves, with the end of the finger in the mouth, especially when it is wide open.

The buccinator is inserted posteriorly in three different places. The middle fibres are fixed transversely in the ligamentum intermaxillare, and run directly to the corner of the mouth. The superior fibres run down in an oblique graduated manner, from the alveoli of the upper jaw to the corner of the mouth ; and the interior fibres run up from the lower jaw in the same manner. All these fibres contract by degrees as they approach the commissure of the lips, where they run in behind the extremities and union of the semi-orbiculares, by which they are covered, and to which they adhere closely. There is a large hollow between this muscle and the masseter filled with fat.

The zygomatici majores are two muscles, situated one

on each side, between the zygoma and the corner of the mouth. Each muscle is thin, long, oblique, and fixed by one extremity to the lower edge of that portion of the os malæ, which is connected with the zygomatic apophysis of the os temporis. From thence it runs down obliquely from behind forward, being in its passage commonly involved in fat. It ends at the commissure of the two lips, adhering strongly to the buccinator which covers it. This muscle is very often complex.

The zygomatici minores are two small slender muscles, lying above the great zygomatici, and almost parallel to them. Their superior extremity seems to be a detachment from the lower fibres of the orbicularis palpebrarum; but they may always be distinguished. Their lower extremity unites with the neighbouring incisorius. These muscles are quite buried in fat, and for that reason often disappear.

Each of the two canini is fixed by a broad insertion in the upper jaw above the socket of the dens caninus, in a depression below the inferior edge of the orbit near the os malæ. From thence it runs down a little obliquely, crossing the lower extremity of the zygomaticus major, which covers it at this place. Afterwards it terminates at the extremity of the arch of the semi-orbicularis superior, and communicates by some fibres with the triangularis. I formerly looked upon this as a neutral muscle, that is, as being neither a proper muscle of the upper lip, nor common to both.

Each of the two incisorii laterales is a sort of biceps, its upper part being divided into two portions which unite below. One of these superior portions is larger than the other, and is fixed in the os maxillare below the middle tendon of the orbicularis palpebrarum, seeming to communicate by some fibres with the contiguous fibres of that muscle. From thence it runs down a little obliquely toward the cheek, along the apophysis nasalis, mixing with the pyramidalis nasi, and sending
some

some fibres to the nares. Afterwards it passes over and adheres to the myrtiformis or transversalis nasi, and unites with the other portion.

This other portion is fixed by a broad insertion immediately below the edge of the orbit, in the os maxillare, near the union of this bone with the os malæ; and likewise a little in the last named bone, being at this place covered by the inferior portion of the orbicularis palpebrarum, with which it has sometimes a kind of communication. From thence it runs down obliquely toward the nose, and unites with the first portion.

The two portions thus united and contracting in breadth, run behind the semi-orbicularis superior, and are fixed therein opposite to the lateral dens incisivus. Sometimes it sends a small fasciculus of fibres to the musculus caninus, which may be reckoned an assistant to that muscle, and named *caninus minor*.

The incisorii medii are commonly called *incisorii minores Cowperi*, or *incisorii minores superiores*. They are two small short muscles situated near each other below the septum narium. They are fixed by one extremity in the os maxillare, on the alveoli of the first incisores behind the semi-orbicularis superior, and by their other extremity in the middle and superior part of the substance of the upper lip, near the nares, in which they likewise have an insertion; and they sometimes send lateral fibres to the semi-orbicularis.

Each of the two triangulares is fixed by a broad extremity in the outside of the basis of the lower jaw, from the masseter to the hole near the chin. From thence it ascends, contracting in breadth in a bent triangular form; runs in between the extremities of the buccinator and zygomaticus major, to both which it adheres very closely; and terminates at the commissure of the lip, partly in the semi-orbicularis superior, and partly, tho' not always equally, in the semi-orbicularis inferior.

rior. This muscle seems sometimes to be a continuation of the *caninus major*.

The *quadratus* forms the thick part of the chin below the under lip. It is a very complex muscle, and very difficult to be prepared, because its fibres are interwoven with a great quantity of fat, or a pellicular texture of the *membrana adiposa*. It is first of all inserted in the foreside of the lower jaw, where it partly fills the broad fossula on each side of the symphysis. From thence it runs up, intersecting, along the symphysis, the contiguous fibres of the skin, and terminates by a broad insertion in the *semi-orbicularis inferior*. The direction of the other fibres of which it is composed varies in different subjects, and it communicates by some fibres with the *cutanei*.

The *incisorii inferiores* are two small muscles, commonly mentioned with the addition of M. Cowper's name. Each of them is fixed by the superior extremity, on the alveoli of the lateral incisores of the lower jaw. From thence they run down, approaching each other, and are inserted together in the lower part of the middle of the *semi-orbicularis inferior*.

On the outside of the superior insertion of each of these muscles, we meet with a fasciculus of fibres, which seem to be detached from it near the incisores. This fasciculus goes off laterally in form of an arch, and unites with the fibres of the *semi-orbicularis inferior*, with which it may be easily confounded. It may be looked upon as a *musculus accessorius* to the *semi-orbicularis inferior*, or as a *collateralis* to the *incisorius minor*.

The two *musculi cutanei* form a kind of fleshy membrane, which covers the whole foreside of the throat and neck, from the cheek and chin, all the way down below the *claviculæ*, and adheres very strongly to the membranous or aponeurotic expansion described above. This expansion has a particular adhesion to the anterior portion of the basis of the lower jaw, of the same kind
with

with that at the lower part of the zygoma; and it is spread over all the muscles that lie round the neck, and over the upper portion of the pectorales majores, deltoides, and trapezii.

The fibres of each cutaneous muscle run obliquely upward and forward, and meet and seem to intersect those of the other muscle at acute angles, from the sternum all the way to the chin. They adhere very closely to the skin by the intervention of the cellular substance. From the clavicles to the upper part of the neck these muscles are very thin, and from thence increase a little in thickness as they approach the basis of the lower jaw, and especially from the masseter to the chin.

They adhere strongly to the lower portion of the masseter, triangularis, and quadratus; and on the masseter and buccinator their fleshy fibres become aponeurotic; but continue longer on the triangularis, being mixed with the fibres of that muscle all the way to the commissure of the lips. They likewise advance a little on the neighbouring portion of the quadratus.

The portion of these muscles which answers to the basis of the triangularis, is in a manner divided into two fleshy laminæ, the outermost of which is in what advances over the triangularis and quadratus, the other being inserted separately in the lower jaw. I have sometimes observed a part of the fleshy extremity of the right side, to pass before the symphysis of the chin, over a like part from the left side, the one covering the other.

The common muscles of the lips either draw both corners of the mouth at once, or only one at a time, according to the different direction of their fibres. The proper muscles pull the different parts of the lips in which they are inserted. The buccinators in particular may serve to move the food in mastication. An entire treatise might be written on the almost innumerable combinations of the different motions of all these

muscles, according to the different passions, and according to the different postures in which a man may put his face. None are more affecting than those produced by the cutanei alone, especially in weeping, which they do by their adhesions to the triangulares, &c. But by their insertions in the bone of the lower jaw, they draw up the lower part of the integuments of the neck, and those of the breast next to these; for they cannot move the jaw. In old people, and in those who are very much emaciated, these muscles may be perceived by the eye, under the chin, and on the neck.

§ 6. *The Salival Glands, &c.*

By saliva we mean in general, that fluid by which the mouth and tongue are continually moistened in their natural state. This fluid is chiefly supplied by glands, called for that reason *glandulæ salivales*, of which they commonly reckon three pairs, two parotides, two maxillares, and two sublinguales. These are indeed the largest, and they furnish the greatest quantities of saliva; but there are a great number of other lesser glands of the same kind, which may be reckoned assistants or substitutes to the former. All these may be termed *salival glands*, and they may be enumerated in the following manner: *Glandulæ parotides*, *glandulæ maxillares*, *glandulæ sublinguales*, *glandulæ molares*, *glandulæ buccales*, *glandulæ labiales*, *glandulæ linguales*, *amygdalæ*, *glandulæ palatinæ*, *glandulæ uvulares*, *glandulæ arytenoidææ*, *glandula thyroidæa*.

The parotides are two large, whitish glands, irregularly oblong and protuberant, situated on each side, between the external ear and the posterior or ascending ramus of the lower jaw, and lying on some part of the neighbouring masseter muscle. The superior portion of this gland lies before the cartilaginous meatus of the ear, and touches the apophysis zygomatica of the os tem-

temporis; and it is extended forward and backward under the lobe of the ear, as far as the mastoide apophysis.

From the anterior and superior portion of this gland, a white membranous duct or canal is produced by the union of a great number of small tubes representing so many roots. This duct runs obliquely forward on the outside of the masseter; and then perforates the buccinator from without inward, opposite to the interstice between the second and third dentes molares, where the hole or orifice represents the spout of an ewer.

This canal is named *ductus salivalis Stenonis*, or *ductus superior*. It is about the twelfth part of an inch in diameter, and in some subjects is partly covered by small glandular bodies united with it in different quantities. The arteria and vena angularis run up over this duct, and the portio dura of the auditory nerve runs thro' the gland itself; and it also receives filaments from the second vertebral pair.

The maxillary glands are smaller and rounder than the parotides; and are situated each on the inside of the angle of the lower jaw, near the musculus pterygoideus inferior. From the inside, or that which is turned to the musculus hyo-glossus, each of them sends out a duct in the same manner as the parotides; but it is smaller and longer, and goes by the name of *ductus salivalis Whartoni*, or *ductus inferior*.

This duct advances on the side of the musculus genio-glossus; along the inner part and superior edge of the glandula sublingualis, to the frænum of the tongue, where it terminates by a small orifice in form of a papilla.

The glandulæ sublinguales are likewise two in number, of the same kind with the former, only smaller, something oblong, and flatted like a blanchéd almond. They are situated under the anterior portion of the tongue, one on each side, near the lower jaw, on the lateral portions of the muscoli mylo-hyoidæi which sustain.

stain them. The two extremities of each gland are turned backward and forward, and the edges obliquely inward and outward.

They are covered on the upper side by a very thin membrane, which is a continuation of the membrane that covers the under side of the tongue. They send out laterally several small short ducts which open near the gums by the same number of orifices, all ranked in the same line, at a small distance from the frænum, and a little more backward. In many animals we find particular ducts belonging to these glands, like those of the *glandulæ maxillares*, but they are not to be found so distinctly in men. The *musculi genio-glossi* lie between the two sublingual glands, and also between the two maxillary ducts.

The molares are two glands nearly of the same kind with the former, each of them being situated between the masseter and buccinator; and in some subjects they may easily be mistaken for two small lumps of fat. They send out small ducts which perforate the buccinator, and open into the cavity of the mouth, almost overagainst the last dentes molares; and from thence M. Heister, who first described them, called them *glandulæ molares*.

All the inside of the cheeks near the mouth, is full of small glandulous bodies, called *glandulæ buccales*, which open by small holes or orifices through the inner membrane of the mouth. The membrane which covers the inside of the lips, a continuation of that on the cheeks, is likewise perforated by a great number of small holes, which answer to the same number of small glands, called *glandulæ labiales*. The *glandulæ linguales* are those of the foramen cæcum of the basis of the tongue, which have been already spoken to.

I have also explained the *glandulæ palatinæ*, or those that belong to the arch and septum of the palate; and the *glandulæ arytenoidææ* were described with the larynx. The uvular glands are only a continuation of the

the membrane of the palate in form of a small bunch of grapes. We might likewise reckon among the salival glands those of the superior portion of the pharynx mentioned in the description of that part, and also the glandular bodies of the membrana pituitaria of the nares, and of the sinuses which communicate with these.

The amygdalæ are two glandular bodies of a reddish colour, lying in the interstices between the two lateral half-arches of the septum palati, one on the right, the other on the left side of the basis of the tongue. Their appearance is not unlike that of the outside of an almond shell, both because their surface is uneven, and because it is full of holes big enough to admit the head of a large pin.

These holes, which represent a sieve, or a piece of net-work, are continued to an irregular sinus or cavity within the gland, filled commonly with a viscid fluid, which comes from the bottom of the sinus, and is from thence gradually discharged through these holes into the throat. To see the true structure of the amygdalæ, they must be examined in clear water, having first been washed in lukewarm water, and handled very gently.

The thyroide gland is a large whitish mass which covers the anterior convex side of the larynx. It seems at first sight to be made up of two oblong glandular portions united by their inferior extremities, below the cricoide cartilage, in such a manner as to have some resemblance to a crescent, with the cornua turned upward. It is of a moderate thickness, and bent laterally like the thyroide cartilage, from which its name is taken. The two lateral portions lie on the muscoli thyrohyoidæi, and the middle or inferior portion on the crico-thyroidæi. The thyro-pharyngæi inferiores send fibres over this gland; and they communicate on each side, by some such fibres, with the sterno-thyroidæi and hyo-thyroidæi.

This gland seems to be of the same kind with the
other

other salival glands, but it is more solid. Some anatomists thought they had discovered the excretory duct, but they mistook a blood-vessel for it. We sometimes meet with a kind of glandular rope which runs before the cartilago-thyroides, and disappears before the basis of the os hyoides.

This glandular rope goes out from the common basis of the lateral portions of the thyroide gland; and is lost between the muscoli-sterno-hyoidæi, behind the basis of the os hyoides, or between that basis and the epiglottis. I have likewise shown, in my private courses, small openings on the side of the anterior ligament of the epiglottis, or that by which it is connected to the basis of the tongue. One of these openings appears like a small papilla; and this is the farthest that I have been able to trace the glandular rope.

The glandulæ lymphaticæ will come in more properly in a latter part of this work, with the description of the absorbent system.

C H A P. II.

Of the THORAX.

§ 1. *Introduction.*

BY the thorax, we commonly understand all that part of the body which answers to the extent of the sternum, ribs, and vertebræ of the back, both outwardly and inwardly.

The thorax is divided into the anterior part, called commonly the *breast*; the posterior part, called the *back*; and the lateral parts, called the *right* and *left sides*.

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The external parts of the thorax, besides the skin and *membrana adiposa*, are principally the *mammæ*; and the muscles which cover the ribs, and fill the spaces between them.

The muscles are the *pectorales*, *maiores*, and *minores*, *subclavii*, *ferrati maiores*, *ferrati superiores postici*, *latissimi dorsi*, and *vertebrales*; and to these we may add the muscles which cover the scapula.

The internal parts of the thorax are contained in the large cavity of that portion of the trunk which the ancients called the *middle venter*, but the moderns name it simply the *cavity of the breast*. This cavity is lined by a membrane named *pleura*, which forms the *mediastinum*; and contains the heart and lungs, with the vessels, &c. which go into or out from them: through it likewise the *œsophagus* passes to the stomach, and part of the nerves are contained in it which go to the contents of the abdomen.

External conformation of the thorax. The whole extent of the thorax in a living subject, is commonly determined not only by the sternum, *vertebræ* of the back and ribs, but also by all that space contained between the articulations of the two arms with the *scapulæ* and *claviculæ*; and in this sense, the outside of the thorax is broader above than below in a healthy subject who has a moderate share of flesh on his bones.

The breadth of the upper part of the breast is owing to the *pectorales maiores* and *latissimi dorsi* viewed directly forward or backward. But when we take a direct lateral view of the breast, it appears narrower above than below, not only in an entire subject, but even after every thing has been removed that covers the sides of the thorax, and in the skeleton itself.

The common integuments of the thorax are the same with those of the abdomen; and the convex side of this part of the body is likewise covered by several muscles. Anteriorly, we find the *pectorales maiores* and *minores*, a large portion of the *ferrati maiores*, the
sub-

subclavii, a portion of the scaleni and of the obliqui abdominis externi. Posteriorly, we have all the muscles which cover both sides of the scapula, the serrati postici, and a part of the sacro-lumbares, longissimi dorsi, vertebrales, &c. as in the history of the muscles. Among all the external parts of the thorax, only two are peculiar to it in the human body. I mean the two eminences called *mammæ*, which must therefore be described in this chapter.

Cavity of the thorax. The hard parts which form the sides of the cavity of the thorax, are, The twelve vertebræ of the back, all the ribs, and the sternum. The soft parts which complete the sides, are, The membrane called *pleura*, which lines the cavity; and the muscoli intercostales, sterno-costales, and diaphragma, already described among the muscles.

All these hard and soft parts taken together, represent a kind of cage, in some measure of a conical figure, flattened on the fore side, depressed on the back side, and in a manner divided into two nooks by the figure of the vertebræ of the back, and terminated below by a broad arched basis inclined backward. The intercostal muscles fill up the interstices betwixt the ribs, and so complete the sides of the cavity: the basis is the diaphragm; and the pleura not only covers the whole inner surface of the cavity, but, by forming the mediastinum, divides it into two, one on the right, the other on the left.

§ 2. *Mammæ.*

THE name of *mammæ*, or *breasts*, is given to two eminences more or less round, situated in the anterior, and a little toward the lateral parts of the thorax, their centre or middle part lying almost opposite to the bony extremity of the sixth true rib on each side. Their size and figure vary in the different sexes and different ages.

In

In children of both sexes, and in males of all ages, they are commonly no more than cutaneous tubercles, or soft verrucæ of a red dish colour, called *papillæ* or *nipples*; each of them being surrounded by a small, thin, and pretty broad circle or disk, more or less of a brownish colour and an uneven surface, termed *areola*.

In females come to the age of puberty, which is sometimes sooner, sometimes later, a third part is joined to the two former, which is a convex protuberance, more or less round, of about five or six fingers in breadth; the papilla and areola being situated near the middle of its convex surface. This is what is properly termed *mamma*; and it may be termed the *body of the breast*, when compared with the other two parts. It increases with age, and is very large in women with child, and in those that give suck. In old age it decreases and becomes flabby, losing its natural consistence and solidity.

Body of the Mammæ. The body of the mammæ is partly glandular, and partly made up of fat; or it is a glandular substance mixed with portions of the membrana adiposa, the cellulous pelliculæ of which support a great many blood-vessels, lymphatics, and serous or lactiferous ducts, together with small glandular molculæ, which depend on the former; all of them being closely surrounded by two membranes continued from the pelliculæ.

The innermost of these two membranes, which is, in a manner, the basis of the body of the mamma, is thick and almost flat, adhering to the musculus pectoralis major. The second or external membrane is thinner, forming a particular integument for the body of the mamma, more or less convex, and adhering closely to the skin.

The corpus adiposum of the mamma in particular, is a spongy cluster, more or less interlarded with fat, or a collection of membranous pelliculæ, which, by the particular disposition of their outer sides, form a kind of mem-

membrane in shape of a bag, in which all the rest of the corpus adiposum is contained. The anterior or outer portion of this bag, or that which touches the skin, is very thin; but that side next the pectoralis major is thick.

Ductus lactiferi. The glandular body contains a white mass, which is merely a collection of membranous ducts, narrow at their origin, broad in the middle, and which contract again as they approach the papilla, near which they form a kind of circle of communication. They are named *ductus lactiferi*; "which, in their course, are accompanied by a ligamentous elastic substance, which terminates with them in the nipple: both this substance, and the ducts it contains, are capable of considerable extension and contraction; but in their natural state are moderately corrugated, so as to prevent an involuntary flow of milk, unless the distending force be very great from the accumulation of too great a quantity."

Areola. The coloured circle or disk already mentioned, is formed by the skin; the inner surface of which sustains a great number of small glandular moleculeæ, of that kind which Morgagni calls *glandulæ sebaceæ*. They appear very plainly all over the areola, even on the outside, where they form little flat heights or eminences at different distances quite round the circle.

These tubercles are perforated by small holes, through which a kind of sebaceous matter, more or less liquid, "is poured out to defend the areola and nipple. Sometimes one or more of the lactiferous ducts have been found to terminate upon the surface of the areola."

Papilla. The tubercle which lies in the centre of the areola, is termed *papilla*, or the *nipple*. It is of different sizes in different ages and constitutions, and in the different conditions of females in particular. In women with child, or who give suck, it is pretty large, and generally longer or higher than it is thick or broad;
and

and when it happens to be short, it causes great uneasiness to the child.

The texture of the nipple is spongy, elastic, and liable to divers changes of consistence, being sometimes harder, sometimes more flaccid. It seems to be made up chiefly of ligamentary fasciculi; the extremities of which form the basis and apex of the nipple. These fasciculi appear to be gently folded, or curled, during their whole length; and if, by drawing the fibres out, these folds be destroyed, they return again as soon as that action ceases.

Between these spongy and elastic fasciculi lie from seven to twelve particular tubes at small distances from each other, and all in the same direction. These tubes end at the basis of the papilla in the irregular circle of communication of the lactiferous ducts, and at the apex in the same number of almost imperceptible holes or orifices; and as they are closely united to the elastic fasciculi, they are folded in the same manner with them.

The body of the papilla is covered by a thin cutaneous production, and by the epidermis. Its outer surface is uneven, being full of small tubercles and wrinkles; among which those near the circumference of the nipple seem to have a transverse or annular disposition, which, however, is not uniform.

This disposition or direction seems to be owing to the elastic folds already mentioned: and from this simple structure it is easy to explain how infants in sucking the nipple, and women in drawing the teats of cows, bring out the milk. For the excretory tubes being wrinkled in the same manner as the fasciculi, do, by these wrinkles or folds, as by so many valves, hinder the milk contained in the ducts from flowing out; but when the nipple is drawn and elongated, the tubes lose their folds, and the passage becomes straight. Besides this, when they are drawn with a considerable force, the whole body of the mamma is increased in length

and contracted in breadth, and thereby the milk is pressed into the open tubes; and thus by barely pressing the body of the breast, the milk may be forced toward the nipple, and even through the tubes: "but those who understand the principles of the air-pump will more readily conceive the manner in which the child draws out the milk."

Arteries, veins, nerves, &c. The arteries and veins distributed through the mammæ, are ramifications of the arteriæ and venæ mammariæ; of which one kind comes from the subclaviæ, and are named *mammariæ internæ*; the others from the axillares, called *mammariæ externæ*.

These vessels communicate with each other, with those near them, and with the vasa epigastrica, as was observed in the description of the arteries and veins. The nerves come chiefly from the costales, and, by means of these, communicate with the great nervi sympathetici.

Uses. The use of the mammæ in the nourishment of children is known to all the world; but it is not certainly known what the papillæ and areolæ in males can be designed for. Milk has been observed in them in children of both sexes; and this happened to one of my own brothers when he was about two years of age.

§ 3. *Pleura and Mediastinum.*

THE pleura is a membrane which adheres very closely to the inner surface of the ribs, sternum, and muscoli intercostales, sub-costales, and sterno-costales, and to the convex side of the diaphragm. It is of a very firm texture, and plentifully stored with blood-vessels and nerves, in all which it resembles the peritonæum; and likewise in that it is made up of an inner true membranous lamina, and a cellular substance on the outside, which is a production or continuation of the lamina.

The

The cellular portion goes quite round the inner surface of the thorax, but the membranous portion is disposed in a different manner. Each side of the thorax has its particular pleura, entirely distinct from the other, and making, as it were, two great bladders, situated laterally with respect to each other in the great cavity of the breast, in such a manner as to form a double septum or partition running between the vertebræ and the sternum, their other sides adhering to the ribs and diaphragm.

This particular duplicature of the two pleuræ is termed *mediastinum*. The two laminæ of which it is made up are closely united together near the sternum and vertebræ; but in the middle, and toward the lower part of the fore-side, they are separated by the pericardium and heart, as we shall see hereafter. A little more backward they are parted in a tubular form by the œsophagus, to which they serve as a covering; and in the most posterior part, a triangular space is left between the vertebræ and the two pleura from above downward, which is filled chiefly by the aorta.

Before the heart, from the pericardium to the sternum, the two laminæ adhere very closely, and there the mediastinum is transparent, except for a small space near the upper part, where the thymus is situated: so that in this place there is naturally no interstice or particular cavity. The apparent separation is owing entirely to the common method of raising the sternum, as was plainly demonstrated by Bartholinus, my first master in anatomy, in his Treatise of the Diaphragm, published at Paris in 1676.

The mediastinum does not commonly terminate along the middle of the inside of the sternum, as the common opinion has been. I demonstrated in the year 1715, to the Royal Academy of Sciences, that from above downward it inclines toward the left side; and that if, before the thorax is opened, a sharp instrument be run through the middle of the sternum, there will be almost

the breadth of a finger between the instrument and the mediastinum, provided that the sternum remain in its natural situation, and the cartilages of the ribs be cut at the distance of an inch from it on each side.

From all this we see, not only that the thorax is divided into two cavities entirely separated from each other by a middle septum without any communication; but also that, by the obliquity of this partition, the right cavity is greater than the left; and from hence we may judge of the uncertainty of trepanning the sternum, which the ancients have recommended in some cases.

The cellular portion of the pleura connects the membranous portion of the sternum, ribs, and muscles, to the diaphragm, pericardium, thymus, and vessels, and, in a word, to whatever lies near the convex side of the membranous portions of the pleura. It likewise insinuates itself between the laminae of the duplicature of which the mediastinum is formed, and unites them together. It even penetrates the muscles, and communicates with the cellular substance in their interstices, all the way to the membrana adiposa on the external convex side of the thorax. In this the pleura resembles the peritonæum.

The surface of the pleura turned to the cavities of the breast, is continually moistened by a lymphatic serosity which transudes through the pores of the membranous portion. This fluid is said to be secreted by imperceptible glands; but the existence of these glands has not been hitherto demonstrated, as was likewise observed of the glands of the peritonæum.

Arteries and veins. The arteries and veins of the pleura are chiefly ramifications of the intercostals; and these ramifications are exceedingly numerous, and for the most part very small. The *mammariæ internæ* and *diaphragmaticæ* likewise send branches hither, which communicate very frequently with those that come from the intercostals.

The

The mediastinum has particular vessels, called *arteriæ* and *venæ mediastinæ*, which are commonly branches of the subclaviæ. The *mammariæ internæ* send likewise ramifications to the fore-part of it, the *diaphragmaticæ* to the lower part, and the *intercostales* and *œsophageæ* to the back-part.

Nerves. The nerves are ramifications of the true *intercostales*, called otherwise *costales* and *dorsales*. Near the *vertebræ* they communicate with the great sympathetic nerves, improperly called *intercostales*, and but very little with the middle sympathetic, or those of the eighth pair.

Use. The pleura serves in general for an inner integument to the cavity of the thorax. The mediastinum cuts off all communication between the two cavities, and hinders one lung from pressing on the other when we lie on one side. It likewise forms receptacles for the heart, pericardium, œsophagus, &c.; and it is continued over the lungs in the manner which shall be explained hereafter.

Before we leave the pleura, it must be observed that these portions of it which adhere immediately to the ribs, may be looked upon as the *periosteum* of their inner sides. This adhesion keeps the pleura stretched, and hinders it from slipping or giving way. It likewise renders this membrane extremely sensible of the least separation caused by a coagulated lymph or accumulated blood; the nervous filaments being likewise in this case very much compressed in inspiration by the swelling of the intercostal muscles.

§ 4. *Thymus.*

THE thymus is an oblong glandular body, round on the upper part, and divided below into two or three great lobes; of which that toward the left hand is the longest. In the *fœtus* it is of a pretty large size; less in children, and very little in aged persons. In child-

ren it is of a white colour, sometimes mixed with red ; but in an advanced age its colour is generally dark.

The greatest part of the thymus lies between the duplicature of the superior and anterior portion of the mediastinum, and the great vessels of the heart ; from whence it reaches a little higher than the tops of the two pleuræ, so that some part of it is out of the cavity of the thorax, and in the fœtus and in children it lies as much without the thorax as within it.

Its particular inward structure and secretions are not as yet sufficiently known to determine its uses ; which, however, seem to be designed more for the fœtus than for adults. It has vessels belonging to it, called *arteriæ* and *venæ thymicæ*.

§ 5. Cor.

Situation in general and conformation. The heart is a muscular body situated in the cavity of the thorax, on the anterior part of the diaphragm, between the two laminæ of the mediastinum. It is in some measure of a conical figure, flatted on the sides, round at the top, and oval at the basis. Accordingly we consider in the heart the basis, apex, two edges, and two sides ; one of which is generally flat, the other more convex.

Besides the muscular body, which chiefly forms what we call the *heart*, its basis is accompanied by two appendices, called *auriculæ*, and by large blood-vessels ; of which hereafter : and all these are included in a membranous capsula, named *pericardium*.

It is hollow within, and divided by a septum which runs between the edges into two cavities, called *ventriculi* ; one of which is thick and solid, the other thin and soft. This latter is generally termed the *right ventricle*, the other the *left ventricle* ; though, in their natural situation, the right ventricle is placed more anteriorly than the left, as we shall see hereafter.

Each ventricle opens at the basis by two orifices ; one of

of which answers to the auricles, the other to the mouth of a large artery ; and accordingly one of them may be termed the *auricular orifice*, the other the *arterial orifice*. The right ventricle opens into the right auricle, and into the trunk of the pulmonary artery ; the left into the left-auricle, and into the great trunk of the aorta. At the edges of these orifices are found several moveable pelliculæ, called *valves* by anatomists ; of which some are turned inward toward the cavity of the ventricles, called *triglochines*, or *tricuspides* ; others are turned toward the great vessels, called *femilunares*, or *sigmoidales*. The valvulæ tricuspides of the left ventricle are likewise termed *mitrales*.

Ventriculi. The inner surface of the ventricles is very uneven, many eminences and cavities being observable therein. The most considerable eminences are thick fleshy productions, called *columnæ*. To the extremities of these pillars are fastened several tendinous cords, the other ends of which are joined to the valvulæ tricuspides. There are likewise other small short tendinous ropes along both edges of the septum between the ventricles. These small cords lie in an obliquely transverse situation, and form a kind of network at different distances.

The cavities of the inner surface of the ventricles are small deep fossulæ or lacunæ placed very near each other, with small prominent interstices between them. The greatest part of these lacunæ are orifices of the venal ducts, to be described hereafter.

Structure of the ventricles. The fleshy or muscular fibres of which the heart is made up, are disposed in a very singular manner, especially those of the right or anterior ventricle ; being either bent into arches, or folded into angles.

The fibres which are folded into angles are longer than those which are only bent into arches. The middle of these arches, and the angles of the folds, are turned toward the apex of the heart, and the extremities of

the fibres toward the basis. These fibres differ not only in length, but in their directions, which are very oblique in all, but much more so in the long or folded fibres than in the short ones, which are simply bent.

It is commonly said that this obliquity represents the figure 8; but the comparison is very false, and can only agree to some bad figures drawn by persons ignorant of the laws of perspective.

All these fibres, regard being had to their different obliquity and length, are disposed in such a manner, as that the longest form partly the most external strata on the convex side of the heart, and partly the most internal on the concave side; the middle of the arches and the angles meeting obliquely and successively to form the apex.

The fibres situated within these long ones grow gradually shorter and straighter all the way to the basis of the heart, where they are very short and very little incurvated. By this disposition, the sides of the ventricles are very thin near the apex of the heart, and very thick toward the basis.

Each ventricle is composed of its proper distinct fibres, but the left ventricle has many more than the right. Where the two ventricles are joined, they form a septum which belongs equally to both.

There is this likewise peculiar to the left ventricle, that the fibres which form the innermost stratum of its concave side, form the outermost stratum of the whole convex side of the heart, which consequently is common to both ventricles; so that, by carefully unraveling all the fibres of the heart, we find it to be made up of two bags contained in a third.

The anterior or right ventricle is somewhat larger than the posterior or left, as was well observed by the ancients, and clearly demonstrated by M. Helvetius. They are both nearly of the same length in men; "the left is sometimes a little longer than the right," and in some

some subjects they end exteriorly in a kind of double apex.

All the fibres are not directed the same way, though they are all more or less oblique : for some end toward the right hand, others toward the left, some forward, some backward, and others in the intermediate places ; so that, in unravelling them, we find that they cross each other gradually, sometimes according to the length of the heart, and sometimes according to its breadth.

The tubes which cross each other transversely are much more numerous than those which cross longitudinally ; which ought to be taken notice of, that we may rectify the false notions that have been entertained concerning the motion of the heart ; namely, that it is performed by a contortion or twisting like that of a screw, or that the heart is shortened in the time of contraction, and lengthened in dilatation.

The fibres which compose the inner or concave surface of the ventricles do not all reach to the basis ; some of them running into the cavity, and there forming the fleshy columnæ, to which the loose floating portion of the tricuspidal valves is fastened by tendinous ropes.

Besides these fleshy pillars, the internal fibres form a great many eminences and depressions, which not only render the inner surface of the ventricles uneven, but give it a great extent within a small compass. Some of these depressions are the orifices of the venal ducts found in the substance of the ventricles, which have been already mentioned. The circumferences of the great openings at the basis of the heart are tendinous, and may be looked upon as the common tendon of all the fleshy fibres of which the ventricles are composed.

Valvula. The valves at the orifices of the ventricles are of two kinds : one kind allows the blood to enter the heart, and hinders it from going out the same way ; the other kind allows the blood to go out of the heart, but hinders it from returning. The valves of the first kind terminate the auriculæ ; and those of the second lie

lie in the openings of the great arteries. The first are termed *semilunar* or *sigmoidal valves*; the others *triglochines*, *tricuspidal*, or *mitral*.

The tricuspidal valves of the right ventricle are fixed to its auricular orifice, and turned inward toward the cavity of the ventricle. They are three triangular productions, very smooth and polished on that side which is turned towards the auricle; and on the side next the cavity of the ventricle, they have several membranous and tendinous expansions, and their edges are notched or indented. The valves of the auricular orifice of the left ventricle are of the same shape and structure, but they are only two in number; and, from some small resemblance to a mitre, they have been named *mitrales*.

These five valves are very thin, and fastened by several tendinous ropes to the fleshy columnæ of the ventricles. The cords of each valve are fixed to two pillars; and between these valves there are other small ones of the same figure. They may all be termed *valvula tricuspides*, *auriculares*, or *venosæ cordis*.

The semilunar valves are six in number, three belonging to each ventricle, situated at the mouths of the great arteries; and they may be properly enough named *valvula arteriales*. Their concave sides are turned toward the cavity of the arteries, and their convex sides approach each other. In examining them with a microscope, we find fleshy fibres lying in the duplicature of the membranes of which they are composed.

They are truly semilunar, or in form of a crescent, on that side by which they adhere: but their loose edges are of a different figure, each of them representing two small crescents; the two extremities of which meet at the middle of this edge, and there form a kind of small papilla.

The aorta in general. The great artery that goes out from the left ventricle, is termed *aorta*. As it goes out, it turns a little toward the right hand, and then bends obliquely backward, to form what is called *aorta descendens*;

scendens; which I shall have occasion to mention again hereafter. From about the middle of the convex side of this curvature three great branches arise, which furnish an infinite number of ramifications to the head and upper extremities of the body; as the descending aorta does in the same manner to the thorax, abdomen, and lower extremities.

The arteria pulmonaris in general. The trunk of the artery which goes out from the right ventricle, is called *arteria pulmonaris*. This trunk, as it is naturally situated in the thorax, runs first of all directly upward for a small space; then divides laterally into two principal branches, one for each lung; that which goes to the right lung being the longest, for a reason that shall be given hereafter.

Auriculae. The auricles are muscular bags situated at the basis of the heart, one towards the right ventricle, the other towards the left; and joined together by an inner septum and external communicating fibres, much in the same manner with the ventricles; one of them being named *the right auricle*, the other *the left*. They are very uneven on the inside, but smoother on the outside; and terminate in a narrow, flat, indented edge, representing a cock's comb, or in some measure the ear of a dog; "this properly gets the name of *auricle*, the larger and smooth part of the cavity being called *sinus venosus*, but as the two parts make one general cavity, the name of *auricle* is commonly applied to the whole." They open into these orifices of each ventricle, which I name *auricular orifices*; and they are tendinous at their opening, in the same manner as the ventricles.

The right auricle is larger than the left; and it joins the right ventricle by a common tendinous opening, as has been already observed. It has two other openings united into one, and formed by two large veins which meet and terminate there, almost in a direct line, called *vena cava superior* and *inferior*. The notched edge
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of this auricle terminates obliquely in a kind of obtuse point, which is a small particular production of the great bag, and is turned toward the middle of the basis of the heart.

The whole inner surface of the right auricle is uneven, by reason of a great number of prominent lines which run across the sides of it, and communicate with each other by smaller lines, which lie obliquely in the interstices between the former. The lines of the first kind represent trunks, and the other small branches in an opposite direction to each other. In the interstices between these lines, the sides of the auricle are very thin and almost transparent, seeming to be formed merely by the external and internal coats of the auricle joined together, especially near the point.

The left auricle is in the human body a kind of muscular bag or reservoir, of a pretty considerable thickness and unequally square, into which the four veins open called *venæ pulmonares*, and which has a distinct appendix belonging to it, like a third small auricle. This bag is very even on both "surfaces, and is therefore called *sinus venosus*; but to distinguish it from the one on the right side, it is called *sinus venosus sinistra*." However, the bag and appendix have but one common cavity; and therefore may still be both comprehended under the common name of the *left auricle*. In men, the small portion may likewise be named *the appendix of the left auricle*; but in other animals, the case is different.

This small portion or appendix of the left auricle is of a different structure from that of the bag or large portion. Exteriorly, it resembles a small oblong bag, bent different ways, and indented quite round the edges. Interiorly, it is like the inside of the right auricle. The whole common cavity of the left auricle is smaller in an adult subject than that of the right; and the fleshy fibres of this left auricle cross each other obliquely, in strata differently disposed.

Arteriæ & venæ coronariæ. Besides the great common vessels, the heart has vessels peculiar to itself, called *the coronary arteries and veins*, because they in some measure crown the basis of the heart. The coronary arteries, which are two in number, go out from the beginning of the aorta, and afterwards spread themselves round the basis of the heart, to the substance of which they send numerous ramifications.

The exterior course of the veins is pretty much the same with that of the arteries; but they end chiefly in the right auricle, and partly in the right ventricle. They likewise terminate in the left ventricle, but in smaller numbers; and in both they end by certain venal ducts, which open into the fossulæ or lacunæ already taken notice of, in the uneven inner sides of the ventricles. There are likewise lacunæ of the same kind in the auricles between the prominent lines before-mentioned; and in the great bag of the left auricle, we find likewise small holes which seem to have the same use.

There are seldom more than two arteries; of which one lies toward the right hand, the other toward the left of the anterior third part of the circumference of the aorta. The right coronary artery runs in between the basis and right auricle, all the way to the flat side of the heart, and so goes half way round. The left artery has a like course between the basis and left auricle; and before it turns on the basis, it sends off a capital branch, which runs in between the two ventricles. Another principal branch goes off from the union of the two arteries on the flat side of the heart, which running to the apex, there joins the other branch.

The coronary veins are distributed exteriorly, much in the same manner. Their trunk opens principally into the right auricle by a particular orifice furnished with a semilunar valve. All the coronary veins and their ramifications communicate with each other; so that if we blow through a small hole made in any of these branches, having first compressed the auricles and
large

large vessels, we observe that the air swells all the vessels, and the ventricles likewise, by passing thro' the ductus venosi.

Particular situation of the heart. The heart lies almost transversely on the diaphragm, the greatest part of it being in the left cavity of the thorax, and the apex being turned toward the bony extremity of the sixth true rib. The basis is toward the right cavity; and both auricles, especially the right, rest on the diaphragm.

The origin or basis of the pulmonary artery is, in this natural situation, the highest part of the heart on the fore-side; and the trunk of this artery lies in a perpendicular plane, which may be conceived to pass between the sternum and spina dorsi. Therefore some part of the basis of the heart is in the right cavity of the thorax; and the rest, all the way to the apex, is in the left cavity; and it is for this reason that the mediastinum is turned toward that side.

According to this true and natural situation of the heart, the parts commonly said to be on the right side are rather anterior, and those on the left side posterior; and that side of the heart which is thought to be the fore-side is naturally the upper side, and the back-side consequently the lower side.

The lower side is very flat, lying wholly on the diaphragm; but the upper side is a little convex thro' its whole length, in the direction of the septum between the ventricles. And it may be proper here to remark, that tho' commonly received terms of art may still be retained, yet it is necessary to prevent their communicating false ideas to those who have not had an opportunity of making observations themselves, or of being instructed by others.

Pericardium. The heart, with all the parts belonging to it, is contained in a membranous capsula called *pericardium*; which is in some measure of a conical figure, and much bigger than the heart. It is not fixed

ed to the basis of the heart, but round the large veins above the auricles before they send off the ramifications, and round the large arteries before their divisions.

The pericardium is made up of three laminæ; the middle and chief of which is composed of very fine tendinous filaments, closely interwoven, and crossing each other in different directions. The internal lamina seems to be a continuation of the outer coat of the heart, auricles, and great vessels. The trunks of the aorta and pulmonary artery have one common coat, which contains them both as in a sheath, and is lined on the inside by a cellular substance, chiefly in that space which lies between where the trunks are turned to each other, and the sides of the sheath. There is but a very small portion of the inferior vena cava contained in the pericardium.

It is the middle lamina which chiefly forms the pericardium; and the figure of this bag is not simply conical, its apex or point being very round, and the basis having a particular elongation which surrounds the great vessels, as has been already said, as amply as the other portion surrounds the heart.

The pericardium is closely connected to the diaphragm, not the apex, but exactly at that place which answers to the flat or lower side of the heart; and it is a very difficult matter to separate it from the diaphragm in dissection. This adhering portion is in some measure of a triangular shape, answering to that of the lower side of the heart; and the rest of the bag lies upon the diaphragm, without any adhesion.

The internal lamina, or common covering, as it may be called more properly, is formed by the duplicature of the mediastinum. It adheres to the proper bag of the pericardium by the intervention of the cellular substance in that duplicature, but leaves it where the pericardium adheres to the diaphragm, on the upper surface

face of which it is spread, as being a continuation of the pleura.

The internal lamina is perforated by an infinite number of very small holes, through which a serous fluid continually transudes, in the same manner as in the peritonæum. This fluid being gradually collected after death, makes what is called *aqua pericardii*, which is found in considerable quantities in opening dead bodies while they remain fresh. Sometimes it is of a reddish colour, which may be owing to a transfusion of blood through the fine membrane of the auricles.

Uses in general. The heart and parts belonging to it are the principal instruments of the circulation of the blood. The two ventricles ought to be considered as two syringes so closely joined together as to make but one body, and furnished with suckers placed in contrary directions to each other, so as that, by drawing one of them, a fluid is let in, and forced out again by the other.

The heart is made up of a substance capable of contraction and dilatation. When the fleshy fibres of the ventricles are contracted, the two cavities are lessened in an equal and direct manner, not by any contortion or twisting, as the false resemblance of the fibres to a figure of 8 has made anatomists imagine. For if we consider attentively in how many different directions and in how many places these fibres cross each other, as has been already observed, we must see clearly, that the whole structure tends to make an even, direct, and uniform contraction, more according to the breadth or thickness, than according to the length of the heart, because the number of fibres situated transversely, or almost transversely, is much greater than the number of longitudinal fibres.

The fleshy fibres thus contracted do the office of suckers, by pressing upon the blood contained in the ventricles; which blood being thus forced toward the basis of the heart, presses the tricuspidal valves against each other,

other, opens the femilunares, and rushes with impetuosity through the arteries and their ramifications, as through so many elastic tubes.

Systole. The blood thus pushed on by the contraction of the ventricles, and afterwards pressed by the elastic arteries, enters the capillary vessels, and is from thence forced to return by the veins to the auricles, which like retirements, porches, or antichambers, receive and lodge the blood returned by the veins during the time of a new contraction. This contraction of the heart is by anatomists termed *systole*.

Diaſtole. The contraction or *systole* of the ventricles, ceases immediately, by the relaxation of their fleshy fibres; and in that time the auricles which contain the venal blood, being contracted, force the blood through the tricuspidal valves into the ventricles, the sides of which are thereby dilated, and their cavities enlarged. This dilatation is termed *diaſtole*.

Circulation. In this manner does the heart, by the alternate *systole* and *diaſtole* of its ventricles and auricles, push the blood through the arteries to all the parts of the body, and receive it again by the veins. This is called the *circulation of the blood*, which is carried on in three different manners.

The first and most universal kind of circulation is that by which almost all the arteries of the body are filled by the *systole* of the heart, and the greatest part of the veins evacuated by the *diaſtole*.

The second kind of circulation opposite to the first, is through the coronary vessels of the heart, the arteries of which are filled with blood during the *diaſtole* of the ventricles, and the veins emptied during the *systole*.

The third kind of circulation is that of the left ventricle of the heart; through the venal ducts of which a small quantity of blood passes, without going through the lungs, which is the course of all the remaining mass of blood.

Besidesthese three different kinds of circulation, there are some peculiarities in the course of the blood, which may be looked upon as particular circulations. Such is the passage of the blood through the liver, spleen, corpora cavernosa of the parts of generation, and thro' the cavernous sinuses of the dura mater. I do not here examine the circulation peculiar to the foetus.

§ 6. *Pulmones.*

Situation in general and figure. The lungs are two large spongy bodies, of a reddish colour in children, greyish in adult subjects, and bluish in old age; filling the whole cavity of the thorax, one being seated in the right side, the other in the left, parted by the mediastinum and heart; and of a figure answering to that of the cavity which contains them, that is, convex next the ribs, concave next the diaphragm, and irregularly flattened and depressed next the mediastinum and heart.

When the lungs are viewed out of the thorax, they represent in some measure an ox's foot, with the fore-part turned to the back, the back-part to the sternum, and the lower part to the diaphragm.

Division and figure in particular. They are distinguished into the right and left lung; and each of these into two or three portions called *lobi*, of which the right lung has commonly three, or two and a half, and the left lung two. The right lung is generally larger than the left, answerably to that cavity of the breast, and to the obliquity of the mediastinum.

At the lower edge of the left lung, there is an indented notch or sinus opposite to the apex of the heart, which is therefore never covered by that lung even in the strongest inspirations, and consequently the apex of the heart and pericardium may always strike against the ribs; the lungs not surrounding the heart in the man-

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ner commonly taught. This sinus is expressed in Eustachius's tables.

Structure. The substance of the lungs is almost all spongy, being made up of an infinite number of membranous cells, and of different sorts of vessels spread among the cells, in innumerable ramifications.

Coats. This whole mass is covered by a membrane continued from each pleura, which is commonly said to be double; but what is looked upon as the inner membrane, is only an expansion and continuation of a cellular substance, which shall be spoken to after I have described the vessels of this viscus.

Bronchia. The vessels which compose part of the substance of the lungs are of three or four kinds; the air-vessels, blood-vessels, and lymphatics, to which we may add the nerves. The air-vessels make the chief part, and are termed *bronchia*.

These bronchia are conical tubes, composed of an infinite number of cartilaginous fragments, like so many irregular arches of circles, connected together by a ligamentary elastic membrane, and disposed in such a manner as that the lower easily insinuate themselves within those above them.

They are lined on the inside by a very fine membrane, which continually discharges a mucilaginous fluid; and in the substance of the membrane are a great number of small blood-vessels, and on its convex side many longitudinal lines, which appear to be partly fleshy, and partly made up of an elastic substance of another kind.

The bronchia are divided in all directions into an infinite number of ramifications, which diminish gradually in size; and as they become capillary, change their cartilaginous structure into that of a membrane. Besides these very small extremities of this numerous series of ramifications, we find that all the subordinate trunks from the greatest to the smallest, send out from

all sides a vast number of short capillary tubes of the same kind.

Vesiculæ bronchiales. Each of these numerous bronchial tubes is widened at the extremity, and thereby formed into a small membranous cell, commonly called *a vesicle*. These cells or folliculi are closely connected together in bundles; each small branch producing a bundle proportionable to its extent and the number of its ramifications.

Lobuli. These small vesicular or cellulous bundles are termed *lobules*; and as the great branches are divided into small rami, so the great lobules are divided into several small ones. The cells or vesicles of each lobule have a free communication with each other, but the several lobules do not communicate so readily.

Interlobular substance. The lobules appear distinctly to be parted by another cellulous substance, which surrounds each of them in proportion to their extent, and fills up the interstices between them. This substance forms likewise a kind of irregular membranous cells, which are thinner, looser, and broader, than the bronchial vesicles.

This substance is dispersed through every part of the lungs, forms cellulous or spongy vaginae, which surround the ramifications of the bronchia and blood-vessels, and is afterwards spread over the outer surface of each lung, where it forms a kind of fine cellular coat, joined to the general covering of that viscus.

When we blow into this interlobular substance, the air compresses and flattens the lobuli; and when we blow into the bronchial vesicles, they presently swell; and if we continue to blow with force, the air passes insensibly into the interlobular substance. We owe this observation to M. Helvetius.

Vascular texture. All the bronchial cells are surrounded by a very fine reticular texture of the small extremities of arteries and veins which communicate every

every way with each other. The greatest part of this admirable structure is the discovery of the illustrious Malpighi.

Blood-vessels. The blood-vessels of the lungs are of two kinds; one common, called *the pulmonary artery and veins*; the other proper, called *the bronchial arteries and veins*.

The pulmonary artery goes out from the right ventricle of the heart; and its trunk having run directly upward as high as the curvature of the aorta, is divided into two lateral branches; one going to the right hand, called *the right pulmonary artery*; the other to the left, termed *the left pulmonary artery*. The right artery passes under the curvature of the aorta, and is consequently longer than the left. They both run to the lungs, and are dispersed through their whole substance by ramifications nearly like those of the bronchia, and lying in the same directions.

The pulmonary veins having been distributed thro' the lungs in the same manner, go out on each side, by two great branches which open laterally into the reservoir or muscular bag of the right auricle.

The ramifications of these two kinds of vessels in the lungs, are surrounded every where by the cellular substance already mentioned, which likewise gives them a kind of vagina; and the rete mirabile of Malpighi, described above, is formed by the capillary extremities of these vessels. It must be observed, that the ramifications of the arteries are more numerous and larger than those of the veins, which in all other parts of the body exceed the arteries both in number and size.

Bronchial arteries and veins. Besides these capital blood-vessels; there are two others called *the bronchial artery and vein*. The artery has become very famous of late, by the description given of it by M. Ruysch. The vein was doubted of for some time; but it exists

as really as the artery, and may be easily demonstrated.

These two vessels are very small, appearing only like very fine arteries and veins coming from the aorta, vena cava, and their branches, in the manner already said in the description of the arteries and veins; and they seem to have no other use but that of nourishing the lungs.

The varieties in the origins of the bronchial arteries and veins, especially of the arteries, their communications or anastomoses with each other and with the neighbouring vessels, and above all, the immediate anastomosis of the bronchial artery with the common pulmonary vein, are of so great consequence in the practice of physic, that it will be proper to repeat here what I have said about them elsewhere, that the attention of the readers may not be diverted by being obliged to turn to another place of this work.

The bronchial arteries come sometimes from the anterior part of the aorta descendens superior, sometimes from the first intercostal artery, and sometimes from one of the œsophagææ. They go out sometimes separately, toward each lung; sometimes by a small common trunk, which afterwards divides to the right and left, near the bifurcation of the aspera arteria hereafter to be described, and follow ramifications of the bronchia.

The left bronchial artery comes pretty frequently from the aorta; and the right, from the superior intercostal on the same side, because of the situation of the aorta. There is likewise another which arises from the aorta posteriorly near the superior intercostal, and above the anterior bronchialis.

The bronchial artery gives off a small branch to the auricle of the heart on the same side, which communicates immediately with the coronary artery.

Sometimes one bronchial artery gives origin to several superior intercostales; and sometimes several bron-

bronchial arteries send off separately the same number of intercostals.

The bronchial veins, as well as arteries, were known to Galen. These veins are sometimes branches of the azygos, coming from the upper part of the curvature or arch. The left vein is sometimes a branch of the common trunk of the intercostals of the same side; and sometimes both veins are branches of the gutturalis.

Nervi. The lungs have a great many nerves distributed through them by filaments which accompany the ramifications of the bronchia and blood-vessels, and are spread on the cells, coats, and all the membranous parts of the lungs. The *nervi sympathetici medii* and *majores*, commonly called the *nerves of the eighth pair* or the *intercostals*, form behind each lung a particular intertexture, called *plexus pulmonaris*, from whence nervous filaments go out, which communicate with the *plexus cardiacus* and *stomachicus*.

Vasa lymphatica. On the surface of the human lungs, between the external and cellular coat, we observe something that looks like lymphatic vessels; but we ought to take care not to mistake for such vessels a transparent reticular substance observable on the surface of the lungs after blowing strongly into the lobuli; this appearance being entirely owing to the air which passes through the bronchial vesicles into the interlobular cells, and which, by separating a certain number of lobuli, finds room to lodge between them. The true lymphatic vessels of the lungs are most visible in brutes; and in a horse particularly, I have observed one of these vessels to run along a great part of one edge of the lungs.

Ligaments. Under the root of each lung, that is, under that part formed by the subordinate trunk of pulmonary artery, by the trunks of the pulmonary veins, and by the trunk of the bronchia, there is a pretty broad membranous ligament which ties the po-

sterior edge of each lung to the lateral parts of the vertebræ of the back; from that root all the way to the diaphragm.

Trachea arteria. The bronchia already described, are branches or ramifications of a large canal, partly cartilaginous, and partly membranous, called *trachea* or *aspera arteria*. It is situated anteriorly in the lower part of the neck, from whence it runs down into the thorax between the two pleuræ, through the upper space left between the duplicature of the mediastinum, behind the thymus.

Having reached as low as the curvature of the aorta, it divides into two lateral parts, one toward the right hand, the other toward the left, which enter the lungs, and are distributed through them in the manner already said. These two branches are called *bronchia*; and that on the right side is shorter than that of the left, whereas the right pulmonary artery is the longest.

The trachea is made up of segments of circles of cartilaginous hoops, disposed in such a manner as to form a canal open on the back-part, the cartilages not going quite round; but this opening is filled by a soft glandular membrane, which completes the circumference of the canal.

Each circle is about the twelfth part of an inch in breadth, and about a quarter of that space in thickness. Their extremities are round; and they are situated horizontally above each other, small interstices being left between them, and the lower edge of the superior segments being turned toward the upper edge of those next below them.

They are all connected by a very strong elastic membranous ligament fixed to their edges. I have observed the first three segments united into one bent alternately in two different places according to its breadth. Sometimes two are continuous in the same manner.

The canal of the *aspera arteria* is lined on the inside by a particular membrane, which appears to be partly fleshy

fleshy or muscular, and partly ligamentary, performed by an infinite number of small holes more or less imperceptible, through which a mucilaginous fluid continually passes, to defend the inner surface of the trachea against the acrimony of the air which we breathe.

This fluid comes from small glandular bodies dispersed through the substance of the membrane, but especially from glands something larger than the former, which lie on the outer or posterior surface of that strong membrane by which the circumference of the canal is completed. The same structure is observable in the ramifications of the trachea from the greatest to the smallest.

All the vessels of which the lungs are chiefly composed, that is, the air-vessels or bronchia, and the blood-vessels, or the pulmonary and bronchial arteries and veins, accompany each other through this whole viscus.

They are disposed commonly in such a manner, even to the last ramifications, as that a subordinate trunk or branch of the bronchia lies between the like trunks or branches of the pulmonary artery and vein; the bronchial vessels being immediately joined to the bronchia. In some places these three kinds of vessels touch each other in such a manner as to leave a triangular space in the middle.

The bronchia are divided into a very great number of ramifications; and the last rami are the pedicles or footstalks of the small lobuli. All the lobuli are angular, oblong, broad, thin, &c. The footstalks send out other smaller membranous pedicles, which are very short, and terminate in the bronchial vesicles or cells, of which they are continuations. The subordinate trunks and rami detach a great number of these pedicles from their convex surface.

When we blow into the lungs, the bronchial cells nearest their outer surface appear like small portions
of

of round vesicles; and from this appearance, all the bronchial-cells have got the name of *vesicles*, though they are all angular, except those which I have now mentioned.

When we examine a lung without blowing it up, we find that the cartilaginous segments of the bronchia lie so near as to be engaged in each other; and in drawing out any portion of the bronchia by the two ends, these segments are parted; and the whole canal is increased in length; but it contracts again, by means of its elastic membrane, as soon as that force is taken off.

When we open lengthwise any portion of the pulmonary artery and vein in the same lung, we meet with a great number of transverse rugæ, which are destroyed when these vessels are elongated. This is an observation made by M. Helvetius.

By virtue of this structure, all the ramifications both of the bronchia and pulmonary arteries and veins, have constantly the same direction, whether the lung be inflated or collapsed; and they contract in length, without being either contorted or folded. In expiration these vessels are elongated, and shortened in inspiration.

These three vessels lie in a sort of cellular vagina, which accompanies all their ramifications; and is a continuation of their interlobular cells, or cellular substance in the interstices of the lobuli. The pelliculæ which compose it, are, however, there disposed in a more regular manner, and more longitudinally, than in other places, and thereby appear to form a true vagina.

When we blow through a pipe introduced so far as to touch immediately a trunk of the blood-vessels or bronchia, the air runs at first through all the cells that lie nearest that trunk or its branches; but if we continue to blow, it insinuates itself through the whole interlobular substance.

Bronchial glands. At the angle of the first ramification

tion of the trachea arteria, we find on both the fore and back sides, certain soft, roundish, glandular bodies, of a bluish or blackish colour, and of a texture partly like that of the thymus already described, and partly like that of the glandula thyroides, of which hereafter. There are other glands of the same kind at the origin of each ramification of the bronchia, but they decrease proportionably in number and size. They are fixed immediately to the bronchia, and covered by the interlobular substance; and they seem to communicate by small openings with the cavity of the bronchia.

The trachea has several coats, as has been already observed. The outermost or common covering surrounds that part of the trachea which lies in the thorax; but out of the thorax, this first coat is derived from the aponeurotic expansions of the muscles of the neck; and it is between this and the following covering that the glands already mentioned are situated.

The second is a proper coat, being a continuation of the cellular covering of the lungs; and the pelliculæ thereof nearest the cartilaginous segments, serve them for an external perichondrium. The third membrane lies on the inside, adhering closely to the same cartilages, and supplying to these the place of an internal perichondrium.

The fourth membrane is that which completes the circumference of the cartilaginous circles of the trachea. It consists chiefly of two laminæ or strata, partly muscular and partly tendinous; the external or posterior lamina being made up of longitudinal fibres; and the internal, or anterior, of transverse fibres. This membrane is perforated by the small ducts of the above-mentioned glands, which discharge a fluid when pressed; and being examined through a microscope they appear vesicular or folliculous, much like that of the stomach.

The ligaments between the cartilaginous circles are very strong and elastic; and each of them is confined

to two cartilages, without communicating with any of the rest; being fixed to the edges of these cartilages, much in the same manner as the intercostal muscles are inserted in the ribs.

As the bronchia penetrate into the substance of the lungs, they gradually lose their cartilages; but the muscular lines or columnæ of M. Morgagni appear as much, and sometimes more than before. The two planes above-mentioned continue likewise to be visible; and we observe very distinctly, sometimes even without a microscope, a great many small holes in the pellicles of the lobuli, and bronchial vesicles or cells, which open from within outwards.

Uses. Respiration is performed by organs of two kinds, one of which may be looked upon as active, the other as passive. The lungs are of the second kind, and the first comprehends chiefly the diaphragm and intercostal muscles.

As soon as the intercostal muscles begin to contract, the arches of the ribs are raised together with the sternum, and placed at a greater distance from each other; by which means the cavity of the thorax is enlarged on the two lateral and anterior sides.

At the same instant the diaphragm is flatted or brought toward a plane by two motions, which are apparently contrary; that is, by the contraction of the diaphragm, and the dilatation of the ribs in which it is inserted. The external surface of the thorax being thus in a manner increased, and the cavity of the bronchia being at the same time, and by the same means, less resisted or pressed upon, the ambient air yields to the external pressure, and insinuates itself into all the places where the pressure is diminished; that is, into the aspera arteria, and into all the ramifications of the bronchia, all the way to the vesicles. This is what is called *inspiration*.

This motion of inspiration is instantaneous, and ceases in a moment by the relaxation of the intercostal muscles;

muscles; the elastic ligaments and cartilages of the ribs bringing them back at the same time to their former situation. This motion by which the ribs are depressed and brought nearer to each other, is termed *expiration*.

The pulmonary arteries and veins which accompany the bronchia through all their ramifications, and surround the vesicles, transmit the blood through their narrow capillary extremities, and thereby change or modify it, at least in three different manners.

The first change or modification which the blood undergoes in the lungs, is to have the cohesions of its parts broken, to be attenuated, pounded, and, as it were, reduced to powder. The second is, to be deprived of a certain quantity of serum, which transpires through the lungs, and is what we commonly call the *breath*. The third is, to be in a manner reanimated by the impression of the air, whether the whole body of the air enters the blood, whether the common air is only the vehicle of some finer parts which are conveyed to it, or whether the air only compresses and shakes the blood as it passes round the bronchial vesicles in the reticular capillary extremities of the vessels.

The cartilages of the *aspera arteria* and bronchia serve in general to compose a canal; the sides of which will not sink in or subside by compression, but will nevertheless yield to certain pressures and impulses without breaking. As these cartilages are not complete circles or rings, and as their circumferences are completed by elastic membranes, they allow of those dilations and contractions which modulate the voice; and as they are connected by elastic ligaments of a considerable breadth, the alternate elongation and contraction of the bronchia is facilitated in the motions of respiration.

The larynx is commonly looked upon as the upper part of the *aspera arteria*: but we have already described it in the preceding chapter of *the Head*, with
which

which it has a particular connection in relation to the tongue.

§ 7. *Oesophagus.*

Situation and figure. THE oesophagus is a canal partly muscular and partly membranous, situated behind the trachea arteria, and before the vertebræ of the back, from near the middle of the neck down to the lower part of the thorax; from whence it passes into the abdomen through a particular hole of the small or inferior muscle of the diaphragm, and ends at the upper orifice of the stomach.

Structure and coats. It is made up of several coats almost in the same manner as the stomach, of which it is the continuation. The first coat, while in the thorax, is formed only by the duplicature of the posterior part of the mediastinum, and is wanting above the thorax and in the neck, where the outer coat of the oesophagus is only a continuation of the cellular substance belonging to the neighbouring parts.

The second coat is muscular, being made up of several strata of fleshy fibres. The outermost are mostly longitudinal; but they are not all continued from one end of the canal to the other. The following strata are obliquely transverse, and the innermost are turned a little obliquely the contrary way. They cross each other irregularly in many places, but are neither spiral nor annular.

The third is termed the *nervous coat*, and is like that of the stomach and intestines. It is differently folded or plaited, according to its length, being much wider than the muscular coat; and it is surrounded by a whitish, soft, fine filamentary substance, like a kind of cotton, which, when steeped in water, swells and grows thicker.

The fourth or innermost coat resembles in some measure that of the intestines; except that, instead of the villi,

villi, it has small and very short papillæ. It is folded lengthwise like the third coat; so that the œsophagus, when cut across, represents one tube within another. Through the pores of this coat, a viscid lymph is continually discharged.

The œsophagus, from its very beginning, turns a little to the left hand, and naturally runs along the left extremities of the cartilages of the aspera arteria. The thyroid gland, and those which lie behind the middle of the œsophagus, are described in another place. The pharynx and the larynx have been already described in the preceding chapter.

§ 5. *Ductus Thoracicus.*

The thoracic duct is a thin transparent canal, which runs up from the receptaculum chyli along the spina dorsa, between the vena azygos and aorta, as high as the fifth vertebra of the back, or higher. From thence it passes behind the aorta toward the left hand, and ascends behind the left subclavian vein, where it terminates, in some subjects, by a kind of vesicula, in others by several branches united together, and opens into the back-side of the subclavian vein near the outside of the internal jugular.

This canal is plentifully furnished with semilunar valves turned upward. Its opening into the subclavian vein in the human body, is, in the place of valves, covered by several pelliculæ, so disposed as to permit the entrance of the chyle into the vein, and hinder the blood from running into the duct. It is sometimes double, one lying on each side; and sometimes it is accompanied by appendices, called *pampiniformes*.

C H A P. III.

Of the ABDOMEN.

THE whole fore-part of the abdomen forms an oblong convexity like an oval vault, more or less prominent in the natural state, in proportion to the quantity of fat upon it and of food contained in it, or to the different degrees of pregnancy in women. The hypogastric and umbilical regions are more subject to these varieties than the epigastric region.

On the sides, between the hypochondria and ossa ilium or haunch, the abdomen is commonly a little contracted; and backward, about the middle of the regio lumbaris, it is gently depressed, forming a kind of transverse cavity, answering to the natural incurvation of the lumbar portion of the spina dorsa.

This anterior convexity, and posterior cavity, change as we sit, stand, kneel, lie at our full length, or with the thighs bent; and these variations depend on the particular situation of the ossa innominata in these different postures.

In standing, the convexity of the belly, and cavity of the loins, are more considerable than in most other situations; for then the lower extremity of the os sacrum is turned very far back, and consequently the os pubis very much down. In this situation of the pelvis, the intestines fall naturally forward, and thus increase the

the convexity of the abdomen; and as the vertebræ of the loins are very much bent at the same time, the cavity in that place must likewise be very considerable.

In kneeling, the ossa pubis are still lower than when we stand: and this not only increases the hollow of the loins, and throws the abdomen and its viscera more outward or forward, but also in some measure strains the abdominal muscles; which is so uneasy to some persons, as to cause them to faint away.

This depression of the os pubis in kneeling depends partly on the tension of the two musculi recti anteriores; the lower tendons of which are, in this situation, drawn with violence under the condyloide pulley of the os femoris.

When we sit in the common manner, that is, with the thighs stretched out in a plane parallel to that of the seat, the convexity of the belly and hollow of the loins diminish.

For the pelvis being in this situation supported on the tubercula ischii, and these tubercles being very near the fore-part of the pelvis, the trunk of the body pressing on the os sacrum must lower the pelvis behind, and raise it before.

When we lie upon the back at full length, and with the thighs extended, the belly is less convex, but more stretched and hard; whereas, when the thighs are bent, it is soft and lax. In this situation, the regio lumbaris is almost flat, and very little depressed.

When we lie on the back, and raise the head, or endeavour to raise it, we feel a tension in the fore-part of the abdomen, which increases in proportion to the force we use in raising the head.

These varieties of the external conformation of the abdomen have a near relation to so great a number of other phænomena in the animal œconomy of the human body, that it would require a whole volume to explain all the particulars thereof: neither are details of this kind very proper in a work designed to be purely

anatomical; in which, consequently, our main business is to give a full and accurate description of the true structure of the parts, and only to point out in general their principal uses.

Integuments of the abdomen. The anterior portion of it is not only thinner and more compact than the posterior, as has been already observed, but it has this likewise peculiar to it, that it may be naturally increased very much in breadth, and sometimes in a very extraordinary manner, without losing any thing of its thickness, in proportion to what it gains in breadth.

This peculiarity likewise belongs to the epidermis. I here speak only of what is observable in the natural state of corpulency or pregnancy; but I have not as yet been able to discover what it is in the texture or structure of the skin and epidermis, on which this peculiarity depends. All that I have been able to remark about it was in the dead body of a woman, whose belly was contracted and fallen; namely, that on the surface of the skin there was a great number of lozenges disposed in a reticular manner.

The marks of these superficial lozenges were in the epidermis. They were composed of several fine lines, which all together extended to a sensible breadth. The areas or meshes of these lozenges, which seemed to be about the sixth part of an inch in breadth, were very flat and thin.

In the manner in which Steno used to open bodies, by making two longitudinal incisions in the integuments, and so leaving a middle band made up of the skin and fat in their true places, it is easy to demonstrate the union of the aponeurotic or tendinous productions with the arteries, veins and nerves, in order to form the skin of the abdomen; and the same use might be made of this method in other parts of the skin, as I shall show in another place.

The cells of the membrana adiposa, which covers the convex part of the abdomen, are disposed in a very regular

gular manner, as I discovered by that method of opening bodies, which I have always made use of, both in my public and private courses. This method is to make two oblique incisions in the integuments, from the navel to the groins, and to separate this angular portion of the integuments, and throw it down over the parts of generation, that they may be covered during the demonstration.

This triangular portion being thus inverted, there appears on the inner surface of the *membrana adiposa* a longitudinal line like a kind of raphe, produced by the meeting of these cellular rows, which form angles successively, one above another, opposite to the *linea alba* of the abdomen. The cells in these rows are more oblong than the rest, and in a mannner oval, or like a grain of wheat.

Cavity of the abdomen. The appendix *ensiformis* of the sternum, the cartilaginous portions of the last pair of true ribs, those of the first four pairs of false ribs, all the fifth pair, the five lumbar vertebræ, the *ossa innominata*, the *os sacrum*, and *os coccygis*, form the bony sides of the cavity of the abdomen.

The diaphragm, the muscles called particularly *musculi abdominis*, the *quadrati lumborum*, *psoai*, *iliaci*, the muscles of the coccyx, and of the *intestinum rectum*, form the chief part of the circumference of this cavity; and its whole inner surface is lined by a membranous expansion, termed *peritoneum*, all these parts being covered by the integuments already spoken to. As additional or auxiliary parts, we might likewise add some portions of the sacro-lumbares, *longissimi dorsi*, *vertebrales*, *glutæi*, &c.

The cavity of the abdomen is of an irregularly oval figure, but still symmetrical. On the foreside it is uniformly arched or oval, and its greatest capacity is even with the navel and nearest part of the hypogastrium. On the upper side it is bounded by a portion of a vault, very much inclined. On the backside it is in a manner

divided into two cavities by the jetting out of the vertebræ of the loins. On the lower side, it contracts gradually all the way to what I call the *little edge* of the pelvis; and from thence expands again a little as far as the os coccygis, and tubercles of the ischium, terminating in the void space between these three parts.

§ 1. *Peritonæum.*

HAVING carefully removed the muscles of the abdomen, the first thing we discover is a very considerable membranous covering, which adheres immediately to the inner surface of the musculi transversi, and of all the other parts of this cavity; and involves and invests all the viscera contained therein, as in a kind of bag. This membrane is named *peritonæum*, from a Greek word, which signifies to be spread around.

The peritonæum, in general, is a membrane of a pretty close texture, and yet very limber and capable of a very great extension; after which it can recover itself, and be contracted to its ordinary size; as we see in pregnancy, dropsies, corpulency, and repletion.

It may be looked upon as a single membrane, although it has been described by many anatomists as a duplicature of two distinct membranous laminæ. But, properly speaking, the internal portion alone deserves the name of a *membranous lamina*, as being the main body of the peritonæum. The external portion may properly enough be termed the *cellular substance of the peritonæum*.

The inner surface of the peritonæum is very smooth, and polished on that side which is turned to the cavity and viscera of the abdomen, and continually moistened by a serous fluid discharged through almost imperceptible pores.

These pores may be seen by spreading a portion of the peritonæum on the end of the finger, and then pulling it very tight on all sides; for then the pores are dilated

lated, and small drops may be observed to run from them, even without a microscope.

The sources of this fluid are chiefly from the exhalent vessels. The whitish corpuscles found in diseased subjects are no proof of the glands, which some anatomists place there in the natural state.

The cellular substance, or external portion of the peritonæum, adheres very closely to the parts which form the insides of the cavity of the abdomen; and it is not every where of an equal thickness. In some places it is in a very small quantity, and scarcely any appears at the tendinous or aponeurotic portions of the musculi transversi, and on the lower side of the diaphragm.

In all other places it is thicker, and forms cells expanded into very fine laminæ, which, in diseased subjects, become sometimes so broad and thick, as to resemble so many distinct membranes.

In some places, this substance is every way like a *membrana adiposa*, being filled with fat, as round the kidneys, and along the fleshy portions of the transverse muscles, to which it adheres. It entirely surrounds some parts, as the bladder, ureters, kidneys, spermatic vessels, &c. and it is in these places improperly termed the *duplication of the peritonæum*.

Besides these differences in thickness, the cellular substance has several elongations, which have been called *productions of the peritonæum*. Two of these productions accompany and invest the spermatic ropes in males, and the vascular ropes, commonly called the *round ligaments*, in women. There are other two, which pass under the ligamentum Fallopii, with the crural vessels, which they involve; and they are gradually lost in their course downward.

To these four productions of the cellular substance of the peritonæum we may add a fifth, which is spread on the neck of the bladder; and perhaps a sixth, which accompanies the intestinum rectum. All these elongations pass out of the cavity of the abdomen, and may

be termed *external*, to distinguish them from others that remain in the abdomen, and are called *internal*; of which hereafter.

The great blood-vessels, that is, the aorta and vena cava, are likewise involved in this cellular substance of the peritonæum. In a word, it involves immediately and separately all the parts and organs which are commonly said to lie in the duplicature of the peritonæum.

The true lamina, or membranous portion of the peritonæum, is connected by the intervention of the cellular substance to the inner surface of the cavity of the abdomen; but it does not naturally accompany the external elongations of that substance. It only covers the origin or basis of these productions, without any alteration in its own surface at these places.

It has, nevertheless, productions of its own; but they are very different from those of the cellular substance; for they run from without inward, that is, they advance from the convex side of the great bag of the peritonæum into the cavity of that bag, some more, some less, and also in different manners, as if the sides of a large ball or bladder were thrust inward into the cavity of the ball or bladder.

Of these internal elongations of the peritonæum, some are simply folded like a duplicature; some are expanded like inverted bags, or sacculi, to contain some viscus; some begin by a simple duplicature, and are afterwards expanded into a cavity which contains some organ; some are alternately extended in the form of simple duplicatures and of cavities; and, lastly, some form only a small eminence on the inner surface of the great cavity of the peritonæum.

Under the first species of these productions, we may bring the membranous ligaments of the abdomen, such as those of the liver, colon, &c. We see the second species in the external membrane of the liver; the third in the mesentery; the fourth in the mesocolon; and the fifth at the kidneys and ureters.

Besides

Besides the external productions of the cellular substance of the peritonæum, it has the same number of internal elongations with the true lamina; which lie between all the duplicatures, and line the insides of all the cavities, or that side next the viscera contained in them.

The uses of the peritonæum, in general, seem to be very evident from the description which I have given of it: and the chief of these uses are, to line the cavity of the abdomen, to invest the viscera contained in that cavity as in a common bag, to supply them with particular coats, to form productions, ligaments, connections, folds, vaginæ, &c. as we shall see hereafter.

The fine fluid which transudes through the whole internal surface of the peritonæum prevents the inconveniences which might arise from the continual frictions and motions, to which the viscera of the abdomen are exposed, either naturally or by external impulses.

I must here observe, that it is the common custom to demonstrate four ligamentary ropes, termed the *umbilical vessels*, before the peritonæum is opened, because they adhere to the umbilicus; and three of them are really vessels in the fœtus, viz. two umbilical arteries and one vein. We are in a manner obliged to submit to this custom in public anatomical demonstrations, where we have but one subject for the whole; but as I am here under no such necessity, I refer the description of these ligaments to other more proper places of this work. The venal ligament shall be described in the history of the liver; and the two arterial ligaments, together with the urachus, which is the fourth, in the history of the bladder.

It is sufficient to observe here in general, that three of these umbilical ropes or ligaments are involved separately, and sustained by a production or duplicature, which the peritonæum sends into the cavity of the abdomen in form of a falx.

§ 2. *Ventriculus.*

Situation and figure of the stomach. THE stomach is a great bag or reservoir, situated partly in the left hypochondrium, and partly in the epigastrium.

The figure of the stomach is like that of a bag-pipe; that is, it is oblong, incurvated, large, and capacious, at one end, and small and contracted at the other. We see this figure most evidently when the stomach is moderately filled with air or with any other fluid.

The curvature of the stomach gives us occasion to distinguish two arches in it; one large, which runs along the greatest convexity; and one small, directly opposite to the former. I name these arches the *great* and *small* curvatures of the stomach; and by the sides of the stomach, I understand the two lateral portions which lie between the two arches.

The stomach has two extremities; one large and one small. It has two openings, called the *orifices of the stomach*; one between the great extremity and the small curvature, the other at the end of the small or contracted extremity. The first opening is a continuation of the œsophagus; the other joins the intestinal canal, and is called by the name of *pylorus*.

The stomach is not situated in the left hypochondrium and epigastric region, in the manner represented in most of the figures. It lies transversely, obliquely, and almost laterally; in such a manner as that the great extremity, and the orifice next it, are on the left hand; and the small extremity, with its orifice, or the pylorus, on the right hand, and lower and more inclined than the former: Therefore we ought, with the ancient anatomists, to call one of these orifices *superior*, the other *inferior*.

The great extremity of the stomach is in the left hypochondrium, and for the most part immediately under the diaphragm: yet the superior orifice is not in the left hypo-

hypochondrium, but almost opposite to, and very near the middle of, the bodies of the lowest vertebræ of the back.

The small extremity of the stomach does not reach to the right hypochondrium. It bends obliquely backward toward the upper orifice: so that the pylorus lies about two fingers breadth from the body of the vertebræ immediately under the small portion of the liver; and consequently lower down, and more forward, than the other orifice by almost the same distance. This extremity of the stomach has sometimes a particular dilatation on the side next the great curvature.

According to this natural situation, the stomach, especially when full, "is situated with its great curvature forward and a little downward, and its small curvature backward and a little upward."

One of the lateral convex sides is turned upward, the other downward; and not forward and backward as they appear in dead bodies, where the intestines do not support them in their natural situation.

If we divide the stomach along the two curvatures into two equal parts, we shall see that the two orifices do not both adhere to the same half of this division, as we would be apt to imagine according to the common notion; but that the diaphragmatic orifice is entirely in the upper half, and the intestinal orifice in the lower.

Therefore the body of the stomach is so far from lying in the same plane with the œsophagus, as it is commonly represented in figures drawn from a stomach taken out of the body and laid upon a table, that it forms an angle or fold immediately at the passage of the œsophagus through the small muscle of the diaphragm; and it is on account of this angle that the superior orifice is turned backward.

Structure of the stomach. The stomach is composed of several parts; the chief of which are the different strata which form its substance, to which anatomists give the name of *tunicæ* or *coats*. These coats are commonly reckoned

reckoned to be four in number; the outer or common, the fleshy or muscular, the nervous or aponeurotic, and the villous or inner coat; and they are afterwards subdivided several ways.

The first or outermost coat is simply membranous, being one of the internal productions of the peritonæum. This appears evidently at the connection of the superior orifice with the diaphragm, where the external membrane of the stomach is really continuous with the membrane, which lines the inferior surface of the diaphragm; and it is from this that it has been named the *common coat*.

The second or muscular coat is made up of several planes of fibres, which may all be reduced to two; one external, the other internal. The external coat is longitudinal, though in different respects following nearly the direction of the curvatures and convexities of the stomach; and the internal plane is transversely circular.

The fibres of the external plane run slanting in several places; and are intersected by small oblique whitish lines, which seem to be in some measure tendinous. This plane is strengthened by a particular fasciculus which runs along the small curvature, its fibres appearing to be less oblique than those of the great plane.

The fibres of the inner or circular plane of this muscular coat are stronger than those of the outer plane. They are rather segments which unite at different distances, than entire circles; and they are likewise intersected by great numbers of small white lines, in some measure tendinous and very oblique, which all together represent a kind of net-work, the areolæ or meshes of which are very narrow.

As these circles or segments advance on the great extremity of the stomach, they diminish gradually, and form a kind of muscular vortex; the centre of which is in the middle of that extremity.

Between the outer and inner planes, round the superior orifice, there are two distinct planes about the breadth

breadth of a finger, and very oblique, which surround this orifice in opposite directions, and intersect each other where they meet on the two lateral sides.

Along the middle of each lateral side of the small extremity, there runs a tendinous or ligamentary flat portion, above a quarter of an inch in breadth, which terminates in the pylorus. These two portions lie between the common and muscular coats, and adhere very strongly to the first.

Between the same two coats, there is a cellular substance which adheres very closely to the external coat, and insinuates itself between the fleshy fibres of the second, all the way to the third, as may be perceived by blowing it up. Some make it a distinct coat, and call it *tunica cellulosa*; but it is no more than the cellular portion of the membranous coat, like the cellular portion of the peritonæum.

The third coat, called commonly *tunica nervosa*, but properly *tunica cellulosa*, is composed of capillary vessels and nerves, with a very large proportion of cellular substance. On the concave side it seems to be of a very loose texture, and as it were spongy or filamentary, containing a number of small glandular bodies, especially near the small curvature and small extremity of the stomach.

This spongy texture resembles fine cotton, as may be seen, by macerating it a little in clear water, which swells it considerably in a very short space of time. It is supported by a kind of ground-work of very fine ligamentary or aponeurotic filaments which intersect each other obliquely, much in the same manner as the third coat of the intestines, of which hereafter; and it adheres to the convex side of the villous coat.

The fourth coat of the stomach is termed *villosa*, because, when it swims in clear water, some have imagined they saw something in it like the pile of velvet. The ancients called it *tunica fungosa*; and perhaps this name agrees best with its true structure. We observe
in

in it a great number of small holes answering to the small glands already mentioned.

These two coats are of a larger extent than the two former, and they join in forming large rugæ on the concave surface of the stomach; the greatest part of which is transverse, though irregular and waving. There are likewise some longitudinal ones which intersect the others; but at the pylorus they all become longitudinal, and terminate there.

At the superior orifice of the stomach, these rugæ are in a manner radiated, and seem to be a continuation of the plicæ or folds of the œsophagus; only they are thicker; and where these rugæ and plicæ meet, they form a sort of crown, which distinguishes the superior orifice of the stomach from the inferior extremity of the œsophagus.

In the interstices of these rugæ, there is often found a sort of slimy mucus, with which the whole cavity of the stomach seems likewise to be moistened. This mucus is much more fluid in living bodies, and is supplied by the glands of the stomach. It may be termed *succus gastricus*, or *stomachicus*.

On the inner surface of the small extremity of the stomach, at the place where it ends in the intestinal canal, we observe a broad, thin, circular border, with a roundish hole in the middle. This hole is the inferior orifice of the stomach, called by the Greeks *pylorus*, which signifies a porter.

This border is a fold or duplicature of the two inner coats of the stomach, the nervosa and villosa; and it is formed in part by a fasciculus of fleshy fibres fixed in the duplicature of the tunica nervosa, and distinguished not only from the other fleshy fibres of the extremity of the stomach, but also from those of the intestines, by a thin, whitish circle, which appears even through the external or common coat, round the union of the stomach and intestines.

The figure of the pylorus is that of a ring, transverse-ly

ly flattened, the inner edge of which, or that next the centre, is turned obliquely toward the intestines. This inner edge runs naturally more or less into little plaits or gathers, like the mouth of a purse almost shut; all which particulars are very different from what figures and dried preparations would make us believe. It is therefore a kind of sphincter, which can contract the inferior orifice of the stomach, but seems not capable of shutting it quite close.

Arteries of the stomach. The principal arteries of the stomach are the coronaria ventriculi, which runs along the small curvature; and the two gastricæ, that is, the sinistra or major, and dextra or minor, both which form one common artery, which runs along the great curvature. The coronaria ventriculi becomes united in the same manner with the pylorica, and both make one common vessel.

These two arterial arches send a great number of branches toward each other on both sides of the stomach; and these branches are gradually ramified in different directions, by very different divisions and subdivisions, the greatest part of which communicate with those from the other artery.

From these frequent ramifications and communications of the arterial arches of the stomach; two different reticular textures arise, whereof one, which is the largest, lies between the common and muscular coats in the cellular substance found there: the other, which is very fine, lies on the surface of the tunica nervosa. This latter is a production of the first, being formed by means of a great number of very short rami, which go out from the other, and pass through the small interstices between the fibres of the muscular coat.

By artificial injections we can show a third extremely fine reticular texture of capillary vessels, which run between the glandular bodies and papillæ of the tunica villosa. These do not seem in the natural state to be purely

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ly blood-vessels, as inflammations and injections may incline us to think.

The arteries of the stomach come originally from the *cæliaca*, by means of the *hepatica*, *splenica*, and *coronaria*. The *pylorica* and *mesenterica superior* likewise contribute to them by communications, more or less immediate. They communicate also with the *mammariæ*, *internæ*, and *diaphragmaticæ*, and, by means of the *epigastrica sinistra*, with the *mesenterica inferior*.

Veins of the stomach. The veins of the stomach are ramifications of the *vena portæ* in general; and in particular, of the *meseraica major*, *splenica*, and *mesenterica inferior*, the distribution of which may be seen in the description of the veins. They accompany the arteries more or less, and form nearly the same kinds of arches and reticular textures; with this difference, that they are proportionably greater, their reticular areolæ larger, and their external communications more frequent.

Nerves of the stomach. Between the common and muscular coats of the stomach, we find a great number of nerves of different sizes. Many of them accompany each other, in form of a broad flat fasciculus, along the small curvature of the stomach, from the superior to the inferior orifice. The rest are spread in different directions, on the sides, extremities, and great curvature, forming at different distances a kind of reticular plexus, from which a great number of filaments are detached to the inner coats.

They arise chiefly from the *nervi sympathetici medii*, or eighth pair, by means of the *plexus coronarius stomachicus* formed round the superior orifice of the stomach, by the expansion of the extremities of two large ropes, which run down upon the *œsophagus*, by the name of *nervi stomachici*. The great sympathetic nerve, commonly called *intercostalis*, contributes likewise to them, by communicating filaments, which the plexus
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stomachicus receives from the semilunar ganglions of the plexus hepaticus, and particularly from the plexus splenicus.

Uses of the stomach. The stomach receives in general, whatever the mouth and tongue send thither, thro' the canal of the œsophagus : but its particular use is to receive the aliments ; to contain them for a longer or shorter time, in proportion as they are more solid or fluid ; and to digest them, that is, to put them in a condition to be turned into that nutritious fluid called *chyle*.

This operation, which goes by the general name of *digestion*, and by which chylicification begins, is performed partly by the succus gastricus, which flows continually from the tunica villosa, and partly by the continual contraction and relaxation of the muscular coat. These motions in men are but very weak, and nowise sufficient for digestion, without the assistance of the alternate motions of the diaphragm, and muscles of the abdomen.

The pylorus, or fleshy circle of the inferior orifice of the stomach, serves to retain the aliments in it, till they have acquired a sufficient degree of fluidity, to pass easily through that opening. I say easily ; for by a particular irritation of the muscular coat of the stomach, and still more by a violent contraction of the diaphragm and muscles of the abdomen, the contents of the stomach may be very soon forced towards the small extremity, and pushed through the pylorus.

The gentle and alternate motions of the orbicular fibres of the muscular coat, may assist in sending through the pylorus, in the natural way, the aliment that is sufficiently digested. This was called the *peristaltic* or *vermicular motion*, by those who believed that it is successively reiterated, like that of earth-worms when they creep.

Trituration might be a proper enough term for this operation, provided it be made to signify only a gentle agitation

agitation or action of the fleshy fibres in a substance continually moistened by the gastric liquor, and not a violent grinding of a dry substance.

The situation of the stomach, which is nearly transverse, is likewise of use in making the aliment remain long enough in that cavity; and may serve to make the length of this stay, in some measure, arbitrary, by means of the different postures of the body; for when we lie on the left side, the aliment must remain longer than when we lie on the right, &c.

The obliquity of the stomach may serve to clear up a difficulty that very much torments those who believe that both orifices of the stomach lie on the same level; which is, how any heavy substance, once got into the stomach, can ever rise again to this level, to pass into the intestines.

§ 3. *The Intestines in general, and Intestinum Duodenum in particular.*

Situation, size, and division of the intestines. Between the pylorus and the very lowest part of the abdomen lies a long canal, bent in a great many different directions by numerous convolutions or turnings, called the *intestines*.

This canal, thus folded and turned, forms a considerable bulk, which fills the greatest part of the cavity of the abdomen; and it is connected through its whole extent to membranous productions or continuations of the peritonæum, principally to those called the *mesentery* and *mesocolon*; of which hereafter.

The incurvations of the intestinal canal form two arches; a small one, by which it is connected to the mesentery and mesocolon; and a great one on the opposite side, which lies loose. The whole canal is generally about six or seven times as long as the subject.

The intestinal canal is neither of an equal size nor thickness through its whole length; from whence anatomists

tomists have taken occasion to consider its different portions as so many particular intestines, and to divide them all into small and great.

And as they still found some differences in each class taken altogether, they divided each into three portions, which they distinguished by particular names. In the small intestines, the three portions are named *duodenum*, *jejunum*, and *ileum*; and in the great intestines, *cæcum*, *colon*, and *rectum*.

Structure of the intestines. The intestines in general are composed of several coats, much in the same manner with the stomach. The first and outermost is a continuation of the mesentery, or of some other elongation or duplicature of the peritonæum.

This is commonly termed the *common coat*; and it has a cellular substance on its inner surface, like that of the stomach, which M. Ruysch thought fit to call a distinct coat by the name of *tunica cellulosa*.

The second coat of the intestines is fleshy or muscular, and made up of two planes; one external, the other internal. The external plane is very thin, and its fibres longitudinal; the internal plane is thicker, and its fibres run transversely round the circumference of the intestinal cylinder.

I am not of opinion that these fibres are spiral, nor that they are perfect circles or rings; but they seem rather to be segments of circles, disposed much in the same manner as in the stomach, and thus surrounding entirely the intestinal canal.

These two planes adhere closely together, and are separated with great difficulty. They adhere likewise to the common coat by the intervention of the cellular substance, which is in greater quantities on the side next the mesentery than on the other.

The third coat is called *nervosa*, and is something like that of the stomach. It has a particular plane, which serves as a basis to sustain it, made up of very fine,

strong, oblique fibres, which seem to be of the ligamentary or tendinous kind.

To see this plane distinctly, a portion of the intestines must be inflated, the common coat removed, and the fleshy fibres scraped off.

This coat sustains two reticular substances, which are both vascular, one arterial, the other venal, accompanied by a great number of nervous filaments. These vessels and nerves are productions of the mesenteric vessels and nerves; and as they surround the whole canal of the intestines, some anatomists have formed them into a distinct coat by the name of *tunica vasculosa*.

The nervous coat sends off from its inner surface a great number of portions of septa, more or less circular, which contribute to the formation of what are called *valvula conniventes*; of which hereafter. It likewise seems to sustain several different glandular bodies, which we discover in the cavity of the intestines.

The fourth or innermost coat is very soft, and is named *tunica villosa*. It has the same extent with the third coat, which supports it; and it lines all the septa of that third coat; but it is not uniform through the whole canal, as we shall show in the particular description.

Intestina tenuia. The small intestines form one continued uniform canal; and although three portions of it have three different names, yet we have no sufficient marks whereby to distinguish them, to fix the precise extent or length of each portion, or to settle its just limits.

The first and smallest portion of the whole canal is called *duodenum*; the second, which is much longer, *jejunum*; and the third, which is still longer than the second, *ileum*.

Situation and connection of the duodenum. The first portion of the small intestines was called *duodenum*, from the
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the length ascribed to it by the ancients, *viz.* the breadth of twelve fingers; and the moderns need not cavil much about this length, if it is measured with the ends of the fingers of the subject.

This intestine having arisen from the pylorus, is immediately bent a little backward and obliquely downward; then it bends a second time toward the right kidney, to which it is a little connected; and from thence passes before the renal artery and vein, ascending insensibly from right to left, till it gets before the aorta and last vertebræ of the back. It continues its course obliquely forward by a gentle turn, which may be reckoned a third incurvation, and also the extremity of the duodenum.

Through this whole course the duodenum is firmly bound down by folds of the peritonæum, especially by a transverse duplicature which gives origin to the mesocolon. The two laminæ of this duplicature being at first separate, and soon afterwards uniting, must leave a triangular space between them, which is lined with a cellular substance.

It is in this space that the duodenum adheres by means of the cellular substance to the parts already named; and the intestine is contained therein, as in a case; so that, without dissection, we can see nothing but its two extremities; and even these are hid by the colon, and by the first convolutions of the jejunum.

Structure of the duodenum. The first coat of the duodenum is consequently different from that of the other small intestines, having this peculiar to it, that it does not invest the whole circumference of the intestine; because, through the greatest part of its length, it lies in the triangular space already mentioned; and, for the same reason, there is a greater quantity of cellular substance belongs to the outer coat of the duodenum than to that of the other intestines.

The muscular coat of the duodenum is thicker than in the jejunum and ileum.

The tunica nervosa and villosa form conjointly, on the insides of this intestine, a great number of small duplicatures, which advance into the cavity more or less directly, like portions of circular planes, with one edge fixed to the intestine, and the other loose. These are what anatomists call *valvulae conniventes*.

The loose or floating edge of these valves is formed into small gathers or waves in the natural state. I say designedly, *in the natural state*, to rectify the false ideas which dry preparations of the intestines are apt to beget. The whole surface of these duplicatures or valves is villous, as well as that of the intestines between them.

The villi of this intestine are thicker than in the stomach; but the texture of them in man is not like hairs, as they are commonly represented in figures, but rather like that of a fungous, granulated substance, composed of an infinite number of very fine papillæ of different figures; in which we see, through a microscope, a multitude of depressed points or pores, by which their whole surface seems to pierce.

By the same help we observe, on different places of the inner surface of this intestine, several round villous tubercles, rising like small verruæ at different distances from each other.

This substance sustains an infinite number of capillary vessels of different kinds; for besides the blood-vessels, we sometimes observe a great number of white filaments which run thro' it, and end at its inner surface like so many capillary roots of the vessels called *venae lacteæ*.

The fungous substance which binds these capillary filaments together, and surrounds them, is very tender; and the capillary extremities of the small blood-vessels distributed through it, seem to be turned toward the pores of the papillæ. Through these pores a mucous fluid, more or less transparent, is discharged, which continually moistens the cavity of the intestine.

Glands of the duodenum. The internal surface of the duode-

duodenum is furnished with a great number of small flat glandular tubercles, raised on the sides, and depressed in the middle by a kind of fossula; and they are more numerous near the beginning of this intestine than any where else. About the pylorus they lie in a manner in heaps or clusters; and from thence the distance between them increases gradually all the way to the other extremity where they are single.

These glands, when examined carefully, appear like little bladders, with the orifices turned toward the cavity of the intestine, and the bodies fixed in the spongy substance next the nervous coat. They furnish a particular fluid, which is often found to be viscid.

The biliary orifice of the duodenum. In the inner surface of the duodenum, almost at the lower part of the first incurvation, and on the shortest side, there is a longitudinal eminence, in the point or apex of which lies a particular opening, which is the orifice of the ductus bilarius, within which the ductus pancreaticus likewise opens.

This intestine is commonly the widest, though the shortest, of the *Intestina tenuia*; and is invested by more cellular substances, especially while within its triangular case, where it wants the outer coat which the others have; and consequently it is more easily dilatable by the substances which might otherwise stick within it.

§ 4. *Intestinum Jejunum.*

Situation and size of the jejunum. The jejunum, so called, because it is oftener found empty than the ileum, begins at the last incurvation of the duodenum, and is there connected to the beginning of the mesocolon.

From thence it bends downward from left to right, and obliquely forward, or from the vertebræ, and makes several convolutions, which lie chiefly in the upper part of the umbilical region. Through all this

course it is connected to the mesentery, in the manner that shall be explained hereafter.

It is a pretty difficult matter to fix the exact bounds between this intestine and the ileum. The external marks of a redder colour in the one than in the other, though pretty common, are not constant; and the internal marks fixed from the plurality of *valvulae conniventes* are indeterminate, and oftentimes appear only from dissection.

These two intestines may be better distinguished by their different situations, which are pretty regular; but as even this mark is not particular enough, the most easy way that I have been able to contrive, and which will in most cases be found sufficiently exact, is to divide both intestines into five parts; and to allow nearly two-fifths to the jejunum, and three-fifths and a little more to the ileum.

Structure of the jejunum. The coats of the jejunum are nearly of the same structure with those of the duodenum, but thinner. The common coat is a continuation of the mesentery; and the cellular substance is in less quantity than in the duodenum, and indeed seems to be altogether wanting along the great curvature of the convolutions, where the longitudinal fibres of the muscular coat adhere very closely to the external membrane.

This muscular coat is not so strong as that of the duodenum. The longitudinal plane of fibres is very thin, and almost imperceptible, except along the great curvature, opposite to the connection of the mesentery, where we see, through the membranous coat, a kind of whitish ligamentary band, about the third part of an inch in breadth, which is continued along the great curvature of all the convolutions of this intestine, and of the ileum.

This ligamentary band is like those which we observe on the sides of the small extremity of the stomach. It adheres perfectly to the membranous coat, and to the
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the longitudinal fibres of the muscular, which are here more visible, and appear to be stronger than in any other place.

The tunica nervosa, which I choose rather to call *reticularis*, and its proper cellular or lanuginous substance, have nothing peculiar to them more than has been already said about the intestines in general. By blowing artfully into this substance, it may be made to swell so much, round the whole cavity of the intestines, as to destroy all the duplicatures or *valvulæ conniventes*.

These valves in this intestine are very broad, very numerous, and very near each other. On the side of the great curvature, their circumference is continuous and uniform; but next the small curvature, there are several breaks in them, the extremities of some advancing beyond the rest, and terminating in points. Some of these valves go quite round, others only some part of the way; and some of them are very small, which go obliquely between two large ones, forming a kind of communication.

The papillæ of the tunica villosa are here more raised, more loose and floating, than in the duodenum; and each of them seems to be divided into several others, by incisures of a very singular kind. In other respects they agree pretty much with what was said in the description of the intestines in general. The observations and figures published by M. Helvetius, first physician to the French queen, in the Memoirs of the Royal Academy, express these papillæ, and the whole tunica *reticularis*, very justly.

The glandular lacunæ of the jejunum are of the same structure with the glandulæ Brunneri or duodenales; but they are disposed in a different manner. They are partly single, at different distances from each other; and partly in several clusters, like flat oblong bunches of grapes, called *plexus glandulosi Peyerii*. These are in the largest quantity near the great curva-

ture, and they cross through several *valvulae conniventes* at once.

The vessels, nerves, connections, &c. must be referred till the mesentery has been described.

§ 5. *Intestinum Ileum.*

Situation of the ileum. The convolutions of the *intestinum* surround those of the *jejunum* on the two lateral and lower sides, and it passes in a winding course from the left side, by the *hypogastrium*, to the right side, where it terminates a little below the right kidney, joining the *intestina crassa*, in the manner that I shall relate hereafter. The lateral convolutions are supported by the *ossa ilium*, so called, not from this intestine, but from the region of the abdomen, termed *ilia*.

Structure of the ileum. The structure of the *ileum* is much the same with that of the *jejunum*; only the internal duplicatures or *valvulae conniventes* decrease gradually both in number and size. Near the extremity of the *ileum* their direction is changed; and instead of being transverse or circular, they become longitudinal, and terminate in a kind of pylorus, which advances into the cavity of the great intestines, as we shall see presently.

We observe likewise in this intestine, as in the *jejunum*, single or solitary glands or *lacunæ*, and also reticular glands or glands in clusters; the last of which, at the extremity of this intestine, is oftentimes of a great extent: but the greatest part of these glands appear to be flatter here than in the *jejunum*. The cellular substance of the external coat is in less quantities than in the foregoing intestines; and the *ileum* appears commonly more pale, or not so red as the *jejunum*.

The vessels, nerves, connections, &c. must be referred to the history of the mesentery.

§ 6. *The Intestina Crassa in general, and Intestinum Cæcum in particular.*

THE great intestines are one continued canal, divided into three portions, like the small ones. This canal begins by a kind of sacculus or bag, which is reckoned the first of the three portions, and called *cæcum*. The second portion, called *colon*, is the longest of the three; and is distinguished from them by a great number of particular eminences or convexities, which appear on its outer surface through its whole length. The last portion is named *rectum*; being more uniform, narrower, thicker, and much shorter, than the colon.

The structure of the great intestines is nearly the same with that of the small ones, in regard both to the number and disposition of their coats. They are shorter, and have fewer convolutions, but are much more capacious. The coats in general are stronger, but especially the muscular coat. The villi and mucilaginous glands are different; and there are several other things relating to them, which will come in better in the particular history.

Situation and structure of the cæcum. The *intestinum cæcum* is only a round short broad bag, the bottom of which is turned downward, and the mouth or opening upward. It lies under the right kidney, and is hid by the last convolution of the ileum. It is about three fingers breadth in length, and its diameter is more than double that of the small intestines.

Appendicula vermiformis. On one side of the bottom of the *cæcum* lies an appendix, resembling a small intestine, nearly of the same length with the *cæcum*, but very slender. It is termed *appendicula vermiformis*, from its supposed resemblance to an earth-worm. Its common diameter is not above a quarter of an inch. By one extremity it opens laterally and a little obliquely
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into the bottom of the cæcum ; and the other extremity is closed, being sometimes greater sometimes smaller than the rest of the appendix.

It has some contortions, like those of a worm when it is touched, from whence comes the epithet of *vermicularis* or *vermiformis*. Its structure resembles nearly that of the other intestines.

The internal coat of this appendix is folliculous, like that of the duodenum ; and it is likewise reticular, the meshes being the glandular lacunæ, which continually discharge a fluid into its cavity.

It has been often disputed whether this appendix, or the large portion, which is, as it were, the head of the colon, ought to be called the *cæcum* ; but the general division of the intestines into great and small, leaves no room to doubt of its being only an appendix in man, whatever reason there may be for talking differently with respect to brutes and birds.

Through the membranous or common coat of the cæcum, we see three white ligamentary bands, which adhere very closely both to the outer and muscular coat. One of them is hid by the adhesion of the mesocolon ; and all the three divide the cæcum longitudinally into three parts more or less equal.

They all unite on the appendicula vermiformis, and cover its whole outer side immediately under the common coat. Though they appear exteriorly on the cæcum to be ligamentary, they are made up interiorly of fleshy fibres which accompany and strengthen the longitudinal fibres of the muscular coat.

The villous substance of the inner coat of the cæcum is very short, and furnished in several places with glandular lacunæ or solitary glands, broader than those of the small intestines.

These glandular lacunæ or folliculi are flattened and depressed in the middle like small-pox. When we blow through a pipe into these lacunæ without touching them, the
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the folliculi are inflated, and represent little caps with a hole in the middle of their convex side.

§ 7. *Intestinum Colon.*

Situation and structure of the colon. The colon is the most considerable of all the intestines. From the cæcum, of which it is a continuation, it reaches, in form of an arch, above the umbilical region, and to the lower part of the left hypochondrium. Its continuity is, however, a little interrupted by the ileum, which advances into the cavity of the colon, and, together with a certain fold of that intestine, forms what is called *valvula coli*.

The whole convex side of the colon is divided longitudinally into three parts, by three ligamentary bands, continued from those of the cæcum, and of the same structure with these. Two of these bands run on each side, along the great curvature of the colon; and the third along the small curvature.

The uppermost band of the two that belong to the great curvature, is the broadest of the three; that which belongs to the small curvature is the narrowest, and lay hid by the connection of the mesocolon, till it was brought to light by M. Morgagni.

These three longitudinal bands do the office of longitudinal fræna, between which this intestine is thro' its whole length alternately depressed into transverse folds, and raised into considerable eminences. All the folds are duplicatures, which form portions of *valvulæ conniventes* in the cavity of the intestine; and the eminences form receptacles, called the *cells of the colon*.

All the coats of the colon concur equally to the formation of these duplicatures and cells, the depth of which decreases gradually toward the extremity of the intestine, and neither of them go any further than the ligamentary bands.

These portions of the colon which are immediately
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covered by the ligamentary bands, are smooth and without rugæ; and therefore, if these bands alone are cut across, the intestine is not elongated sufficiently to destroy all the folds and cells.

The common coat on one side is a continuation of the mesocolon, and on the other side it contributes, by the same continuation, to form the omentum. The longitudinal fibres of the muscular-coat are very slender; and those which answer to the annular or circular fibres of the small intestines, are only segments stretched over the eminences and folds. The other coats are nearly as in the cæcum; only the glandular lacunæ or solitary glands are broader and more numerous.

The arch of the colon begins under the right kidney, near the haunch. It runs up on the fore-side of that kidney to which it is connected; passes under the vesicula fellis, which tinges it with a yellow colour at that place; and continues its course before the first incurvation of the duodenum, to which it adheres, and partly hides it. In this part of its course, therefore, there is a remarkable connection between the colon, duodenum, right kidney, and vesicula fellis.

From thence the arch of the colon runs before the great convexity of the stomach, and sometimes a little lower; then turns backward under the spleen, in the left hypochondrium; runs down on the fore-side of the left kidney, to which it is connected; below this kidney, turns toward the vertebræ, and terminates there by a double incurvature, or by two opposite convolutions, which represent in some measure an inverted Roman S.

These last convolutions of the colon are sometimes multiplied, and even advance to the right side of the pelvis; and along the great arch, and the two last incurvations, there are a kind of fringes, called *appendices coli adiposæ*, which I shall afterwards explain, as also the connections of the colon with the mesocolon and omentum.

Valvula coli. At the place where the cæcum joins the colon, one portion of the circumference of both is depressed, and forms a large fold on the inside, which advances into the cavity of the intestine. It is a little open in the middle, and its extremities are very thick, by reason of the mutual duplicature of the coats of the cæcum and colon.

The extremity of the ileum is as it were grafted in the opening of this fold, and strongly united to its sides by the adhesion of its transverse fibres to the transverse fibres of the cæcum and colon.

This union forms a pretty thick ring, which likewise advances into the common cavity of the cæcum and colon, where it is wrinkled or formed into gathers, almost like the lower extremity of the œsophagus, the pylorus, or inside of the anus. Its circumference is more or less oval; and, by a kind of continuity with the common fold of the cæcum and colon, it forms two productions, which M. Morgagni calls the *fræna* of the valvula coli.

The membranous coat of the extremity of the ileum is continued on the cæcum and colon, without sinking into any fold at the place where the ileum enters the colon. The longitudinal fibres of the muscular coat seem here to be confounded with the nearest circular fibres of the cæcum and colon.

The inner portion of the muscular coat of the ileum runs in between the circular fibres of the ileum and colon, as into a common fold of these two intestines; from all which a pretty thick short portion of a fleshy tube is formed, which is the circular rising already mentioned.

The tunica nervosa and villosa of the extremity of the ileum likewise enter the common cavity of the cæcum and colon, and on the edge of the circular rising join the like coats of these two intestines; so that the circular rising or short muscular tube is covered both on the outer and inner sides by a nervous and villous coat; that

that on the inside being supplied by the ileum, and the other by the two great intestines.

The situation of this extremity of the ileum is most commonly transverse, and is inserted almost in the same direction in the common cavity of the two intestines already mentioned; but it is often a little more inclined toward the cæcum, than to the colon; and whereas in all other places the ileum is wide and easily dilatable, it is very narrow at its insertion, and its sides are more solid and firm.

It is chiefly in this structure that the mechanism of the insertion of the ileum in the cæcum and colon consists; about which insertion or opening, authors are very much divided, some reckoning it a valve, others only a sphincter.

It is very evident, from what I have said, that it is a double machine contrived to hinder the return of the excrements into the ileum, because it can produce this effect partly as a valve, and partly as a kind of sphincter. The dried preparations of this part give a very false idea of its structure and conformation; and the same thing is to be said of the opening of the appendicula vermiformis into the cæcum.

The capacious arch of the colon is connected by both extremities to the regio lumbaris, near the kidneys, by two particular ligaments, one on the right side, the other on the left, which are only small duplicatures of the peritoneum, more or less transverse.

The remaining portion, which forms the two convolutions in form of the Roman S, contracts below the left kidney, being narrower there than lower down. The coats of this portion become gradually thicker and stronger, and likewise the ligamentary bands, which approach each other by degrees, and seem to increase in breadth.

The vessels, nerves, &c. will be found in the description of the mesentery.

§ 8. *Intestinum rectum, and Anus.*

Situation, figure, and size of the rectum. The last of all the intestines is named *rectum*, or the *straight gut*, from its situation; for, when viewed directly forward, it appears to run down in a straight course from the last vertebra of the loins, on the foreside of the os sacrum, all the way to the os coccygis, where it ends in what is called the *anus*.

This intestine, properly speaking, is a true continuation of the last convolution of the colon; and it is the repository, sink, and common sewer of the whole intestinal canal. It has likewise a special relation to the bladder, and to the parts of generation in both sexes.

The rectum having passed below the last vertebra of the loins, to the inside of the os sacrum, is bent backward, on that concave side, to which it is connected, in the manner that shall be afterwards explained; and having reached the os coccygis, it runs likewise in the direction of that bone, and bends a little forward, terminating beyond the extremity of the coccyx.

The figure of this intestine varies according as it is full or empty. When empty, it is irregularly cylindrical, and sinks in by a kind of transverse folds; and in that state, it is about three fingers breadth in diameter more or less. When full, it is wider in proportion to the quantity of fæces, wind, or whatever else is contained in it; and it may be extended to the size of a large bladder, so as to represent a kind of stomach.

Structure of the rectum. The membranous coat often contains a great quantity of fat, spread between it and the muscular coat, and forming round the intestine numerous eminences, in the room of the appendices adiposæ of the colon, which shall be explained in the history of the omentum.

The muscular or fleshy coat is very thick; and the longitudinal fibres, which in the other intestines are very thin,

thin, are in this stronger than the circular fibres of the rest. The ligamentary bands continue to increase in breadth, and to approach each other, as has been said; and it is to the fleshy fibres of these bands, that the thickness of the longitudinal fibres seems to be owing.

The nervous or filamentous and internal coats, are larger here than in the other intestines; and when the rectum is empty, they form a great number of waving rugæ in its cavity, which disappear in proportion as that cavity is filled.

The innermost coat is very improperly termed *villosa*, and scarce deserves the name of *papillaris*, because of the smallness of the little corpuscles spread on its surface. It contains a great number of single or solitary glands; and it is always moistened by a mucus of different consistences, discharged by these glands or folliculi, and perhaps by the corpuscles also.

Near the extremity of this intestine the rugæ or folds become in a manner longitudinal; and at last, towards the circumference of the inner margin of the anus, they form little bags or semilunar lacunæ, the openings of which are turned upward, toward the cavity of the intestine. These lacunæ are something like those at the lower extremity of the œsophagus, or upper orifice of the stomach.

Muscles of the anus. At length the extremity of the rectum contracts, and terminates by a narrow orifice called the *anus*, the sides of which are disposed in close folds or gathers. This extremity of the intestine has several muscles belonging to it, some of which surround it like sphincters; the rest are broad fleshy planes inserted in it, and which, being likewise fixed to other parts, sustain it in its natural situation, and restore it to that situation after being disturbed by the force necessary for the exclusion of the fæces. These latter muscles are termed *levatori ani*, the first go by the general name of *sphincters*.

These sphincters are three in number, one intestinal or orbicular, and two cutaneous or oval; whereof one is large, superior, and internal; the other small, inferior, and external.

The intestinal or orbicular sphincter of the anus, consists merely in an augmentation of the inferior portion of the fleshy fibres of the extremity of the rectum.

In the description of the fresh bones, I omitted two ligaments, one called *ligamentum cutaneum ossis coccygis*, the other *ligamentum pubis interosseum*. These two ligaments must be here described, before I proceed to the cutaneous sphincters.

The cutaneous ligament goes out anteriorly, from the extremity of the os coccygis. It is very slender, and divides into two portions at the orifice of the anus, which run into the membrana adiposa, and are inserted in the skin on each side of the anus, by a kind of expansion, and, continuing to devaricate, they are lost on the two sides of the perinæum.

The interosseous ligament of the ossa pubis is a very strong triangular membrane, fixed by two of its edges in the inferior rami of these bones, all the way up to their common symphysis. The third edge, which is the lowest, is loose; and this whole membrane, the middle of which is perforated by a particular hole, is stretched very tight between the two bones, and under their cartilaginous arch, to which it adheres very closely.

At the lower part of this interosseous ligament, along its whole lower or loose edge, lies a digastric muscle, fixed by its two extremities in the rami of the ossa pubis, its middle tendon lying on the middle of the edge of the ligament. The description of that muscle does not belong to this place; and I mention it here only because of the relation it bears to the cutaneous sphincters of the anus. It is called by some, *musculus transversalis perinei*; by others, *musculus triangularis*.

The cutaneous sphincters have each an anterior and

posterior insertion, ending both ways in a kind of point, and comprehending the orifice of the anus between their middle portions.

They are distinguished from each other by their situation, by their size, and by a kind of white cellular line. The greatest of the two appears to be double; and the smallest lies nearest the skin, and adheres most closely to it.

They are inserted backward, partly in the apex of the os coccygis, and partly in the contiguous portion of the cutaneous ligament of that bone. Forward their chief insertion is in the middle tendon of the transversalis urethrae; and they have likewise some connections to other muscles of the urethra, of which hereafter.

The levatores ani are broad, thin, muscular portions, fixed by one extremity of their fleshy fibres round the concave side of the inferior portion of the pelvis, from the symphysis of the ossa pubis, beyond the spine of the ischium. The other extremity of these fibres runs down on each side behind, and under the curvature of the end of the rectum, where they meet together, and unite from the basis of the os coccygis all the way to the margin of the anus.

By their superior insertions, these portions are on each side of the pelvis divided into three classes, an anterior, middle, and posterior class. The two anterior classes reach from about the middle of the symphysis of the ossa pubis, to the upper border of the foramina ovalia of the pelvis. The middle classes continue the same course immediately above the insertion of the obturator internus, on the ossa ischium, and a little on the ossa ilium. The posterior classes are spread on the inner sides of the ossa ischium to the spinal apophyses of these bones, and even a little beyond these, on the ligamenta sacro-sciatica.

The anterior portions are in their passage connected to the prostate glands, to the neck of the bladder, to the

the bulb of the urethra, as shall be shown in the description of those parts; and they sometimes send fibres to the musculus transversalis urethræ abovementioned.

The fibres of all these portions having by their superior insertions formed this large and ample circumference, run down obliquely from before backward, contracting in breadth, and approaching each other in the manner of truncated radii; and behind, and under the extremity of the rectum, they form a digastric muscle, something like the mylo-hyoidæus; which terminates the bony pelvis below, and forms the bottom of the cavity of the abdomen, as the diaphragm forms the upper part.

Here we ought to remark, that the margin or edge of the anus is formed by the union of the skin and epidermis with the internal coat of the rectum; so that the most superficial portion of that coat seems to be a continuation of the epidermis.

I refer the arteries, veins, nerves, connections, uses, &c. to the place already mentioned in the description of the other intestines.

§ 9. *Mesenterium et Mesocolon.*

Division of the mesentery, &c. This great bundle of intestines is not left to move at random in the cavity of the abdomen; but artfully bound down by a membranous web, which prevents the intestinal convolutions from being intangled in each other, and from being twisted or compressed in all their different ways of meeting; and yet allows them a gentle floating, but limited motion.

This web goes still by the ancient Greek name of *mesentery*, as being in some measure in the middle of the intestines. It is distinguished into two portions, one of which being very broad and very much plaited, connects the small intestines; the other, which is

long and incurvated, does the same office to the great intestines.

These two portions are in reality only one and the same continuation of the membranous lamina of the peritonæum doubled back upon itself, and they are distinguished only by their breadth. Taken both together, they form a kind of spiral roll, more or less plaited in its circumference. The first portion has retained the name of *mesentery*, the other is termed *mesocolon*.

Structure of the mesentery, &c. The mesentery begins at the last incurvation of the duodenum, and runs obliquely from left to right, along the vertebræ of the loins. In this space, the membranous portion of the peritonæum is detached on both hands, produces a duplicature by two elongations or particular laminæ applied to each other, and thus forms the mesentery.

It is narrow at its upper and lower parts, but chiefly at the upper. The middle portion is very broad, and the edge of it next the intestines is every where very much plaited. These plaits or folds are only waving inflexions, such as may be observed in the edge of a piece of shamoy which has been often drawn through the fingers. They make this edge of the mesentery very long, and they run through about one third of its breadth.

The two laminæ are joined together by a cellular substance, which contains glands, vessels, and nerves; that shall be described hereafter; and in some subjects it has a great quantity of fat, which keeps the two laminæ at a good distance from each other.

Along the whole circumference of the mesentery, the two laminæ are naturally separated, and applied to the two sides of the small intestines which they invest by their union or rather reciprocal continuation on the great curvature of that canal, and carry it as in a scarf or sling. This is what forms the external or membranous coat of the intestines.

The mesocolon is the continuation of the mesentery,
which

which having reached the extremity of the ileum, contracts and changes its name. At this place, the particular lamina which is turned to the right side, forms a small transverse fold, called *ligamentum coli dextrum*.

Afterwards the mesocolon ascends toward the right kidney, where it seems to be lost by the immediate adhesion of the colon to that kidney, and to the first incurvation of the duodenum. Then it appears again, and increasing in breadth, it continues its course almost transversely under the liver, stomach, and spleen, where it begins to turn downward, under the left hypochondrium, toward the kidney on the same side.

Through this whole course the mesocolon extends in breadth, and forms nearly a transverse semicircular plane, very little plaited at its great circumference. By this circumference or edge, it is connected to the colon, and hides that ligamentary band of this intestine, which runs along its small curvature. By its short or small edge, it forms the triangular case of the duodenum; and, by its great edge, the external coat of the colon, in the same manner as the mesentery does that of the small intestines. As it passes under the large extremity of the stomach, it adheres a little to the lower portion of that extremity, as the diaphragm does to the upper.

Having got below the left kidney, it contracts, and forms another transverse fold, called *ligamentum coli sinistrum*. Afterwards it expands again, but not so much as in the upper part; and runs down on the left psoas muscle, toward the last vertebræ of the loins. This descending portion is fixed to their convolutions of the colon, in the same manner as the superior portion is to the arch of that intestine.

The intestinum rectum is likewise invested by a particular production of the peritonæum, called commonly by the barbarous name of *meso-rectum*. This production is very narrow; and about the middle of the fore-side of the rectum, it forms a transverse semicircular fold,

which appears when the intestine is empty, but is lost when it is filled.

Between the laminæ of the mesentery, a great number of glands lie scattered through the cellular substance. In the natural state, these glands are something of the figure of lentils or little round beans, some of them being orbicular, others oval, but all of them a little flattened, and in corpulent subjects we find them surrounded with fat.

These glands are of the number of those that anatomists call *glandula conglobata*, the structure of which is not as yet sufficiently known. They seem to be of a cellular substance, surrounded by a very fine membrane or coat, on which, by the help of microscopes, we discover an intertexture, of particular filaments, which Malpighi believed to be fleshy fibres.

The nicest anatomical injections have not hitherto given us any satisfaction about these particulars: for though they be made with all possible care, they always fill the folliculous texture of these glands; and though by means of these injections we may discover a great many vessels, which were before invisible, we are not a whit the nearer our purpose, because we cannot by this method distinguish the secretory, excretory, and blood-vessels from each other.

Besides the blood-vessels, which are distributed in a reticular manner in the mesenteric glands, and besides many nervous filaments spread through them, we discover an infinite number of small vessels of another kind, running from gland to gland.

These vessels are extremely thin and transparent, and furnished on the inside with numerous valves, which appear on the outside like little small knots very near each other. They go out from each gland by ramifications, as by so many roots; and having formed a small trunk, they are again divided, and enter some neighbouring gland by the same kind of ramifications by which they went out from the former,

Lacteal vessels. These are termed *lymphatic vessels*, because for the most part they contain a very clear, limpid, though mucilaginous serum, called *lymph* by anatomists. But as they have likewise been observed to be filled with a white milky fluid, called *chyle*, they have been called *vasa chylofera*, or *venæ lacteæ*. They have the name of *veins*, because their valves are disposed as those of the ordinary blood-veins, and because the fluid which they contain runs from smaller into larger tubes: But the particular description of these will come in more properly in a latter part of the work.

§ II. *The Blood-vessels and Nerves of the Intestines.*

Blood-vessels of the intestines. The duodenum has commonly a particular artery called *duodenalis* or *intestinalis*, which comes indifferently from the *stomachica coronaria*, *pylorica*, *gastrica major*, or *hepatica*. It has likewise several distinct ramifications from these trunks, and from the *mesenterica superior* and *splénica*, which ramifications communicate with each other.

The *arteria duodenalis*, and the other additional small arteries, form a vascular net-work round the muscular coat of the intestine, which sends out a great number of capillaries toward both the outer and inner sides, that make the whole intestine look of a red colour.

The veins of the duodenum are *ramæ* of the *vena portæ*, and the distribution and denomination thereof is pretty much the same with that of the arteries; only they communicate more with each other than the arteries, and also with the great hæmorrhoidal vein.

The venal ramifications form round the duodenum a net-work like that of the arteries; and the same kind of vascular texture is more or less to be found in all the other intestines.

The arteries of the jejunum come chiefly from the

mesenterica superior, and some from the ascending branch of the mesenterica inferior. The veins are for the most part branches of the great meseraica; and the rest come from the splenica and small meseraica or hæmorrhoidalis interna.

The principal subaltern trunks of these arteries and veins accompany each other through the cellular substance between the laminæ of the mesentery; are distributed by branches and rami; and form the meshes, lozenges, and arches, mentioned in the description of the arteries and veins. The last of these arches and lozenges, or those next to the intestine, produce two small vascular planes, which separate from each other very distinctly, and surround the intestinal canal in a reticular manner.

The blood-vessels of the ileum come from the same sources with those of the jejunum, as has been said in the history of the arteries and veins; and it ought to be observed concerning both these vessels, and those of the jejunum, that in their whole course through the mesentery, they give ramifications to the glands, laminæ, and cellular substance of the mesentery; and also that there is a kind of communication between several small meseraic veins, and the capillary rami of the venæ lumbares and spermaticæ.

The arteries of the cæcum and appendicula vermiformis, are ramifications of the last branch from the convex side of the mesenterica superior; and they have likewise some small ones from the second and third branches, when both are found. The veins of these two parts are ramifications of the great meseraica, and one of these rami is by Riolan termed *vena cæcalis*.

The straight portion of the arch of the colon, or that which is an immediate continuation of the cæcum, is supplied with arteries by the second branch that comes from the concave side of the mesenterica superior, and likewise a little by the third, when there is a third.

The superior or middle portion of the arch of the colon,

lon, is furnished by the first branch from the same side of the mesenterica superior, which by a bifurcation communicates on both hands with the other portions of the arch of the colon.

The left portion of this arch derives its arteries partly from the first branch of the same mesenterica, and partly from that of the mesenterica inferior; which two branches form the celebrated communication or common arch of the two mesentericæ.

By means of this communication or continuation, in case one artery should be obstructed or compressed, the other would furnish blood to all the branches below the place of the obstruction. The second branch of the mesenterica inferior gives likewise small arteries to the left extremity of the colon.

The descending convolutions of the colon, which represent a Roman S, are supplied by the other branches of the mesenterica inferior; the last of which forms the hæmorrhoidalis interna.

The veins of all these portions of the colon are branches and ramifications of the vena portæ ventralis, and principally of the subaltern trunks, the meseraica major, and meseraica minor or hæmorrhoidalis interna. The distribution of these branches and ramifications is in some measure the same with that of the arteries, as may be seen in the description of the veins.

The arteries of the rectum are furnished by the hæmorrhoidalis interna, the last branch of the mesenterica inferior, which communicates with the hypogastricæ, and particularly with the hæmorrhoidalis externa, a production of one of these arteries.

The veins of the rectum are ramifications of the last branches of the meseraica minor or hæmorrhoidalis interna; and they communicate with the hæmorrhoidales externæ, which are rami of one of the hypogastricæ. They communicate likewise with the capillary ramifications of the other hypogastric veins, which go to the internal parts of generation of both sexes.

It is here to be observed in general, that there is a successive continuation, more or less simple or multiplied, between all the arteries of the intestinal canal, and likewise between all the veins; and also that the veins are here thinner and more capacious than the arteries, in a greater proportion than in the other parts of the body.

Nerves of the intestines. The nerves of the duodenum are the middle plexus of the semilunar ganglion, and some filaments of the plexus stomachicus and hepaticus.

The nerves of the jejunum, ileum, and mesenteric glands, are the plexus mesentericus superior, the posterior mesenteric fasciculi, and the plexus mesentericus inferior.

The nerves of the cæcum are the posterior mesenteric fasciculi or plexus, and the plexus mesentericus inferior.

The nerves of the arch of the colon are the same fasciculi, and the two plexus mesenterici.

The nerves of the last convolutions of the colon are the posterior mesenteric fasciculi, and the plexus mesentericus inferior and sub-mesentericus.

The nerves of the rectum are the plexus mesentericus inferior, plexus sub-mesentericus or hypogastricus, and the two ganglions of that plexus.

The nerves of the anus, and of its muscles, are the ganglions of the plexus sub-mesentericus, the inferior rope of both sympathetici maximi, and the common arch of the extremities of both ropes.

Before I proceed to the liver, it must be remarked, that the omentum and appendices adiposæ have so near a relation to the liver and spleen, that it is impossible to describe them without mentioning several things belonging to these two viscera; and therefore I think it more proper to give the history of these after that of the other two, and even of the pancreas, than to begin the history of the parts contained in the cavity of the

the abdomen by that of the omentum, as is commonly done.

For the same reason, I shall not give the uses of these parts till after they have been all explained; and together with these uses, I shall speak to those of the intestinal canal, mesentery, vasa lactea, mesenteric glands, muscles of the anus, &c.

§ 12. *Hepar, and Vescula Fellis.*

Situation, figure, and division, of the liver. The liver is a large and pretty solid mass, of a dark red colour, a little inclined to yellow, situated immediately under the arch of the diaphragm, partly in the right hypochondrium, which it fills almost entirely, and partly in the epigastrium, between the appendix ensiformis and spina dorsi, and terminating commonly in the left hypochondrium, into which it sometimes runs a considerable way.

The figure of the liver is irregular, it being arched or convex on the upper part, unequally concave on the lower, and very thick on the right and back sides. Towards the left and anterior sides, its thickness decreases very much, and terminates there by a kind of edge; and it is broader from right to left than from before backwards.

The liver may be divided into two extremities, one great, the other small; two edges, one anterior, and one posterior; two sides, one superior and convex, which is smooth, polished, and proportioned to the arch of the diaphragm, and one inferior, concave and uneven, with several eminences and depressions; of which hereafter.

It may likewise be divided into two lateral parts, called *lobes*; one of which is termed the *great* or *right lobe*, the other the *small* or *left lobe*. These two lobes are distinguished above by a membranous ligament, and

and below, very plainly, by a considerable scissure, lying in the same direction with the superior ligament.

The eminences on the concave side of the liver belong to the great lobe. The principal eminence is a sort of triangular or pyramidal apophysis, situated backward near the great scissure which distinguishes the two lobes.

This triangular eminence is termed *lobulus Spigelii*, or simply the small lobe of the liver. One of its angles advances a considerable way toward the middle of the lower side of the great lobe, and is lost there. This angle I call the *root* of the lobulus. Toward the fore-side there is another eminence less prominent, but broader; and to this eminence, and the former, the ancients gave the general name of *portæ*.

The depressions on the concave or lower side of the liver, which deserve our attention, are four in number. The first is the scissure that separates the two lobes, which runs across the concave side, from the eminences already mentioned, to the anterior edge, where it terminates by a notch of different depths in different subjects. This is termed the *great scissure* of the liver; and in some subjects part of it is an entire tube. The second depression is situated transversely between the two eminences of the great lobe, and filled by the sinus of the *vena portæ*, so called by the ancients because it lies between the eminences of the same name. The third depression is backward between the great lobe and lobulus spigelii, and the vena cava passes through it. The fourth is a kind of sulcus between the lobulus and small lobe of the liver, which in the foetus served to receive a venal canal lost in adults, in whom it appears only as a kind of ligament. This sulcus is in some measure a continuation of the great scissure, and joins the vena cava by an acute angle.

Besides these four depressions, there is one on the fore-part of the great lobe, in which the vesicula fellea is lodged; and it sometimes runs as far as the edge, where

where it forms a small notch. We may likewise reckon among these depressions a small superficial cavity in the posterior and lateral part of the lower side of the of the great lobe, by which it rests on the right kidney; and likewise a superficial cavity in the left lobe, where it runs over the stomach.

Lastly, on the posterior edge of the liver, there is a preat sinus common to both lobes, which gives passage to the spina dorfi and œsophagus, near the place where the vena cava descends; and we sometimes meet with scissures on both sides of the liver, which are not ordinary.

Ligaments of the liver. The convex side of the liver is commonly connected to the diaphragm by three ligaments, which are only continuations of the membranous lamina of the peritonæum. One lies near the edge of the extremity of each lobe, and one in the middle; and they are accordingly termed the *right*, *middle*, and *left ligaments*. There is a cellular substance in the duplicature of each, in which the blood-vessels and lymphatics run, and which sends off a kind of lamina into the substance of the liver.

The right ligament sometimes connects the great lobe to the cartilages of the false ribs; and the left ligament, or that of the small lobe, is often double, and advances toward the middle ligament. This middle ligament begins below in the great scissure of the liver, near the eminences called *portæ*; and from thence passes through the anterior notch, and over the convex side of the liver at the union of the two lobes, and is fixed obliquely in the diaphragm.

It is likewise fixed along the upper and inner part of the vagina of the right musculus rectus of the abdomen, in such an oblique manner as to be nearer the linea alba below than above.

Besides these ligaments, the great lobe of the liver is likewise connected to the right ala of the tendinous portion of the diaphragm, not by a ligament, but by

a broad and immediate adhesion, without the intervention of the membrane of the peritonæum, which is only folded quite round this adhesion, to form the external membrane of all the rest of the body of the liver.

This broad adhesion is commonly, though improperly, called *ligamentum coronarium*: but in the first place it is not a ligament, as has been already observed; and, secondly, it is not circular, but oval and very oblong.

It is not on the upper part of the convex side of the liver, but along the posterior part of the great lobe; the broad extremity of the adhesion lying nearer the notch, and the pointed extremity towards the right hypochondrium.

The middle ligament, called improperly *ligamentum hepatis suspensorium*, contains in its duplicature a thick white rope, like a round ligament, which was the umbilical vein in the fœtus. Thus the lower part represents a falx; the convex edge of which is sharp, and the other rounded.

All these ligaments serve to keep the liver in its proper situation, and to hinder it from inclining too much towards either side: but we must not imagine that any of them serve to suspend it; because it is sufficiently supported by the stomach and intestines, especially when they are filled.

When the stomach is empty, or when we fast longer than ordinary, it is a common expression to say the stomach pinches us. As the liver is not then sustained by the stomach and intestines, it descends by its own weight, and, chiefly by means of the middle ligament, pulls the diaphragm along with it. It is in that place, therefore, that we have this uneasy sensation; and not at the superior orifice of the stomach, as is commonly believed.

The right or great lobe of the liver, which lies in the right hypochondrium, rests on the right kidney by a small superficial depression above-mentioned; and it like.

likewise covers a portion of the arch of the colon and the pylorus. About two third parts of the small or left lobe lie in the middle of the epigastrium, and the remaining third part advances over the stomach towards the left hypochondrium.

This small lobe is situated almost horizontally; the great lobe is very much inclined, and its thick extremity runs down almost in a perpendicular direction to the right kidney on which it lies, in the manner already said. This observation is of use to distinguish the different parts of the liver in wounds and chirurgical operations.

It may likewise serve to direct us in examining a liver taken out of the body; the situation of which may be otherwise very easily mistaken, especially that of the garts of the concave side. The passage of the vena cava, between the body of the great lobe and the lobulus Spigelii, may likewise serve for a rule in placing a detached liver in its true situation.

Structure of the liver. The liver is composed of several kinds of vessels; the ramifications of which are multiplied in an astonishing manner, and form, by the intertexture of their capillary extremities, an innumerable collection of small pulpy friable corpuscles, which are looked upon to be so many organs designed to separate from the mass of blood a particular fluid, termed the *bile*.

The greatest part of these vessels, from one end to the other, is included in a membranous vagina, called *capsula venæ portæ*, or *capsula Glissoni*, from an English author who first described it particularly.

The vessel which carries the blood to the liver is called *vena portæ*, for the reason already given. In the description of the veins, I observed that the vena portæ might be considered as two large veins, the trunks of which are joined endwise, and send out branches and ramifications in opposite directions to each other; that one of these veins is ramified in the liver, the other lying

ing without the liver, and sending its branches and ramifications to the viscera of the abdomen; and, lastly, that the first of these large veins may be termed *vena portæ hepatica*, the other *vena portæ ventralis*.

Vena portæ hepatica. The particular trunk of the *vena portæ hepatica* is situated transversely between the broad anterior eminence of the great lobe of the liver and the root of the lobulus in a particular scissure, and forms what is called the *sinus of the vena portæ*. From this sinus five principal branches go out, which are afterwards divided into millions of ramifications through the whole substance of the liver.

At this place the *vena portæ* lays down the common office of a vein, and becomes a kind of artery as it enters, and is again ramified in the liver. The extremities of all these ramifications of the trunk of the *vena portæ hepatica* end in the pulpy friable corpuscles, which seem to be thick villous folliculi when examined thro' a microscope in clear water.

Pori bilarii et ductus hepaticus. It is in these folliculi that the bile is secreted; and it is immediately collected in the same number of extremities of another kind of vessels, which unite, by numerous ramifications, into one common trunk. These ramifications are termed *pori bilarii*, and the trunk *ductus hepaticus*; and the ramifications of these two kinds of vessels are invested together by the capsula of the *vena portæ*.

Hepatic veins. The blood deprived of this bilious fluid is reconveyed to the heart by a great number of venal ramifications, which afterwards unite into three principal branches, besides others that are less considerable; that terminate in the *vena cava*, and are all called by the name of *vena hepatica*.

The capillary extremities of the ramifications of the *vena cava*, join those of the *vena portæ*, and accompany them through the liver; and yet the great branches of both veins intersect each other in several places.

When we cut the liver in slices, it is easy to distinguish in each slice the ramifications of the vena cava from those of the vena portæ; the first being thinnest and largest, and adhering closest to the substance of the liver; whereas those of the vena portæ, which are invested by the cellular capsula, appear to be a little ruffled when empty; because the cellular capsula subsides when it is cut, but the other veins remain uniformly open, their sides adhering to the substance of the liver.

Hepatic artery and nerves. The liver receives from the arteria cæliaca a particular branch, termed *arteria hepatica*; which being very small when compared with the bulk of that viscus, seems designed only for the nourishment thereof, and not for the secretion of the bile. The plexus hepaticus, formed by the nervi sympathetici maximi et medii, furnishes a great number of nerves to the substance of the liver. The ramifications of the artery and nervous plexus are included in the cellular capsula, together with those of the vena portæ and pori bilarii.

The pulsation of this artery has been by some anatomists taken for that of the capsula; and by this they have endeavoured to explain the arterial function of the vena portæ: but they have not considered, that the blood in this vein does not require to be pumped forward; because so swift a motion would have been prejudicial to the secretion of the fine oil of the bile, for which a slow and almost insensible motion is necessary.

The liver is covered exteriorly by a particular membrane or coat, which is a continuation of the peritonæum. There is likewise a membranous or filamentary substance that runs through this whole viscus, and connects the ramifications and extremities of all its vessels to each other. This substance seems to be a complicated production of the capsula of the vena portæ, and of the external membrane of the liver.

The outer surface of this coat is very smooth, but its inner surface is uneven, being made up of a great

number of thin membranous laminæ ; between which we observe, very distinctly, numerous lymphatic vessels, on both the convex and concave sides of the liver ; but it is more difficult to trace those which accompany the filamentary substance through that viscus.

I have already observed, that the substance of the liver is chiefly made up of an infinite number of pulpy friable corpuscles ; each of which is bounded, and in a manner surrounded, by a particular expansion of the capsula Glissoni ; and all these expansions are connected by common septa, in some measure resembling a beehive.

These corpuscles have several angles, especially in the inner surface of the liver ; but near the surface they are raised in the form of small tubercles. Their pulpy texture appears like radiated villi, a small void space being left in the middle of each.

If we blow through a pipe into the vena portæ, vena cava, arteria hepatica, or trunk of the pori bilarii, but especially through the two veins, we observe the liver to swell, and the corpuscles near the surface are raised, and become more sensible. If we blow with much force, we burst these corpuscles ; and the air getting between them and the external membrane, raises it from the substance of the liver in blisters.

Ductus cholidochus. The ductus hepaticus, or trunk of the pori bilarii, having run a little way, joins another canal, called *ductus cysticus* or *vesicularis* ; because it comes from the vesicula fellis, as we shall see in the description of that organ. These two united ducts form a common trunk, named *ductus cholidochus* ; because it conveys the bile. This duct having reached the incurvation of the duodenum, insinuates itself thro' the coats of that intestine, and opens into the cavity thereof, not by a round papilla, but by an oblong orifice rounded at the upper part, and contracted at the lower like the spout of an ewer, or like a common tooth-picker.

The

The edges of this orifice are raised, broad, and plaited, as we may see by making this portion of the duodenum swim in clear water. At the entry of this orifice we see another small opening distinct from it, which is the orifice of the ductus pancreaticus ; of which hereafter.

Vesicula fellis. The gall-bladder is a kind of small bag, shaped like a pear ; that is, narrow at one end, and wide at the other. The wide extremity is termed the *fundus* or *bottom*, the narrow extremity the *neck*, and the middle portion the *body*. About one third of the body of the vesicula lies in a depression on the concave side of the liver, from the trunk or sinus of the vena portæ, where the neck is situated, to the anterior edge of the great lobe, a little toward the right side, where the bottom is placed ; and in some subjects it advances beyond the edge.

Therefore when we stand, the vesicula fellis lies in a plane inclined a little from behind forward. When we lie upon the back, it is almost inverted. When we lie on the right side the bottom is turned downward, and it is turned upward when we lie on the left side ; and these situations vary according to the different degrees of each posture.

The gall-bladder is composed of several coats ; the outermost of which is a continuation of that which invests the liver, and consequently of the peritoneum.

The second coat is said by some to be fleshy, and made up of two strata ; one longitudinal, the other transverse, “ like that of the stomach or intestines ; but excepting in some very robust subjects, there are scarcely any muscular fibres to be seen.”

A whitish stratum is looked upon as the third coat of the gall-bladder, answering to the tunica nervosa of the intestines.

The innermost, or fourth coat, has on the inside a great number of reticular folds, filled with small lacunæ, like perforated papillæ, especially near the neck of the

vesicula, where these folds are longitudinal, and afterwards form a kind of small pylorus, with plaits of the same nature with those in the great one. These lacunæ are looked upon to be glands.

That side of the body of the vesicula which lies next the liver is connected to that viscus by a vast number of filaments, which run a great way into the substance of the liver. "Among these fibres, in some animals," ducts have been observed a long time ago. They are most numerous near the neck of the vesicula; and they are named *ductus cysto-hepatici*, or *hepatico-cystici*: "but no such ducts can be demonstrated in the human body."

The neck of the vesicula is formed by the contraction of the small extremity; and this neck bending afterwards in a particular manner, produces a narrow canal, named *ductus cysticus*. This incurvation represents, in some measure, the head of a bird, of which the cystic duct, by the gradual diminution of its diameter, expresses the beak. This cannot be seen when the liver is *extra situm*; and even *in situ* it is but very imperfectly seen, when, in order to view the concave side, the liver is raised and thrust too much against the diaphragm; for by thus inverting the liver, the curvature is disordered, and we see two in the place of one.

To see this curvature in its true natural situation, the liver is to be raised but very little, and the duodenum left untouched; then we must stoop and look under the liver, without disordering any thing. This incurvation may be of use to hinder too precipitate a discharge of the bile contained in the vesicula, which some situations of the body might occasion.

The neck of the vesicula is nearly of the same structure with the other parts. It has on the inside several reticular rugæ and some folds, which appear like fragments of *valvulæ conniventes*, situated very near each other, from the neck to the contraction of the cystic duct. The first of these folds is pretty broad and large,
and

and almost circular; the next is more oblique and smaller in size, and the rest diminish in the same manner. Taken all together, they form a kind of spiral flight, which may be seen through the neck on the outside, where it sometimes appears like a screw, especially when the neck is filled with any fluid. This observation is owing to M. Heister.

By slitting the neck and duct, we see all these folds very distinctly, especially when we examine them in clear water. When they are viewed in any other manner, they easily deceive us, being mistaken for true valves, because of their transverse situation. They may, however, in some measure, supply the place of valves, by hindering the bile from running too fast into the duodenum, and the contents of the duodenum from entering this duct.

The internal surface of all these biliary ducts, that is, of the ductus hepaticus, cysticus, and cholidochus, being examined through a microscope in clear water, appears to be nearly of the same structure through their whole extent.

The cystic and hepatic ducts do not, in their ordinary and natural situation, represent the capital Y of the Greeks, where they form the ductus cholidochus. After the incurvation of the neck of the vesicula, these two ducts run very near each other, and they appear to be separated only by raising up the liver to view them. The same disorder happens in an inverted liver extra situm; for then the body of the liver subsides, and is flattened, and thereby separates the ducts; whereas, in its true situation, it is very much incurvated, and the ducts very near each other.

The ductus cholidochus appears rather to be a continuation of the ductus cysticus than the common trunk of that and of the ductus hepaticus: for I have observed, that this last duct runs for some space within the sides of the former, before it opens into the cavity; much in the same manner as the ductus cholidochus

passes into the duodenum. I have likewise observed, at the opening of the hepatic into the cystic duct, a small loose valvular membrane, which may hinder the bile from returning out of the ductus cholidochus into the hepaticus.

The bile, which passes through the ductus hepaticus into the cholidochus, may be called *hepatic*; and that which is collected in the vesicula fellis, may be termed *cystic*. The hepatic bile flows continually through the ductus cholidochus into the duodenum; whereas the cystic bile flows only by reason of plenitude or by compression.

Remarks on the vessels, &c. of the liver. The trunk of the vena portæ ventralis terminates between the lobulus and the opposite part of the great lobe; and there joins the trunk of the vena portæ hepatica in the transverse sinus of the liver, between the right extremity and the middle of that sinus.

The umbilical ligament, and consequently the umbilical vein in the foetus, joins the trunk of the vena portæ hepatica toward the left extremity of the transverse sinus of the liver. The canalis venosus in man is not exactly opposite the vena umbilicalis, but a little to the right hand; and therefore these three vessels lie in such a direction as to form two opposite angles, resembling those of the handle of a wheel or of a spit.

In the foetus, therefore, the blood which comes from the umbilical vein does not run directly through that contained in the vena portæ hepatica in the sinus, and from thence into the canalis venosus; but is obliged to turn from left to right, and so to mix with the blood in the vena portæ, before it enters that canal which opens into the trunk of one of the great hepatic veins of the vena cava near the diaphragm.

The hepatic vena portæ gives off commonly five large branches into the liver, viz. three from its right extremity into the great lobe, and two from its left extremity into the small lobe; and from the interstice between

tween these, a small branch goes directly to the middle of the convex side of the liver.

The hepatic veins are commonly three large branches of the trunk of the vena cava inferior, which go out from it by one common opening, especially two of them; and then separating, they enter the substance of the liver, intersecting the branches of the hepatic vena portæ, and are ramified in all directions in the manner already explained. The inferior portion of the opening of these veins into the vena cava, forms a kind of semilunar valve.

Below these hepatic veins, the vena cava inferior sends off, in its passage by the liver, several other small hepatic veins immediately from the trunk, which seem to have the same relation to the hepatic artery as the great veins to the vena portæ.

The passage of the vena cava is through the right portion of the posterior sinus of the liver, and consequently on the side of the great lobe, which is hollowed at this place sufficiently to give passage to the vein, of which it surrounds about three fourths, sometimes more, and sometimes the whole.

This passage answers to the interstice between the lobulus and the rest of the great lobe; and its direction is, in the natural state, from above downward, and a little from right to left: but when the liver is viewed extra situm, and inverted, it appears very oblique; but still it serves as a guide to beginners, who are very apt to be mistaken in examining an inverted liver, as I have already observed.

The trunk of the great vena portæ, the hepatic arteries, the ductus hepaticus, or trunk of the pori bilarii, and the nerves of the plexus hepaticus, form all together a large bundle before they enter the liver. The trunk of the hepatic vena portæ is in the middle of this bundle; the hepatic arteries lie on the right and left sides of this trunk, the nerves surround it on all

sides, and they communicate with the plexus mesentericus superior.

Afterwards the first branches of the arteries, nerves, and pori bilarii, leave the trunk of the great vein, and join in the same manner the trunk of the small or hepatic vena portæ, and its ramifications in the capsula Glissoni explained above.

All these branches of the vena portæ, and of the arteries, nerves, and pori bilarii, accompany each other by ramifications through the whole substance of the liver, forming every where small fasciculi, in the same manner as the large bundles formed by their trunks. Each ramus of the vena portæ, artery, nerve, and porus bilarius, has a proper vagina, and all the four have a common vagina distinguished from the former cellular septa, which are only continuations of the vaginæ of both kinds.

The convex side of the common cellular vagina is connected quite round to the substance of the liver by numerous filaments which arise from it, and which form the cellular substance found between the glandular corpuscles. The concave side produces the cellular septa above-mentioned.

In this common vagina, the vessels, ducts, and nerves, are disposed in such a manner, as that the rami of the vena portæ chiefly fill the cavity of it, and is in a lateral situation: the arterial ramus and porus bilarius lie together on the side of the vein, and the nerve is divided into several filaments, which run in between the vessels and ducts, and chiefly accompany the artery and porus bilarius; the vena portæ having by much the fewest.

The uses of the liver shall be explained after the description of the pancreas, spleen, and omentum, all these viscera having a great relation to the liver.

§ 13. *Pancreas.*

Figure, division, and situation, of the pancreas. The pancreas is a long flat gland, of that kind which anatomists call *conglomerate*, situated under the stomach, between the liver and the spleen. Its figure resembles that of a dog's tongue; and it is divided into two sides, one superior, the other inferior; two edges, one anterior, the other posterior; and two extremities, one large, which represents the basis of a tongue, and one small and a little rounded like the point of a tongue.

The pancreas is situated transversely under the stomach, in the duplicature of the posterior portion of the mesocolon. The large extremity is connected to the first incurvation of the duodenum, and from thence it passes before the rest of that intestine all the way to its last incurvation; so that a great part of the duodenum lies between the pancreas and the vertebræ of the back. The small extremity is fixed to the omentum near the spleen.

Structure of the pancreas. The pancreas is composed of a great number of soft glandular molecularæ, combined in such a manner, as to exhibit the appearance of one uniform mass on the outside, the surface of which is rendered uneven, only by numerous small convexities, more or less flattened. When these molecularæ are separated a little from each other, we find, along the middle of the breadth of the pancreas, a particular duct, in which several smaller ducts terminate laterally on each side, like small rami in a stem.

This canal, named *ductus pancreaticus* or *ductus Virungi*, from the discoverer of it in the human body, is very thin, white, and almost transparent, and the extremity of the trunk opens commonly into the extremity of the ductus cholidochus. From thence it diminishes gradually, and terminates in a point, next the spleen. The small lateral branches are likewise pretty large

large near the trunk, and very small toward the edges of the pancreas, all of them lying in the same plane like the branches of the common filix or fern.

The pancreatic duct is sometimes double in man, one lying above the other. It is not always of an equal length, and sometimes runs in a winding course, but always in the same plane; and it is nearer the lower than the upper side of the pancreas. It pierces the coats of the duodenum, and opens into the ductus cholidochus, commonly a little above the prominent point of the orifice of that canal; and sometimes it opens immediately into the duodenum.

The small pancreas. In man, I observed several years ago, that where the great extremity of the pancreas is connected to the curvature of the duodenum, it sends down an elongation, which adheres very closely to the following portion of the intestine; and, upon a careful examination, I found a particular pancreatic duct ramified like the large one, which ran toward and intersected this great duct, into the extremity of which it opened, after having perforated the duodenum. This portion I term *pancreas minus*; and it sometimes opens separately into the duodenum, in which we likewise observe several small holes round the ductus cholidochus, which answer to the pancreas.

Blood-vessels and nerves of the pancreas. The arteries of the pancreas come from the pylorica, duodenalis, and chiefly from the splenica, which adheres very closely to the whole lower side of the pancreas near the posterior edge, and it sends off in its passage a great many rami named *arteria pancreaticæ*, which go off from each side, more or less transversely. It receives also some small ramifications from the gastrica major, and mesenterica superior.

The pancreatic veins are rami of the splenica, one of the principal branches of the vena portæ major or ventralis. This vena splenica runs likewise along the lower side of the pancreas near the edge, in a shallow depression

sion formed in the substance of the gland. These veins answer to the arteries of the same name ; and there are likewise other small veins corresponding to the small arteries, which are productions of the great meseraica, &c.

The nerves of the pancreas come partly from the plexus hepaticus, partly from the plexus splenicus, and partly from the plexus mesentericus superior, and it likewise receives some from the flat ganglion or plexiform intertexture, mentioned in the description of the nerves, by the name of the *transverse rope*.

The pancreatic duct is not only double in some subjects, as has been said, but the collateral branches have communications in form of islands in several places, within the body of the pancreas. The uses of this viscus shall be explained hereafter.

§ 14. *Lien.*

Situation, division, and figure of the spleen. THE spleen is a bluish mass, something inclined to red, and of a long oval figure, being about seven or eight fingers breadth in length, and four or five in breadth. It is of a softish substance, and is situated in the left hypochondrium, between the great extremity of the stomach, and the neighbouring false ribs, under the edge of the diaphragm, and above the left kidney.

It may be naturally divided into sides, edges, and extremities, as I have always done in my ordinary courses, for these many years past. It has two sides, one external and gently convex, and one internal which is irregularly concave; two extremities, one posterior which is pretty large, and one anterior which is smaller and more depressed; two edges, one superior, and one inferior, on both which there are, in some subjects, several inequalities.

The inner or concave side is divided by a longitudinal

nal groove or scissure, into two planes or half sides, one upper, the other lower; and, by this groove, the vessels and nerves enter in human subjects. The superior half side is broader and more concave than the inferior, being proportioned to the convexity of the great extremity of the stomach. The inferior half side lies backward on the left kidney, and forward on the colon; and sometimes this side of the spleen appears to have two superficial cavities, one answering to the convexity of the stomach, the other to that of the colon. The convex side of the spleen is turned to the left ribs.

It is connected to the stomach by the vessels called *vasa brevia*; to the extremity of the pancreas, by ramifications of the splenic artery and vein; and to the omentum, by ramifications which the same artery and vein send to the spleen, and which run in the longitudinal groove.

It is connected to the edge of the diaphragm by a particular membranous ligament of different breadths in different subjects, fixed in its convex side, sometimes near the upper edge, and sometimes near the lower. This ligament is situated transversely with respect to the whole body, and longitudinally with respect to the size of the spleen. In some subjects, it is connected by other ligaments to the stomach and colon; but in all this there are considerable varieties.

The figure of the spleen is not always regular, and is as various as the size. Sometimes it has considerable scissures both in the sides and edges, and sometimes it has appendices. I have sometimes found a kind of small distinct spleens, more or less round, and connected separately to the omentum, at some distance from the anterior extremity of the ordinary spleen.

Structure of the spleen. The structure of the spleen is not easy to be unfolded in man; and it is very different from that of the spleens of brutes, from which both public and private demonstrations are commonly made.

Its

Its coverings adhere to it so closely in man, that it is difficult to distinguish the common from the proper coat; whereas in some brutes, such as oxen, sheep, &c. nothing is more easy; for in such animals we find two coats separated by a cellular substance. This covering seems to be no otherwise a continuation of the peritonæum than by the intervention of the omentum and mesocolon; and even in man the two coats may be distinguished, where the vessels enter by the longitudinal scissure.

In man, the substance of the spleen is almost wholly vascular, that is, composed of the ramifications of all kinds of vessels. In oxen, the substance of the spleen is chiefly reticular, and in sheep it is cellular. In oxen and sheep, there are no venal ramifications; but instead thereof, only open sinuses disposed like branches, except a small portion of a venal trunk perforated on all sides, at the extremity of the spleen.

In the human spleen, we see something like glandular corpuscles, as in those of other animals; and there are numerous venal ramifications through its whole extent. Between these ramifications we every where observe an appearance of extravasated blood, lying in a kind of filamentary, transparent, and very delicate substance expanded through the whole spleen.

This filamentary substance having surrounded all the ramifications, terminates in almost imperceptible cells which communicate with each other; so that, if we blow through a small hole made in the membranous covering, the whole spleen will immediately be inflated.

The surface of the spleen of oxen and calves is visibly full of a great number of lymphatic vessels, which may at any time be easily demonstrated; but in man it is a very difficult matter either to discover or demonstrate them.

Blood-vessels and nerves of the spleen. The splenic artery, which is one of the principal branches of the cæliaca,

liaca, runs along the lower side of the pancreas, as has been already said, and passes from thence in a winding course to the spleen. The splenic vein, which is larger than the artery, is but little inflected in this part of its course.

This artery and vein having got beyond the extremity of the pancreas, send out several rami together, which immediately afterwards divaricate in the same plane, run in the membranous duplicature of the neighbouring portion of the omentum, and, lastly, intersect each other in their common plane, all the way to the scissure of the inner or concave side of the spleen.

These arterial and venal rami enter the substance of the spleen together by the same scissure; being accompanied by the cellular substance belonging to the membranous duplicature of the omentum. We may likewise observe, that at this place the coat of the spleen sends from its concave side a portion of the lamina, which is incurvated in the scissure, and penetrates into the substance of the spleen.

The nerves of the spleen are very numerous, and come from the plexus splenicus already described. These nerves send out, at different distances, round all the arterial ramifications of the substance of the spleen, a great number of filaments in form of an irregular net-work.

The arteries, veins, and nerves, having entered the spleen, are there divided and subdivided into a great number of ramifications, and accompany each other to the very last extremities of their divisions. They are contained in a kind of common cellular capsula or vagina, which first surrounds all the three, and then sends off particular septa between them. This capsula seems to be formed by a continuation of the cellular substance of the omentum, and of that particular lamina of the coat of the spleen which I mentioned above.

The capillary extremities of all these vascular ramifications,

fications, both arterial and venal, end in the filamentary cells already mentioned. Malpighi considered them as distinct capsulæ or folliculi, containing the same number of small glands. They all communicate together; so that, wherever we pierce the coat of the spleen, we may, through that hole, inflate the whole viscus.

In oxen and sheep, there are no venal ramifications, as I have said. The vena splenica having entered the great extremity of these spleens, runs first of all for about half an inch or an inch; and afterwards, instead of an ordinary vein, we find a canal perforated on all sides. The beginning of this canal has still some remains of the coats of a vein; but the form of it is soon lost, and then we find nothing but sinuses or fulci in the reticular substance in oxen, and in the cellular substance in sheep.

The splenic artery and nerves are there ramified in a particular vagina, as in men; and the extremities of these arterial ramifications seem to swim or float in the cells, and to fill their filamentary substance with blood. At the ends of several of these capillaries, I have observed small corpuscles disposed like bunches of grapes; and I have seen two small tubes going out from each corpuscle, one long and open, the other small and short, which was lost in the sides of the spleen.

I imagine that the long tube, the extremity of which I was not able to find, may be the origin of a lymphatic vessel, especially because these vessels are so very numerous and visible in an ox's spleen, as has been already said. These small corpuscles may easily be discovered in an ox's spleen, when boiled by a particular administration, of which I shall say more in another place. They are indeed much larger before than after boiling; but they are not so solid, and subside more easily when cut. The same sort of corpuscles may be discovered in the human spleen, but they are so extremely small as not to be visible without a microscope.

The

The uses of the spleen shall be explained after the description of the omentum.

§ 15. *Omentum and Appendices Epiploicæ.*

Situation, division, and connection of the omentum. The omentum is a large, thin, and fine membranous bag, surrounded on all sides by numerous portions of fat, which accompany and even invest the same number of arteries and veins adhering closely to each other.

The greatest part of it resembles a kind of flat purse, or a sportsman's empty pouch; and is spread more or less on all the small intestines from the stomach to the lower part of the regio umbilicalis. Sometimes it goes down to the lower part of the hypogastrium, and sometimes does not reach beyond the regio epigastrica. It is commonly plaited or folded in several places, especially between the bands of fat.

It is divided into a superior and inferior, an anterior and posterior, and a right and left portion. The superior portion is in a manner divided into two borders, one of which is fixed along the great curvature or convex side of the arch of the colon, and the other along the great curvature of the stomach. The commissure or union of these two borders on the right side, is fixed to the common ligament or adhesion of the duodenum and colon, and to the contiguous parts of these two intestines. That on the left side is fixed to the longitudinal scissure of the spleen, to the extremity of the pancreas, and to the convex side of the great extremity of the stomach. It is likewise fixed to the membranous ligament which sustains the ductus cholidochus, and connects it to the vena portæ ventralis.

Below these adhesions, the other portions, that is, the anterior, posterior, two lateral and inferior portions, which last is the bottom of the sacculus epiploicus, have commonly no fixed connections, but lie loose between the fore-side of the cavity of the abdomen and the intestines.

stines. The anterior and posterior portions are generally called the *laminæ* of the omentum; but as that term is ordinarily employed to express the duplicature of some compound membrane, it would be more convenient to call them *folia*, *ala*, or some such name.

Structure of the omentum. The membrane of the omentum is, through its whole extent, made up of two extremely thin laminæ joined by a cellular substance; the quantity of which is very considerable along the blood-vessels, which it every where accompanies in broad bands proportioned to the branches and ramification of these vessels. These cellular bands are more or less filled with fat, according to the corpulency of the subject; and for that reason I have called them *bands* or *portions of fat*.

Little omentum. Besides this large membranous bag, which I name the *great omentum*, there is another much smaller, which differs from the large one, not only in size, but also in figure, situation, and connection; and this I name the *little omentum*. This small bag is fixed by its whole circumference, partly to the small curvature of the stomach, and partly to the concave side of the liver before the sinus of the vena portæ, so as to surround and contain the prominent portion of the lobulus.

The little omentum is thinner and more transparent than the other, and its cavity diminishes gradually from the circumference to the bottom, which in some subjects terminates in several small cavities or fossulæ more or less pointed. Its structure is pretty much the same with that of the great omentum, it being composed of two laminæ, with a mixture of the same portions of fat, which are considerably finer than in the other.

We see from this situation of the two omenta, that in the space left between the lower side of the stomach and upper side of the mesocolon, they have a very broad communication with each other; so that if either of them contained in its cavity any fluid, that

fluid might readily get between the stomach and mesocolon, and so pass into the other bag; especially when the stomach is empty, and consequently its situation easily changed.

Therefore, by means of this interstice between the stomach and mesocolon, the two omenta form one cavity, which opens into the cavity of the abdomen by one common orifice, situated near the commissure on the right side of the great omentum. This orifice is semilunar or semicircular, and formed by the union of two membranous ligaments, whereof one connects the beginning of the duodenum and neck of the vesicula fellea to the liver; the other connects the contiguous portion of the colon to the same viscus, and extends to the pancreas. From thence arises an incurvated border, which surrounds the root of the lobulus, leaving an opening wide enough to admit the end of the finger.

To discover this orifice of the omentum, we need only raise a little the great lobe of the liver, and find out the root of the lobulus, and apply to it a large pipe wrapped round with cotton, wool, or tow, to hinder the regress of the air. Then if we blow gradually, the air will inflate the sides of the great omentum, and give it the appearance of a large bladder irregularly divided into several lobes or tubercles by the bands of fat, which appear in this state like so many fræna between the lobes.

To be sure of succeeding in this experiment, the two omenta must be in their natural state, and they must be handled very gently with the fingers first dipped in oil. It succeeds better in young, lean subjects, than in old or fat subjects.

When we touch these membranes with dry fingers, they stick to them so closely as hardly to be separated without being torn, as we see by the reticular holes which appear in those portions of membranes that have been thus handled. In that case it is to no purpose.

pose to blow through the natural orifice already mentioned; and it is owing to these small holes that the membranes of the omentum have been supposed to be naturally reticular.

The membranous laminæ of the little omentum are continuous partly with the external membrane of the liver, partly with that of the stomach, and a little with the membrane that lines the neighbouring portion of the diaphragm. Those of the great omentum are continued partly with the same coat of the stomach, and partly with the external covering of the colon, and consequently with the mesocolon; and they likewise communicate with the covering of the spleen.

We may satisfy ourselves concerning these continuations, by making a small hole in one of the laminæ of the omentum near the stomach, colon, &c. and by blowing into that hole, through a pipe well fitted to it; for the air will gradually insinuate itself under the common coats of these viscera; but if the parts be dry, they must be moistened a little, before the experiment is made.

Appendices epiploicæ. The fatty appendices of the colon and rectum have always appeared to me to be a kind of small omenta or appendices epiploicæ. They are situated at different distances along these intestines, being particular elongations of their common or external coat. They are of the same structure with the great omenta; and there is a cellular substance contained in their duplicature, more or less filled with fat, according as the subject is fat or lean.

Next the intestine, each of them forms a broad, thin basis; and they terminate by irregular papillæ, thicker than their bases. These bases are at first disposed longitudinally; then obliquely; and lastly, more or less transversely, especially near the rectum, and upon that intestine.

These appendices are for the most part separated from each other; but some of these which have longitudinal

bases communicate together, the vestiges of these communications being very narrow, and not very prominent. By blowing through a small hole made in one of these appendices, it is inflated like a small irregular bladder, and the air passes under the external coat of the colon or rectum.

Besides these appendices epiploicæ, we observe at different distances along the colon, between the ligamentary band, which lies hid, and one of the other two, that is, on both sides of the adhesion of the mesocolon, several adipose strata, which may likewise be looked upon as appendices of the same nature with the former, but these strata are very seldom observed between the two apparent ligamentary bands of the colon.

Vessels of the omentum. The arteries and veins of the great omentum are branches of the gastricæ, and for that reason go by the name of *gastro-epiploicæ dextræ* and *sinistræ*. The arteries on the right side answer to the hepatic artery, and those on the left side to the splenic; and both communicate with the arteria ventriculi coronaria, and respectively with the arteriæ mesentericæ. The gastro-epiploic veins answer, in the same manner of distribution, to the vena portæ.

The vessels of the little omentum come chiefly from the coronariæ ventriculi, and those of the appendices and strata are ramifications from the reticular texture of the arteriæ and veins of the colon and rectum.

§ 26. *Uses of the Abdominal Viscera described in the thirteen foregoing Paragraphs.*

THE intestines in general finish what the stomach had begun. The alimentary pulp having been sufficiently prepared by the succus gastricus, or lymph of the stomach, undergoes a farther change by the intestinal lymph, bile, and pancreatic juice, by which the milky liquor called *chyle* is produced, and this liquor rendered

ed fluid enough to enter the lacteal vessels through the tunica villosa of the small intestines, while the grosser portion of the aliment continues its course, and becoming gradually thicker as it advances toward the great intestines, is there collected by the name of *fæces*.

The dilatation of the intestines is bounded by their common coat. The undulating, successive, and periodical contraction of the fleshy fibres, especially of the orbicular fibres of the muscular coat, expresses the intestinal lymph, beats it up into an emulsion with the alimentary paste, strains that emulsion through the lacteal vessels, and propels the residuum in the manner already said.

The nervous coat serves to sustain the tunica villosa; and, by the oblique disposition of its fibres, yields to the periodical motions of the muscular coat, without compressing the chyliferous ducts which pass through the meshes of this coat in the small intestines. The uses of the villous or internal coat are sufficiently apparent from the description given of it.

The length of the small intestines gives a great extent to what may be called the *strainer of the chyle*, and this extent is very much enlarged by the numerous folds termed *valvulae conniventes*. By means of this large extent, there is a great quantity of chyle strained through these intestines, and the valves hinder the alimentary pulp from passing through them too fast, that is, before all the milky juice has been expressed; and this may be observed chiefly in the beginning of the intestines, where these valves are most numerous and broadest, and the aliment most fluid.

The cavity of the great intestines serves to receive the *fæces* of the aliment, and to contain a considerable quantity thereof for a certain space of time, without any inconvenience, and without being obliged to discharge them continually, which would be as great an inconvenience as any. The incurvation of the colon, its cells, and contraction of its last convolutions, contri-

bute to this retention of the fæces; but the cæcum seems to be the first organ thereof, because the fæces being first collected there, are obliged afterwards to move in a contrary direction as they ascend into the colon.

The valve of the colon, which might more properly be termed the *sphincter* or *pylorus* of the ileum, hinders the fæces from returning into the small intestines: I say, the fæces or gross matter, because it is not certain that this valve entirely stops that passage, or that it always hinders any fluid matter forced downward by the colon from entering the ileum, even in a natural state.

The glandular lacunæ of the great intestines furnish continually a kind of mucilage, which not only defends the internal coat from the acrimony of the fæces, but serves also to lubricate these fæces in proportion to their different degrees of solidity.

The appendicula vermiformis is so very small in adults, that its use cannot be determined with certainty. Perhaps the mucilaginous matter in its cavity, furnished by the numerous glandular lacunæ of its internal coat, which can only be evacuated by plenitude, may, during its stay there, contract an acrimony, which may velligate or stimulate the cæcum, in order to throw its contents into the colon.

The intestinum rectum is the last reservatory of the fæces. The great thickness of its muscular coat, and the great number of longitudinal fibres by which this thickness is chiefly formed, enable it to yield to the collected fæces to so great a degree as to represent a large bladder or stomach. The muscoli levatores ani serve to suspend the lower portion of this intestine, especially when full; and it is partly by the contraction of these muscles which overcome the sphincter of the anus, that the fæces are discharged out of the body. These sphincters form the third pylorus of the whole alimentary canal.

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The mesentery and mesocolon connect the intestines, in such a manner, as that they cannot be twisted or run into knots, without hindering them from sliding and yielding to each other according to the different postures of the body, or according as they are more or less empty or full.

The adhesions of the mesentery form the convolutions of all the small intestines into a large bundle, irregularly round, which fills a great part of the cavity of the abdomen. from the epigastrium downward.

The mesocolon, by its adhesion to the colon, forms a kind of septum transversum, between the small intestines and the viscera contained in the epigastrium; and this septum supports the liver and stomach under the arch of the diaphragm, just as much as it is sustained by the intestines. This natural situation of these viscera is most commonly altered in dead bodies opened after the common method, and without the necessary precautions.

The breadth of the mesentery and mesocolon affords a large extent to the ramifications of the arteries, veins, and nerves, distributed through them by innumerable communications and anastomoses, by means of which any portion of the intestines may be supplied, though the principal branch which leads to it should happen to be compressed or obstructed.

The cellular substance in the duplicature of the mesentery and mesocolon, serves not only for a soft bed to all these ramifications, but also to contain those collections of fat, necessary for the formation of the bile, as I shall observe hereafter; and the cellular substance of the mesentery has likewise one use peculiar to it, which is to invest the lymphatic glands and lacteal vessels, and upon this account it is thicker than that of the mesocolon.

The lacteal vessels being first formed by a copious reticular texture round the circumference of the intestines, resembling the vascular net-work of that canal,

and afterwards uniting every where through the duplicature of the mesentery, with the arterial ramifications, which they likewise accompany in many places; it is easy to conceive that the pulsation of the mesenteric arteries must propel the chyle in the lacteal vessels from the intestines to the receptaculum chyli, that motion being suitable to the direction of their valves.

The liver is the principal organ for the secretion of the bile. The villi of that immense number of glandular cells of which it is composed, filtrate continually from the blood of the vena portæ small drops of bile, which afterwards insinuate themselves into the pori bilarii, and are in part lodged in the vesicula fellea, and in part run directly into the duodenum, in the manner already explained in describing the biliary ducts.

The spleen, omentum, appendices epiploicæ, adipose strata of the mesentery, and those of the great intestines, and even of the pancreas, with the whole series of glands in the intestinal canal, seem to contribute to the formation of the bile, as so many auxiliary, or rather preparatory organs; but each of them in a different way.

It appears, (1.) That the venal blood that returns from all the intestinal glands, and from the pancreas, has left a great portion of its serum. (2.) That the blood which returns from the spleen has undergone a certain change, by its course being mechanically retarded; and likewise that its texture is altered by the action of the numerous nerves sent thither by the plexus splenicus. (3.) That the blood which returns from the omenta, appendices epiploicæ, and from the strata and other collections of fat, is loaded with oil.

These three kinds of venal blood meet in the trunk of the vena portæ ventralis, where they are mixed together; and from thence they enter the transverse sinus or trunk of the vena portæ hepatica. In this sinus they are still more intimately mixed, as in a kind of lake, and become one uniform mass of blood; which being forced

forced into the branches of the *vena portæ hepatica* only by the supervening blood from the other *vena portæ*, and by the lateral pulsations of the ramifications of the hepatic artery, its course must be very slow. The secretion of the bile depends partly on this slow motion, and partly on these external impulses, as I shall show in another place.

The vesicular bile appears to be more exalted than that in the hepatic duct; and by meeting in the *ductus cholidochus*, they seem to compose a third kind of bile, which, without the cystic or vesicular bile, would perhaps be too mild, and too acrid without the hepatic. This bile mixes in the duodenum with the pancreatic juice, and with that of the intestinal glands; and from this mixture a fluid results, which is proper to separate the chylous matter from the gross and useless part of the alimentary pulp, as it comes from the stomach.

§ 17. *Renes et Urteres.*

Situation, figure, and division of the kidneys. The kidneys are two pretty solid glandular bodies, situated in the posterior part of the cavity of the abdomen, on each side of the lumbar vertebræ, between the last false ribs and os ilium. The right kidney lies under the great lobe of the liver; and is consequently lower than the left, which lies under the spleen.

The figure of the kidneys resembles that of a large bean, their circumference being convex on one side, and concave on the other. The concave side is turned to the vertebræ, and the convex side the opposite way. Their length answers to the distance between the last false rib and os ilium; they are about half as broad as long, and half as thick as broad.

In each kidney we observe a fore and back side, an upper and lower extremity, a great and small curvature, and a convexity and concavity.

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The backside is broader than the foreside; and the upper extremity is a little broader and more incurvated than the lower. The depression in the small curvature is oblong and uneven, resembling a sinus, surrounded by several tubercles; and as it is turned a little toward the foreside, this side is something narrower than the other.

Blood-vessels of the kidneys. The descending aorta and inferior vena cava lie between the kidneys, pretty close to the bodies of the vertebræ and to each other; the artery being on the left hand, the vein on the right. Each of these large vessels sends out transversely toward each side commonly one capital branch, which goes to the kidney, and enters the sinus or depression thereof, by several rami; of which hereafter.

These vessels were by the ancients termed the *emulgent arteries and veins*, but I choose rather to call them *arteriæ venæ renales*. Sometimes there are more than one of each kind, which is oftenest found in the arteries, sometimes on one side only, and sometimes in both.

The artery and vein are not of an equal length, and the difference depends on the situation of the aorta and vena cava; for the left renal artery is shorter than the right, because the aorta lies nearest the left kidney; and the left renal vein is longer than the right, because the vena cava lies furthest from the left kidney.

These vessels are likewise disposed in such a manner, as that the veins lie more anteriorly than the arteries; because the aorta lies close to the spina dorſi; whereas the vena cava, which perforates the diaphragm at some distance from the vertebræ, does not join them till after it has given off the renal veins.

Nerves of the kidneys. Each artery is surrounded by a nervous net-work, called *plexus renalis*; which furnishes a great number of filaments to the kidneys, that come partly from the semilunar ganglions of the two great sympathetic nerves, and partly from the plexus
he-

hepaticus and splenicus. This renal plexus sends likewise some filaments round the renal veins.

Coats of the kidneys. The kidneys are surrounded by a very loose membranous and cellular covering, called *membrana adiposa*; because, in fat persons, the cells of this substance are filled with fat. This was for a long time impertinently taken for a duplicature of the peritonæum; the true membranous lamina of which covers only the foreside of the kidneys; and consequently they lie without the peritonæum, because the portion of that membrane that covers them cannot be looked upon as an entire coat: so that the only common coat they have is the cellular substance, which likewise invests the renal arteries and veins in form of a vagina.

The proper coat or membrane of the kidneys is "strong and dense, and adheres very closely to their surface; for it penetrates every where by numerous elongations into their substance, from which it cannot be separated without tearing these."

The external surface of this lamina is very smooth, polished, and glistening; and it renders the whole surface of the kidney very even and uniform in adults. In children, this convex surface is in a manner divided into several lobes or tubercles, almost as in oxen and calves; and in grown persons we sometimes observe the same inequalities.

The blood-vessels having entered the kidneys, are ramified every way; and these ramifications send out other capillary rami, which go all the way to the surface, where they appear like irregular stars, and furnish the proper membrane of the kidneys. Sometimes these two ramifications penetrate to the *membrana adiposa*, and communicate there with the *arteriæ* and *venæ adiposæ*.

The proper membrane having surrounded the kidney all the way to the sinus, joins the vessels at that place, and accompanies all their ramifications through the body of the kidney in form of a vagina or capsule,
and

and likewise contributes in part to form the pelvis and calices or infundibula; of which hereafter.

We sometimes observe a considerable vessel to go in or come out from the convex surface of the kidney; but this is not common; and in that case there is a depression, by which the proper membrane enters, and communicates with that portion which goes in by the sinus.

The tunica adiposa, or common coat, which likewise invests the great vessels to their entry into the kidneys, does not seem to accompany them any further, but terminates at the sinus, in the interstices between the ramifications.

Structure of the kidneys. We may distinguish three kinds of substances in the kidney; an exterior substance, which is thick, granulated, and in a manner cortical; a middle substance, which is medullary and radiated, called *friata*, *sulcata*, or *tubularis*, because it seems to be made up of radiated tubes; and an inner substance, which is only a continuation of the second, and terminates on the inside by papillæ; for which reason I have given it the name of *papillaris*.

These three substances may be seen distinctly in a kidney cut into two equal parts through the great curvature. The cortical substance may be observed round the whole circumference; and, by the microscope, we perceive it to be of a spongy, granulated, and waving texture, all its parts adhering together in a radiated manner. Its colour is a bright whitish grey.

By fine anatomical injections and inflammations, we discover an infinity of small capillary vessels, which run in various directions between and round the different portions of this substance; and, by the help of a microscope, we see likewise great numbers of small red corpuscles more or less round, and disposed almost like bunches of currants. These small corpuscles are perhaps only the extremities of the cut vessels, filled either with blood or with a coloured injection.

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The other two substances, that is, the medullary or striated, and the papillary, are really but one and the same mass, of a more reddish colour; the convex side of which rises at several places into narrow tubercles, lodged in the same number of cavities or depressions. The radiated striæ are afterwards continued to the papillary portion; and the papillæ form in some measure so many centres of these radii, opposite to the tubercles.

The medullary substance is likewise distinguished from the cortical, by the arterial and venal arches, which send capillary ramifications on all hands; and its colour is more or less red.

The papillæ, which are only a continuation of the medullary substance, as has been said, are often a little paler than that substance. They are ten or twelve in number, very distinct from each other, resembling the same number of cones, with very broad bases and obtuse apices.

At the point of each papilla we see, even without a microscope, in a small depression, several very small holes, through which little drops may be perceived to run when the papillæ are compressed. These are little drops of urine, which being filtered, partly in the cortical, partly in the medullary or tubular substance, do afterwards pass through the substance of the papillæ, and are discharged by these orifices.

The pelvis of the kidneys. Each papilla lies in a kind of membranous calix or infundibulum, which opens into a common cavity, called the *pelvis*. This pelvis is membranous, being of the same structure with the calices, of which it is a continuation; and its cavity in man is not uniform, but distinguished into three portions, each of which contains a certain number of infundibula or calices, together with the papillæ which lie therein; and sometimes we find two or three papillæ in the same infundibulum.

At the place where these infundibula surround the bases of the papillæ, they send productions into the

medullary or radiated substance of the kidney, which accompany the blood-vessels, and serve for capsules or vaginæ to all the vascular arches, both arterial and venal, and to their different ramifications, quite thro' the cortical substance, and as far as the surface of the kidney.

Ureters. After the infundibula have contracted in a conical form round the apices of the papillæ, each of them forms a small short tube or gullet, which uniting at different distances along the bottom of the sinus of the kidney, form three large tubes which go out from the sinus, in an oblique direction from above downwards, and immediately afterwards unite into one trunk.

This trunk becomes a very long canal, called the *ureter*. In men, the three tubes supply the place of what is called the *pelvis* in brutes, and might more properly be called the *roots* or *branches* of the ureters than the *pelvis*; which name would agree best to the trunk, as being larger than the rest of the ureter. The ureters are commonly two in number, one for each kidney; but sometimes there are more than two.

The situation of the trunk, and of the roots and branches of each ureter, with respect to the renal artery and vein, is in the following manner: The artery is in the upper part of the sinus, and partly before the vein. The vein is about the middle, and between the artery and ureter. The ureter is in the lower part, a little behind the vein, and it is partly surrounded by one branch of the artery.

This disposition appears plainer near the anterior than near the posterior side of the kidney, because this last is broader than the former; and we likewise see there the three branches of the ureter, of which the uppermost is the longest, and the lowest is the shortest, because of their oblique direction downward.

From this description, we see, that in the human kidney there is no other common or uniform *pelvis*, but the trunk

trunk or head of the ureter, and the three great branches. To have a true idea of their disposition, we must imagine that the ureter enters the kidney by the lower part of the oblong sinus; that it increases gradually in breadth as it advances; and that it is divided into three branches, before it enters the substance of the kidney.

One of these branches may be reckoned a direct continuation of the ureter, and it is longer than the rest, being extended from the lower to the upper part of the sinus; and it may be found without much preparation. The other two branches are shorter, and cannot be well discovered without an artificial separation. The angles between these branches at their bases, or at the head of the ureter, are not pointed as those of other ramifications, but formed by a round incurvation, which is generally surrounded by fat.

These first branches of the ureters produce other small branches at the bottom of the sinus, which are disposed in pairs. These small collateral branches extend in breadth, and form the infundibula or calices, in which the papillæ are lodged; the great circumference of which produces, in the substance of the kidney, the different vaginæ of the vascular arches and of their ramifications. The internal lamina of the kidney is continued round these vaginæ; and the external lamina is expanded round the first branches, round the trunk, and round all the rest of the ureter.

If the trunk of the ureter be split on that side which is next the vertebræ, and this section be continued to the extremity of the superior branch, we may observe immediately above the trunk, two holes lying near each other, which are the orifices of the small collateral branches and gullets of the infundibula. A little above these holes, there are other two very much like them, and so on all the way to the extremity of the superior branch, which terminates likewise by these gul-
lets

lets of the infundibula; and in each of these gullets may observe at least the apex of one papilla.

A section begun on the convex surface of the ureter, and carried from thence to the trunk of the uterus, discovers the extent of the papillæ very plainly, and likewise the infundibula, their gullets, &c.; but it would be difficult to give beginners a just idea of the structure of these parts, without the other section.

The ureters run down obliquely, and with a very small degree of inflexion, from the kidneys to the lateral parts of the inner or anterior side of the os sacrum, and passing between the rectum and bladder they terminate in the last of these viscera, in the manner that shall be explained hereafter.

They are composed of three proper coats; the first of which, that surrounds the rest, is of a whitish colour, and of a very compact filamentary texture, being stretched with difficulty, and appearing like a filamentary substance degenerated. The next coat is of a reddish colour, stronger than the first, and is composed of muscular fibres, although this has been doubted by some authors."

The innermost coat is in some measure ligamentary, and lined by a very fine membrane, which covers a very delicate reticular texture of vessels, and is moistened all over by a mucilaginous liquor.

Besides these proper coats, the ureters are invested by the cellular substance of the peritonæum; the membranous lamina of which covers likewise about two thirds of their circumference, sometimes more, sometimes less, but never surrounds them entirely: so that when they are examined in their natural situation, they appear like ropes lying behind the peritonæum, and jutting out more or less toward the cavity of the abdomen, together with that portion of the peritonæum which covers them.

All that has been said about the structure of the ureters, pelvis, arches, striæ, fossulæ, and holes at the

apex of the papillæ, appears most distinctly when these parts are examined in clear water, as I have already often observed.

§ 18. *Glandulæ renales, vulgo Capsulæ atrabiliaræ.*

Situation, figure, and size of the renal glands. Immediately above each kidney lies a glandular body, called by the ancients *capsulæ atrabiliaræ*; by others, *capsulæ renales*, *renes succenturiati*, and *glandulæ renales*; and they might be properly enough termed *glandulæ supra renales*. They are situated on the upper extremity of each kidney a little obliquely, that is, more toward the inner edge and sinus of the kidney than toward the outer convex edge.

Each gland is an oblong body with three sides, three edges, and two points, like an irregular crescent with its great or convex edge sharp, and the small concave edge broad. Its length is about two thirds of the greatest breadth of the kidney, and the breadth of its middle portion is about one-third of its extent between the two extremities, sometimes more, sometimes less. Its colour is a dark yellow.

It has one anterior, one posterior, and one lower side, which last may be termed the *basis*; and it has one upper, and two lower edges, whereof one is anterior, the other posterior. The upper edge may be called the *crista*, and the two lower edges the *labia*. One of its extremities is internal, or turned inward toward the sinus of the kidney; the other is external, or turned outward toward the gibbous part of the kidney. The figure of this glandular body may likewise be compared to that of a single cock's-comb, or to the top of an helmet.

Structure of the renal glands. The surface of these glands is uneven; the fore-side is the broadest, and the lower side or basis the narrowest. Along the middle of the anterior side, a ridge runs from the edge of the

inner extremity a little above the basis, to the point of the other extremity, and divides this side into two equal parts, like the middle rib of the leaf of a tree, and on the lower side under the basis, there is a kind of raphe or future.

The blood-vessels of these glands come from the arteriæ, and venæ renales, and diaphragmaticæ, and likewise from the aorta and vena cava, from the arteria cæliaca, &c. These vessels are termed the *capsular* arteries and veins; and as they enter the glands, they seem to be invested by a vagina. They are not always derived from the same sources, neither is their number the same in all subjects; and there is commonly a pretty large vein which runs along the ridge. The nerves on each side are furnished by the neighbouring semilunar ganglion, and by the renal plexus which depends on it.

In the inside of these capsulæ, there is a narrow triangular cavity, the surface of which is full of short, strong villi of a yellowish colour; but in children it is reddish, and of a dark brown in aged people. The sides of this cavity are connected by a great number of filaments; and they appear to be wholly glandular, that is, to be filled with very fine small folliculous corpuscles. Along the top of the gland these sides touch each other immediately.

In opening this cavity, we find a granulated or follicular substance, which fills it almost entirely; and the blood-vessels are distributed on this substance, as well as on the sides of the cavity. If the section be begun at the great extremity of the capsula, and be continued through the upper edge; and if the lateral portions be afterwards separated, the glandular body appears like a kind of crista, raised from the middle of the bottom of the cavity.

This glandular body or nucleus adheres more closely to the bottom or basis of the cavity, than to the two sides, especially near the great extremity; but yet it
may

may be separated both from the basis and sides, being connected to them by a great number of small filaments. It adheres least to the basis near the small extremity.

The capsular vein, which comes ordinarily from the vena renalis, is much larger than the arteries; and it communicates with the inside of the capsula much in the same manner as the vena splenica with the cells of the spleen, for it may be inflated by blowing into any part of the capsular cavity, and the air likewise passes into the vena renalis, &c.

This cavity contains an unctuous viscid liquor, of a yellowish red colour, which, with age, changes gradually into a yellowish purple, a dark yellow, and a black yellow: sometimes it is perfectly black; but even then, if it be spread thin on a large surface, it appears yellow. I have sometimes found it not only reddish, but mixed with real blood.

The uses of these renal glands have not as yet been discovered; and all that we know about the liquor contained in them is, that it has somewhat the appearance of the bile. They are very large in the foetus, and diminish in adults. These two phænomena deserve our attention.

They lie sometimes directly on the top of the kidneys, but I never found them on the gibbous part. The gland on the right side is partly connected to the diaphragm, under and very near the adhesion of the great lobe of the liver to that muscle. That on the left side adheres to the diaphragm below the spleen; and both these connections are confined to the contiguous portions of the inferior muscle of the diaphragm. They are involved, together with the kidneys, in the membrana adiposa, of which a very thin portion insinuates itself between the kidneys and glands, and also between them and the diaphragm; so that they adhere to both by the intervention of the cellular substance, which in some subjects contains a stratum of fat.

The renal ridge already mentioned, sinks so deep into the foreside in some subjects, that the upper part of this side appears to be separated from the lower; but this is seen most distinctly when the capsula is examined in clear water.

When the capsular vein is opened lengthwise with the point of a lancet, we discover in it a great many small holes, many of which are only the orifices of the rami of the vein, others are simple holes; and it is perhaps through these that the air passes into the gland, as already mentioned.

On the outer surface of these capsulæ we observe a very thin, distinct coat, separate from the cellular substance that surrounds them. Sometimes this coat is raised by an uneven stratum of fat, which makes it appear granulated; and, for the same reason, the capsulæ are of a pale colour like a corpus adiposum.

The liquor contained in them appears sometimes, in the foetus, and in young children, of a bluish colour inclined to red.

To be able to discover the uses of these capsulæ, we must not only attend to the two circumstances already mentioned, but also to their external conformation, which is commonly more regular in the foetus and in children, than in adults and old people. We must likewise consider the consistence and solidity of their substance; which is greater before birth, and in childhood, than in an advanced old age; in which they are often very flaccid, and very much decayed; and this perhaps may be the reason, why the figures given of these glands taken out of their membrana adiposa, are so very irregular and different from what I have demonstrated for above 20 years past.

§ 19. *Vesica Urinaria.*

Situation, figure, and division of the bladder. The bladder is a kind of membranous and fleshy pouch or bottle,

bottle, capable of dilatation and contraction, situated in the lower part of the abdomen immediately behind the symphysis of the ossa pubis, and opposite to the beginning of the intestinum rectum. The figure of it is nearly that of a short oval. It is broader on the fore and back sides, than on the lateral parts; rounder above than below, when empty; and broader below than above, when full.

It is divided into the body, neck, and bottom; into an anterior, posterior, and two lateral parts. The upper part is termed the *fundus*, or *bottom*; and the neck is a portion of the lower part, which is contracted like the gullet of some vessels.

Structure of the bladder. The bladder is made up of several coats, almost like the stomach. That part of the external coat which covers the upper, posterior, and lateral sides of the bladder, is the true lamina or membrane of the peritonæum; and the rest of it is surrounded by a cellular substance, by the intervention of which, the peritonæum is connected to the muscular coat.

The proper coats are three in number; one muscular, one cellular, and an internal smooth one commonly called *villous coat*. The muscular coat is composed of several strata of fleshy fibres; the outermost of which are mostly longitudinal; the next to these are more inclined toward each hand; and the innermost, more and more oblique, and they become at length almost transverse. All these fibres intersect each other in various manners; and they are connected together by a fine cellular substance, and may be separated by inflating that substance.

The cellular coat is nearly of the same structure with what is called the *tunica nervosa* of the stomach.

The internal coat is something granulated and glandular; and a mucilaginous serum is continually discharged through it, which moistens the inner surface of the bladder, and defends it against the acrimony of the

urine. It appears sometimes altogether uneven on the inner side, being full of eminences and irregular rugæ when empty and in its natural state of contraction. These inequalities disappear when the bladder is full, or when it is artificially distended by air, or by injecting any liquid.

Urachus. At the top of the bladder above the symphysis of the ossa pubis, we observe a ligamentary rope, which runs up between the peritonæum and the linea alba of the abdomen, all the way to the navel, diminishing gradually in thickness as it ascends. This rope had a particular use in the fœtus, as shall be said in another place. It is sufficient to add here, that it is in part originally a production of the inner coats of the bladder, which production is termed *urachus*.

Arteriæ umbilicales. This rope is composed likewise of two other ligamentary elongations, which are the extremities of the umbilical arteries. These arteries come from the hypogastricæ, run up by the sides of the bladder, and remain hollow and filled with blood, even in adults, as high as the middle of the bladder, through all which space they likewise send off ramifications. Afterwards they lose their cavity, and become ligamentary as they ascend. At the upper part of the bladder they approach each other; and joining the urachus, form that rope, which may be termed the *superior ligament of the bladder*.

The external fibres of the muscular coat are more numerous than the internal; and the most longitudinal anterior fibres form a kind of incurvation round the urachus at the top of the bladder, much like that of one of the fleshy portions which surround the superior orifice of the stomach and lower extremity of the œsophagus. This incurvation passes behind the urachus.

The portion of the peritonæum, which covers the posterior convex side of the bladder, forms a very prominent transverse fold, when the bladder is contracted,
which

which disappears when the bladder is extended. This fold surrounds the posterior half of the bladder, and its two extremities are elongated toward each side; by which elongations a kind of lateral ligaments of the body of the bladder are formed, which are more considerable in children than in adults.

The lower part of the bladder, which deserves the name of *fundus* much better than the upper part, is perforated by three openings, one anterior, and two posterior. The anterior opening is formed by an elongation of all the proper coats, in form of a gullet, turned much in the same manner with the inner orifice of the rostrum of the head of an alembic. This elongation is called the *neck of the bladder*, the description of which belongs to that of the parts of generation in men.

The other two openings in the true fundus of the bladder, are formed by the ureters, which in their course downward, already described, run behind the spermatic vessels, and then behind the lower part of the bladder, approaching each other. Each ureter lies between the umbilical artery and vas deferens of the same side; the artery lying on the outside of the ureter, and the vas deferens on the inside.

Afterwards they get between the vasa deferentia and the bladder, crossing these canals: and then, at about a finger's breadth from each other, they begin to pierce the coats of the bladder. They run a little way between the muscular and nervous coats, and open into the bladder obliquely, something nearer each other than when they first entered in coats.

The orifices of the ureters in the bladder are something oval and narrower than the cavity of the ureters immediately above them. The edge of these orifices is very thin, and seems to be formed merely by the union of the internal coat of the bladder with that of the ureters.

Blood-vessels and nerves of the bladder. The arteries
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of the bladder are furnished by the hypogastricæ or ili-acæ internæ, being rami of the arteria sciatica, epigastrica, and umbilicalis on each side. The veins come from those of the same names with the arteries.

The nerves of the bladder come from the crurales, and also from the sympathetici maximi, by means of their communication with the curales. It has likewise some nerves from the plexus mesentericus inferior.

Besides the ligaments already mentioned, there are likewise two small ones, by which the anterior part of the true fundus of the bladder is connected to the ossa pubis, which shall be described with the neck and sphincter, after the history of the parts of generation in both sexes; and I refer to the same place, all that relates to the connection of the bladder with the other neighbouring parts.

§ 20. *The parts of Generation in Males.*

Situation in general, and division of these parts. The parts of generation in males are of different kinds, some of them being wholly contained in the abdomen, and others lying without it. From this situation, they might properly enough be divided into external and internal parts; and all those belonging to the first class might be described before those of the second.

But as it is still more proper to have a regard to the œconomy of these parts, according to which, their functions begin in some internal parts, are continued in some external parts, return again to the internal, and are finished in the external; I shall follow the same order in describing them, and this is what I constantly observe in my public lectures.

The first of these four classes comprehends the spermatic veins and arteries; the second, the testes, epididymis, and scrotum; the third, the vasa deferentia, vesiculæ seminales, and prostates; and the fourth,

fourth, the corpora cavernosa, urethra, integuments, &c.

I formerly made a fifth class out of some of these parts, which I looked upon as accompanying the rest; but I now think it better to include them all in the four classes that I have mentioned.

The spermatic vessels. The spermatic arteries go out most commonly from the anterior part of the inferior aorta, near each other, and about an inch lower than the arteriæ renales. Their origin oftentimes varies: for I have observed them to arise from the renal artery; and sometimes they go out higher, lower, or more laterally than is common, and each artery has been seen to arise from different places.

They run down obliquely in the posterior part of the abdomen within the cellular substance of the peritonæum, passing insensibly from behind, forward; and so, parting gradually more and more from the aorta, they cross over the fore-side of the ureters, and run thro' the openings or rings of the abdominal muscles along with the elongations or productions of the cellular portion of the peritonæum.

They are small at their origin; and, in their course downward they give off pretty considerable lateral ramifications, to the membrana adiposa, peritonæum, and also the mesentery, where they seem to communicate with the mesenteric arteries.

They sometimes pass through the areolæ or meshes of the spermatic veins; and before they go out of the abdomen, they are divided into very fine rami, which run in a more or less winding course, almost parallel to each other.

Afterwards they enter the cellular productions of the peritonæum, which serve them for vaginæ. They do not fluctuate indifferently from one side to the other of these vaginæ; but are connected along their inner surface by thin membranous laminæ, which are likewise

wife continuations of the cellular substance of the peritonæum.

The arteries continue the same winding course within these vaginæ, passing before the vasa deferentia, which are likewise contained in them; and at length they terminate by ramifications in the epididimis and testes, in the manner that shall be afterwards explained.

The spermatic veins accompany the arteries, and have nearly the same course. The right vein arises commonly from the trunk of the vena cava, in the same manner as the artery from the aorta; and I have sometimes observed it to go out from the union of the right renal vein with the vena cava, and sometimes I have seen three veins on the right side go out separately from the trunk of the vena cava. The left spermatic vein arises most commonly from the vena renalis sinistra.

In their course downward, they first join the arteries, and, together with them, enter the cellular productions of the peritonæum, to which they are connected in the same manner. From their origin to their passage through the openings or rings of the abdominal muscles, they send off several rami to the membrana adiposa of the kidneys, peritonæum, and mesentery, where they seem to communicate with the venæ meseraicæ, and consequently with the vena portæ.

A little below the place where they cross over the ureters, they send out a considerable branch, which is afterwards divided into two rami, one of which communicates with the vena capsularis, and the other sometimes with the renalis; and lower down they give out the vein, which communicates with the vena meseraica, as already observed.

They differ from the spermatic arteries, not only in that they are larger, and their coats thinner, but also in being more divided and multiplied as they descend to the rings of the abdominal muscles; and as they gradually produce a large fasciculus of ramifications, the an-

ancients gave to them, and to the arteries, the name of *vasa pyramidalia*.

These ramifications often communicate with each other in this course, and form a great number of areolæ, contortions, and convolutions, so as to represent a kind of plexus, which is connected to the cellular vagina of each side by very fine laminæ; and the artery which accompanies the vein crosses it in several places, and runs through the areolæ in different directions. These frequent convolutions gave rise to the name of *vasa pampiniformia*, formerly given to these vessels; and their particular adhesions to each other at some places, made it believed that there were real anastomoses between the artery and the vein.

Leal Lealis, an Italian anatomist, not attending to the lateral ramifications of the spermatic arteries and veins, believed himself able to establish and demonstrate these pretended anastomoses. The experiments made by him on living animals prove nothing. His way was, to make a common ligature on both vessels, a little above the testicle, and another on the trunk of the vein, after he had emptied it. Then pressing the aorta to force the blood into the spermatic artery, the vein which he had before emptied was found to be presently filled.

From thence he concluded, that the course of the blood to and from the testicle being obstructed by the inferior ligature, there must be some anastomoses between the two ligatures, through which the vein was supplied with blood. But it is very plain, that this effect was owing to the lateral ramifications of the spermatic artery and vein, and not to his pretended anastomoses. These fine lateral ramifications were well known to Eustachius, but had escaped Leal Lealis.

Testes. The testes are two glandular bodies, situated near each other, without the abdomen, below the interstice between the groins in an adult. The ancients named them *didymi* or *gemini*. Their size is nearly that
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of a pigeon's egg, and they are of an oval figure, a little flattened at each side. We may consider in each testicle two extremities, two edges, and two sides. One extremity is situated forward and a little upward, the other backward and a little downward; and their edges lie upward and downward.

At the upper edge they have each an appendix, called *epididymis*, together with which it is involved in several coverings; and they are both suspended in a common covering, called the *scrotum*.

Each testicle is a spermatie gland formed by a vast number of fine whitish tubes, folded and twisted in different manners, and distributed in different fasciculi, between membranous septa; the whole being surrounded by a strong common covering, named *tunica albuginea*.

These septa are disposed longitudinally, divaricating from each other on one side, and approaching on the other. They approach each other along one edge of the testicle, and terminate in a long narrow whitish body, as in a kind of axis.

From thence they divaricate in a regular manner, and are fixed by their opposite edges in the inner surface of the tunica albuginea, of which they appear to be a continuation. This white body may be termed the *nucleus* of the testicle.

From this description we see, that all these septa are not of an equal breadth; that the interstices between them are in some measure triangular; and that the extent of the small tubes, which lie therein, must be very considerable. They have been reckoned to amount to many yards, by taking the sum of all their several portions; and they may be easily unfolded by a long maceration, which destroys the delicate substance by which all their folds and convolutions are connected and tied down.

All these small canals "are collected into bundles above twenty in number, divided by distinct cells or partitions, which

which descend from the tunica albuginea, to conduct the arteries and veins. In each of these cells there is a seminiferous duct to convey the secreted humour from the testicle. The ducts form a net-work, adhering to the surface of the albuginea, and forming inosculations one with another. From the said net, in the upper part of the testicle, ascend ten or twelve ducts; which being contorted together into folds, form as many vascular cones, that are joined together by an intermediate cellular substance; and, lying incumbent one upon another, there form the epididymis, which goes round the outer and posterior margin of the testicle, to which it adheres by its thicker head, joined with a good deal of cellular substance: While in its lower, middle, and more slender part, it adheres in some measure, and is in part free; in such a manner that it intercepts a sort of impervious bag betwixt itself and the testicle. The vascular cones, at the upper part of the epididymis, by degrees uniting, form at length one duct; which grows larger as it descends, being largest at the bottom of the testicle; from whence again ascending along the posterior face of the testicle, in a direction contrary to itself, it by degrees spreads open its spiral convolutions, and comes out much larger, under the name of *vas deferens*."

Epididymis. The epididymus thus formed, may be reckoned a production of the testicle, or a kind of testes accessorius; and it resembles in some measure an arch supported by its centre or frame. It is more contracted at the middle than at the extremities, by which it is closely united to those of the testicle.

Between its extremities it does not immediately touch the testicle; but is only loosely connected to it by the duplicature of a very fine and almost transparent membrane, as by a kind of ligament. This membrane is the continuation and duplicature of the tunica albuginea, or proper coat of the testicle; which having supplied

plied the place of a ligament to the epididymis, afterwards invests it.

The epididymis is flat, a little concave on the under side or that next the testicle, irregularly convex on the upper side, that turned from the testicle: and these two sides are distinguished by two angular edges; by the innermost of which it is connected to the testicle in the manner already said, but the outer edge and flat side are loose and free.

The anterior extremity or head of the epididymis arises from the testicle; and the posterior extremity or tail, which likewise adheres very closely to it, is incurvated from behind, forward and a little upward, and contracting by degrees forms a particular canal, termed *vas deferens*; which shall be described after the scrotum. By this description of the extremities and edges of the epididymis, I demonstrated, many years ago, a method to discover whether a testicle, viewed externally, belongs to the right or left side.

Scrotum. The scrotum is the cutaneous covering of the testes. Outwardly, it is a bag common to both, formed by a continuation of the skin of the neighbouring parts, and commonly very uneven, having a great number of rugæ on its outer surface. Interiorly, it is fleshy, and forms a muscular capsula for each testicle, termed *dartos*.

The exterior or cutaneous portion of the scrotum is nearly of the same structure with the skin in general, of which it is a continuation; only it is something finer, and it is likewise plentifully stored with sebaceous glands and bulbs of roots of hairs.

Though it is a common covering for both testicles, it is nevertheless distinguished into two lateral parts by a superficial and uneven prominent line, which appears like a kind of suture, and from thence has been termed *raphe*.

This line is a continuation of that which divides, in the same manner, the cutaneous covering of the penis; and

and it is continued through the perinæum, which it divides likewise all the way to the anus. It is only superficial, and does not appear on the inside of the skin.

The inner surface of this cutaneous bag is lined by a very thin cellular membrane, through which the bulbs and glands appear very distinctly when we view its inside. The rugæ of the scrotum are in the natural state commonly a mark of health, and then its size is not very large. It increases in size, chiefly according to its length; and then the rugæ disappear more or less, according to the degrees of the preternatural state or indisposition.

The dartos of the scrotum has been looked upon as a true cutaneous muscle; "but is chiefly a cellular substance condensed, with a great number of blood-vessels entering into its composition, but without fat." This substance is thin; and by the disposition of its fibres, forms a bag with two cavities, or two small bags joined laterally to each other, and contained within the cutaneous portion.

The lateral parts of these two bags, which are turned from each other, are longer than those which are joined together; and by this union a septum is formed between the testes, which may be called *mediaſtinum ſcroti*.

The raphe or future already mentioned, adheres to the edge of this septum, and thereby braces down the middle of the cutaneous portion; which from thence appears to have in part two cavities; and this was perhaps what gave occasion to make the French word for the scrotum to be in the plural number. The other edge of the septum adheres to the urethra.

The "dartos has a strict connection with the rest of the cellular substance," especially at the upper part below the groin, where its anterior and external lateral portions terminate by a kind of tendinous or ligamentary expansion, which is strongly united to the internal cellular membrane. I have often shown this as a particular

ticular fascia lata, which gives insertion to the portions of the dartos just mentioned, and as a broad frænum which keeps the same portions together.

The aponeurotic or ligamentary expansion of the dartos is fixed in the ramus of the os pubis, between the musculus triceps and the origin of the corpus cavernosum of the same side, which shall be described hereafter, all the way to the lower part of the symphysis of these bones. The internal portion of these muscular bags, or that which forms the septum scroti, is fixed to the urethra by means of a communication between the same ligamentary expansion; and another, which shall be explained in its proper place.

Vasa deferentia. The vasa deferentia are two white solid flattened tubes; one lying on the right side, the other on the left. From the epididymis, of which they are continuations, as has been already said, each of them runs up in the cellular vagina of the spermatic vessels, as high as the openings in the abdominal muscles; the blood-vessels lying forward, and the vas deferens behind them.

This fasciculus thus formed, by the blood-vessels, vas deferens, and their common covering, is termed the *spermatic rope*. The covering is smoother on the outer than on the inner side; and for that reason it has been looked upon as a vagina; the internal substance of which is most cellular, and connects all the vessels together, while the external forms a covering to invest them.

The vas deferens having reached the membranous lamina of the peritonæum, where that lamina runs over the orifice of the vagina, separates from the blood-vessels, and runs backward, in form of an arch, in the cellular substance of the peritonæum, as far as the nearest side of the bladder.

It passes afterwards behind the body of the bladder, to which it adheres very closely, as also to the lamina of the peritonæum which covers it, and then continues

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its arched course towards the neck of the bladder, where both vasa deferentia meet, and their arches terminate.

In this course, the vas deferens passes behind and crosses the neighbouring umbilical artery; crosses the extremity of the ureter of the same side, in its passage between that extremity and the bladder; and having got behind the bladder, it meets the vas deferens of the other side between the insertions of the ureters, and they run down together to the neck of the bladder.

This canal, which at the origin of the epididymis is pretty large and plaited, becomes immediately afterward smaller and smoother, and continues in that form till it gets behind the bladder, where it begins again to be larger and more uneven.

It arises from the angular portion or posterior extremity of the epididymis; and from thence runs forwards in a very oblique course, on the posterior half of the epididymis, where it is a little incurvated as it joins the back side of the spermatic vessels.

The texture of the smooth portion of this canal is very solid, and in a manner cartilaginous, especially near the surface of its cavity; which, though very narrow, is still kept open by means of the solidity and thickness of its sides.

The cavity of the vas deferens is cylindrical, though the whole tube is flat, and its external circumference oval, as may be seen by cutting it transversely; and the cavity enlarges as it passes behind the bladder. The termination of these canals must be referred to the history of the urethra.

Coats of the testes. The particular coverings of the testes are commonly called *coats*; and they are reckoned to be three in number, the tunica musculosa named *cremaster*, vaginalis, and albuginea. The first two are common to each testicle, and to the spermatic rope that belongs to it; and the third is peculiar to the testicle alone.

The tunica vaginalis is the most considerable of the three, and must be described first, in order to conceive the structure and connection of the cremaster, which is very improperly called a *coat*. The albuginea has been already described with the testes.

The tunica vaginalis is a continuation of the vagina of the spermatic rope, which, as it approaches the testicle, is gradually dilated, and forms two capsulæ, one contained within the other, the external being the longest and broadest at bottom; so that there is a void space there left between them, in which the testicle is lodged.

This structure may likewise be explained in the following manner. The vagina having reached as low as the testicle, is divided into two laminæ; the innermost of which is the bottom of the vagina, and the outermost is expanded round the testicle, and gives it a coat, called *vaginalis*, from the Latin word *vagina*. The ancients termed it likewise *elytroides*, from a Greek word that signifies the same thing.

The inner surface of this coat is lined by a fine membrane, which strengthens the bottom of the vagina, and forms a kind of diaphragm; which prevents all communication between the vagina of the spermatic rope and the tunica vaginalis of the testicle.

Cremaster. The cremaster, improperly termed a *coat*, is a thin muscle or fleshy plane, which runs down round the vagina of the spermatic rope, and terminates in the tunica vaginalis of the testicle.

It surrounds almost the whole vagina; and afterwards expands itself on the upper and external part of the tunica vaginalis, in which it is inserted and lost.

It arises partly from the ligamentum Fallopii, but chiefly from the lower edge of the internal oblique muscle of the abdomen.

It is covered by a very fine cellular membrane, detached from the outside of the aponeurosis of the obliquus externus, round the opening commonly called
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the *ring*. This membrane is lost in the cellular substance of the inside of the dartos.

From all this we see, that the cremaster is rather a muscle of the tunica vaginalis than a particular coat. Those among the ancients who believed it to be a coat, called it *tunica erythroides*, from a Greek word which signifies *red*; but this muscle is not always red, neither is that colour essentially necessary to a fleshy substance.

Corpora cavernosa. The corpora cavernosa are two ligamentary and very limber tubes, united laterally to each other through the greatest part of their length, and solid at their two extremities; two of which are connected together, and rounded like the end of a finger; the other two divaricate, like the branches of the Greek τ ; and, diminishing gradually in size after the divarication, terminate in an oblique point. These divaricated and pointed extremities may be called the *roots*, and the round extremities the *heads*.

These two bodies are almost cylindrical, being round, and of an equal diameter from the roots to the heads, where they are in some measure conical. The ligamentary substance of their sides is elastic, and composed of fine close fibres; which are partly transverse, and partly more or less oblique.

The cavity of these ligamentary tubes is entirely filled by a strong cellular or cavernous substance, which does not seem to be a continuation of the substance of the sides. These cells communicate with each other, and are always more or less full of blood, resembling pretty much the cellular substance of the spleen, only with this difference, that the sides of the cells are thicker in these cavernous bodies, and without any additional substance.

By the union of the two corpora cavernosa, two external grooves are formed; one on the upper side, the other on the lower. The lower groove is something broader than the upper; and it is filled through its whole length by a third tube, narrower than the cor-

pora cavernosa, called the *urethra*; which shall be presently described.

The roots of the corpora cavernosa are fixed, each, to the edge of the small ramus of the ischium and os pubis. They meet at the symphysis of the ossa pubis, where each of them becomes a cylindrical tube, and unites with the other in the manner already said.

The heads or rounded extremities join the basis of a distinct body, called the *glans*, which is an expansion of the urethra, and closely united to it in the manner that shall be explained hereafter.

By the union of the corpora cavernosa from their roots to their round extremities or heads, a particular septum is formed by the transverse fibres of both. Between the fibres of this septum several small void spaces are left, by which the corpora cavernosa communicate with each other; and therefore, by blowing into one of them, we presently inflate the other. Toward the rounded extremities, the septum diminishes every way.

Urethra. The urethra is the third spongy tube which composes the penis; and it adheres to the corpora cavernosa, through the whole length of the inferior groove formed by their union. It differs from the other two, both as it is narrower, and as it forms a true hollow canal. Its substance is spongy or cavernous, except a small portion next the bladder; and its inner and outer surfaces are membranous.

It is at first no more than a membranous canal continued from the anterior opening of the bladder, at the place called the *neck* of the bladder, which is a name that would be more proper for this portion of the urethra.

About a finger's breadth and an half from its origin, it joins a cavernous substance like that of the two other tubes, only smaller, which surrounds it through the whole extent of the inferior groove of the corpora cavernosa.

But before this spongy substance begins to surround
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the urethra, it forms a distinct oblong body, like a pear or onion, which is connected only to the lower convex side of the canal; and afterwards being split on each side, invests it quite round. This body is called the *bulb* of the urethra, being larger than any other part of that canal, and divided interiorly by a very fine membranous septum into two lateral parts; and therefore, when it is inflated, it appears to be double, or with two heads.

Prostata. The first portion of the urethra, or that which is not covered by the cavernous substance, and which from the bladder to the bulb is only a membranous canal, is sustained by a large solid whitish mass, of the figure of a chestnut, and situated between the bladder and the bulb of the urethra; its basis being toward the bladder, the apex or point toward the urethra, and the sides lying upward and downward.

This body is termed the *prostates*, from a Greek word that expresses its situation before the vesiculæ seminales, and implies a plurality, because it appears to be divided into two lateral lobes by a hollow groove, which runs through its upper side from the basis to the apex. The first portion of the urethra lies in this groove, adhering very closely to the prostates which surround it.

The body of the prostates lies on the intestinum rectum, and the apex is under the internal labium of the cartilaginous arch of the ossa pubis. The inner substance is spongy, but very compact; and in each lobe there are several folliculi, which open into the first portion of the urethra, toward the bottom of the groove, as we shall see hereafter. The small portion of the urethra, between the apex of the prostates and the bulb, perforates the interosseous ligament of the ossa pubis, formerly described. This portion is very short, its length being no more than what is sufficient to pass through the hole in the ligament; the backside of which consequently touches the apex of the prostates,

and its foreſide the bulb of the urethra. This portion might be called the *neck* of the urethra, and that which lies between the body of the bladder and the proſtates might be called the *neck* of the bladder.

Glans. The ſpongy ſubſtance of the urethra having reached the extremity of the corpora cavernoſa, forms a large head called the *glans*, which crowns the three ſpongy pillars; with this difference, however, that it is a continuation of the ſpongy ſubſtance of the urethra, and only adheres to the extremity of the corpora cavernoſa, without any direct communication.

It is for this reaſon, that if we blow into the ſpongy ſubſtance of the urethra, the glans is preſently inflated, and no air paſſes into the corpora cavernoſa; but when we blow into one of theſe bodies, the air paſſes immediately into the other, the urethra and glans remaining as they were.

The figure of the glans is that of a rounded cone, a little flattened at the lower part, and with an oblique prominent baſis; the circumference of which is ſomething greater than that of the corpora cavernoſa.

The ſpongy ſubſtance of the glans is thick and uniform next the corpora cavernoſa; but next the urethra it is perforated by a continuation of that canal, and is there no thicker than the urethra before the formation of the glans.

Therefore the canal of the urethra does not lie in the middle of the glans; but continues its direct courſe through the lower flat ſide of it, all the way to the extremity, where it terminates by an oblong orifice.

All the convex ſurface of the glans is covered by a fine villous ſubſtance, and that again by a fine membrane, reſembling the red part of the lips. The circumference of the baſis of the glans has a double row of ſmall papillæ, which may be reckoned ſebaceous glands, from which a thick matter is diſcharged.

Caruncula. We have ſeveral things to take notice of in the cavity of the urethra. At the bottom of the cavity

vity of the first portion, or that which lies within the prostates, there is a small oblong oval eminence, pretty large on the back part, and terminating forward in a point, called *caruncula*, or *verumontanum*. The large portion of it is commonly perforated by two holes, sometimes only by one, and very seldom by three; and these are the excretory orifices of the *vesiculæ seminales*; of which hereafter. Each orifice has a small thin membranous border, which may serve for valves to the excretory ducts of the *vesiculæ*.

On each side of the large portion of the *caruncula*, there are five or six holes ranked in form of a crescent round its lateral parts, which are the orifices of the excretory ducts of the prostates that come from the folliculi already mentioned, and run in an oblique course to the orifices, in a kind of membranous duplicature.

Vesiculæ seminales. The *vesiculæ seminales* are soft whitish knotted bodies, about three or four fingers breadth in length, one in breadth, and about three times as broad as thick, situated obliquely between the rectum and lower part of the bladder, in such a manner, as that their superior extremities are at a distance from each other, and their lower extremities united between those of the *vasa deferentia*, of which they imitate both the obliquity and the incurvation.

They are irregularly round on the upper part, and their breadth decreases gradually from thence. By the union of their lower extremities they form a kind of fork, the branches of which are broad, and bent like rams horns. These extremities are very narrow, and form a small neck, which runs behind the bladder toward its orifice, and continues its course in the groove of the prostates, through the substance of the contiguous portion of the urethra, till its extremities pierce the *caruncula* in the manner already said.

The inner substance of the *vesiculæ* is plaited, and in a manner distinguished into several *capsulæ* by convoluted folds. Their external surface is covered by a

fine membrane, which serves for a border and frænum to the folds, and is a true continuation of the cellular substance of the peritonæum. The vesiculæ may easily be unfolded, and all their contortions straightened; and by this means they become much longer than in their natural state.

Their inner surface is villous and glandular, and continually furnishes a particular fluid, which exalts, refines, and perfects the semen, which they receive from the vasa deferentia, and of which they are the repositories for a certain time.

The passage of the vasa deferentia into the vesiculæ, is very particular. I have already observed, that these canals are incurvated behind the bladder, and that their contracted extremities unite at that place. They unite in an angle, and run between the contiguous extremities of the vesiculæ; and this union is so close, that the adhering portions seem to form only one middle septum, between two small tubes; each of which is formed, partly by the extremity of one vas deferens, and partly by that of the neighbouring vesicula.

This lateral union of the extremities of the vas deferens, and vesicula seminalis on each side, forms likewise a kind of short septum, which terminates in a crescent, like a small semilunar valve; and the extremity of the vas deferens is narrower than that of the vesicula. By this mechanism, the fluid contained in each vas deferens has liberty to enter the contiguous vesicula; but that contained in the vesicula cannot return into the other canal.

If we blow into one of the vasa deferentia, after having compressed the urethra, the air inflates the contiguous vesicula seminalis, and the bladder of urine, without passing into the vesicula or canal of the other side, except we blow with too great violence.

Afterwards the two small tubes, formed each by the extremities of the vas deferens and vesicula, run in between the basis of the prostates and canal of the urethra; and

and perforating the sides of that canal obliquely, they terminate in the caruncula in the manner already said.

Lacunæ of the urethra. The inside of the canal of the urethra is lined by a fine membrane, full of capillary blood-vessels; and its surface is perforated by a great number of oblong holes, or small *lucunæ* of different sizes, the largest lying near the glands.

These *lucunæ* or orifices of the excretory ducts of the same number of small glands, are dispersed through the substance of the urethra: which ducts run for some way in the spongy substance along the convex side of the internal membrane of the urethra, and open obliquely from behind forward into the great canal. The edges of the *lucunæ* are semilunar, or like a crescent, because of the obliquity of their opening.

Anti-prostata. A little way from the beginning of the cellular substance of the urethra, we meet with two *lucunæ* more considerable than the rest, and their ducts are very long. These *lucunæ* and ducts lead to two glandular bodies, situated on the two convex sides of the spongy substance of the urethra near the bulb. Each of them is about the size of a cherry-stone; but they are oblong and flat, and covered entirely by the muscles called *acceleratores*; of which hereafter. These two bodies are commonly called *prostatæ inferiores*; but if their situation be carefully examined, they will be found to be higher than the true prostates. There is a third body of the same kind situated more anteriorly.

Orifice of the urethra. The cavity of the urethra resembles nearly that of a small writing-pen. It is not every where round, and towards the glans becomes broader and flatter on each side, especially in the glans itself, where there is a kind of oval or navicular fossula.

This canal terminates at the extremity of the glans by a narrow oblong orifice or fissure, which is much less than the rest of the cavity. The commissures of this small fissure are turned, one toward the convex, the

the other toward the flat side of the glans ; and the labia of the fissure are its lateral parts ; and it seems to be surrounded by fleshy fibres.

The common integuments. The integuments which cover all these parts are three or four in number. The first is the skin with the cuticula ; the second is the common cellular membrane, which in this place seldom contains any fat ; the third is termed *nervous* ; and the fourth is a particular cellular membrane, which is not always to be found.

Præputium. The first of these integuments, the skin, is a continuation of that of the pubes and scrotum ; and it adheres to the second all the way to the basis of the gland, where that second integument ends. The rest of the cutaneous integument covers the glans without adhesion, and terminates by an opening. This portion is named *præputium* ; and along the whole lower or back side, both of the whole integument in general, and of the *præputium* in particular, there runs a fine suture, which is a continuation of the raphe of the perinæum and scrotum.

The inner surface of the *præputium* is lined with a fine membrane from the opening all the way behind the basis of the glans, and the same membrane is folded from behind, forward, round the glans, forming the proper integument thereof, and covering very closely its whole villous surface, as far as the orifice of the urethra, where it joins the membrane which lines the inside of that canal.

This proper membrane of the glands, and internal membrane of the *præputium*, form conjointly along the flat part of the glans, from its basis to the orifice of the urethra, a membranous duplicature, which like a septum or mediastinum divides this part into two lateral portions, and limits the motions of the *præputium* ; for which reason it is called *frænum præputii*.

The surface of the internal membrane of the *præputium* discharges a fluid which prevents it from adhering

to the glans, and perhaps serves likewise to dilute that which is collected at the basis of the glans, from the glandulæ sebaceæ, already mentioned.

The second common integument of these parts, is nearly the same with what is every where found under the skin, except that it is not filled with fat, and that it is more fibrous than cellular, and a little loose. It accompanies the skin to the basis of the glans, as has been already observed.

Ligamentum suspensorium. The third common integument, improperly called *tunica nervosa*, is of a firm, elastic, ligamentary substance, and its fibres are sometimes of a yellowish colour. It invests the corpora cavernosa and urethra from the glans to the symphysis of the ossa pubis; and at some distance from these bones, it forms on the superior groove of the corpora cavernosa a close duplicature; and by this duplicature, a flat broad ligament which runs directly upward, and is inserted in the forementioned symphysis, as far as the tendinous basis of the muscoli pyramidales of the abdomen.

This ligament has been called *ligamentum elasticum*, because it yields and recovers itself; and *suspensorium*, because it suspends these parts, by means of its insertion in the symphysis. It sends off a detachment or ala toward each side, one edge of which is fixed between the musculus triceps and the corpus cavernosum, and forms the ligamentary expansion in which the dartos is inserted, as has been already said. It seems likewise to send down another elongation directly to the perinæum and anus.

The fourth integument of these parts is the tunica cellulosa of M. Ruysch, which immediately surrounds the corpora cavernosa and urethra, lying between these and the third integument, from which it seems to be distinguished only by the closeness and fineness of its texture; and it is sometimes hardly perceivable.

The muscles. Several muscles are inserted in the parts

parts which we have just described. They may be reckoned to be six in number, two for the corpora cavernosa, two for the urethra, and two common muscles called *transversales*.

The first two muscles are commonly termed *erectores*, but might be more properly named *ischio-cavernosi*. The next two are called *acceleratores*, but the name of *bulbo-cavernosi* would better agree to them. It may be observed, that the names taken from the supposed uses are very equivocal.

The musculi ischio-cavernosi lie along the roots of the corpora cavernosa; each of them being fixed by one extremity very obliquely, in the internal labium of the ramus of the os ischium, from the tuberosity upward. From thence it accompanies the root of the corpus cavernosum, all the way to the symphysis of the ossa pubis; and is fixed, by its other extremity, in the corpora cavernosa, near their union; where the fibres of both muscles meet, and are reciprocally expanded over both corpora. They lie a little lower and more interiorly than the roots of these cavernous bodies.

I have shown two other musculi accessorii, which I looked upon as lateral acceleratores, or as acceleratores accessorii; fixed lower and more interiorly in the os ischium than the former, which they accompany all the way to the corpora cavernosa, and then leaving them they are inserted chiefly in the urethra near the bifurcation of the musculus bulbo-cavernosus.

These bulbo-cavernosi, commonly termed *acceleratores*, form first of all a penniform muscle, by means of a middle tendon, fixed in the lower part of the interosseous ligament of the ossa pubis, and to the union of the musculi transversales with the sphincters of the anus. From which they pass in an expanded form over the bulb of the urethra, covering that bulb and the urethra itself, and adhering in some measure to both,

as high as the origin of the ligamentum suspensorium, the middle tendon answering to the septum of the bulb.

Afterwards the two fleshy planes separate, and run obliquely to the right and left hands, from behind forward, and from below upward; surrounding the corpora cavernosa, in the outer sides of which they are inserted. The middle tendon adheres very strongly to the lower part of the septum of the bulb, in which, and in the urethra itself, several of the fibres of these muscles are fixed.

The musculi transversi, called also *triangulares*, are two long, narrow, fleshy fasciculi, inserted, each, by one extremity, in the root or beginning of the ramus of the os ischium; from whence they run transversely along the edge of the interosseous ligament of the ossa pubis, as far as the apex of the prostates, where their other extremities meet, and form commonly a kind of digastric muscle, the middle of which gives insertion to the muscles of the urethra, and to the cutaneous sphincters of the anus.

Blood-vessels. The arteries of these parts come chiefly from the iliacæ internæ or hypogastricæ, and the rest from the iliacæ externæ or crurales. The principal arteries are termed *pudicæ*, of which one is external, the other internal.

The pudica externa sends a branch to each side, which having passed out of the pelvis by the side of the os sacrum, runs on the inside of the tuberculum ischii, to the roots of the corpora cavernosa, along the inside of the musculi ischio-cavernosi or erectores. It sends ramifications to the bulbous head of the urethra and to the corpora cavernosa; and together with the glutææ, with which it communicates in its passage, it likewise supplies the scrotum.

The pudica interna having furnished the intestinum rectum, bladder, vesiculæ seminales, and prostates, communicates with the hæmorrhoidales, passes under the

the arch of the ossa pubis, and partly enters the corpora cavernosa, and partly runs along their upper side, sending off small lateral branches, which surround these bodies, like irregular half arches, and penetrate them, by numerous ramifications.

The crural arteries send each likewise a branch, which, running behind the contiguous crural vein, is distributed to the integuments of the penis, by the name of *pudica externa*, and communicates, by lateral ramifications, with those of the *pudica interna*. These communications are not only between the internal and external pudicæ of the same side, but also between those of both sides, which reciprocally communicate with each other.

The distribution of the veins follows nearly that of the arteries; but they have more ramifications and communications, as in other places. The principal vein is that which passes directly under the symphysis of the ossa pubis between the two arteries, and runs along the whole superior groove formed by the union of the corpora cavernosa. It is very large, often double, and very seldom triple, but the trunks do not separate while in the groove; and it has a great number of valves.

This great middle vein is formed by the union of the hypogastric branches, which, after passing on the two inner sides of the pelvis, meet about the middle of the arch of the ossa pubis. At this place we observe a venal plexus, which covers the upper convex side of the first portion of the urethra, before it is surrounded by the spongy substance.

The spermatic vessels, of which I have already described the origin and course all the way to where they go out of the abdomen, having reached on each side near the testicle, are divided into two principal fasciculi, one of which is larger than the other. The largest is the anterior, and is distributed through the testicle, by a prodigious number of very fine capillary ramifications, which

which accompany all the convolutions and folds of the small canals.

The other fasciculus is posterior, and is distributed to the epididymis in the same manner.

The spermatic artery is accompanied by a ramus of the epigastric artery, which runs down on the side of it as far as the testicle, where they communicate reciprocally with each other. There is sometimes a small ramus of the hypogastric artery, which accompanies the vas deferens to the epididymis, and there communicates with the arteria spermatica.

Nerves. The nerves of these organs come from the lumbares and sacri; and they communicate with the sympathicus maximus, and plexus mesenterici. Near the arch of the os pubis, they form together, on each side, a particular rope, which passes under that arch along the upper side of the neighbouring corpus cavernosum, near the artery already mentioned.

In their passage over the corpora cavernosa, they send off a great many rami, which surround these bodies on all sides, between the skin and ligamentary integument; being so disposed, as that the arteries lie between them and the middle vein. They must be examined presently after the skin has been raised, because when the ramifications are dried by the air, they disappear.

There are two nerves which accompany the spermatic rope; whereof one comes from the nervi lumbares, near the anterior spine of the os ilium, which is incurvated in its passage out of the abdomen through the muscles, and serves to distinguish the cremaster; the other nerve comes from the plexus renalis.

There is likewise one nerve on each side; which being produced from the union of the second, third, and fourth pairs of the nervi sacri, especially from the third, goes out of the abdomen above the ligamentum ischio-sacrum, passes by the inside of the tuberosity and small branch of the os ischium, and is distributed to the corpora

pora cavernosa, to the muscles belonging to them, and to the neighbouring parts.

§ 21. *The Parts of Generation in Females.*

The parts of generation in females are several in number, some of them external and some internal; and they are all subordinate to one principal internal part, called the *uterus*. The other internal parts are the tubæ Fallopianæ, ovaria, vasa spermatica, ligamenta lata, the ropes or bands called *ligamenta rotunda*, and the canal of the uterus. The external parts are the pubes, the alæ, nymphæ, clitoris, orifice of the urethra, and orifice of the canal of the uterus.

Uterus. The uterus lies between the bladder and the intestinum rectum. It is a body inwardly hollow, outwardly of a whitish colour, of a pretty solid substance, and, except in time of pregnancy, of the figure of a flat flask, being in adults about three fingers breadth in length, one in thickness, and two in breadth at one end, and scarcely one at the other. This size varies, according to the age of the subject.

The broadest portion is termed the *fundus*, and the narrowest the *neck*. Its situation is oblique, the fundus being turned backward and upward, and the neck forward and downward; the broad sides lie next the rectum and bladder, and the narrow sides are lateral.

The cavity of the uterus is flat; and resembles an oblong triangle, the shortest side of which answers exactly to the fundus; and the two longest sides lie one on the right hand, the other on the left; and they are all bent inward, or toward the cavity formed by them.

Of the three angles of this cavity, the two which terminate the fundus are perforated each by a narrow duct, which with difficulty admits a hog's bristle. The third angle forms a flat duct wider than the former, which

which perforates the neck of the uterus lengthwise, and terminates at the extremity of that neck, by a transverse opening.

This opening is termed *the internal orifice of the uterus*; and in the natural state is narrower than the duct of the colum uteri, so that only a small stilet can be passed through it. At the edge of this orifice are several small holes, answering to the same number of glandular corpuscles, which discharge a viscid lymph.

The inner surface of the cavity of the uterus, is lined by a very fine membrane, which at the fundus or broad portion is smooth and even, but in the narrow portion which leads to the orifice, it is wrinkled in a particular manner.

The portion of this membrane, which covers the bottom of the cavity, is perforated by a great number of considerable holes, through which small drops of blood may be observed to pass, when the whole uterus is compressed; and sometimes it appears to have very small hairs or villi. Both these villi and holes are observed to be more or less tinged with blood, in those women who die in the time of their menses.

In the narrow part, which answers to the colum, each side is divided into two lateral parts by a kind of prominent longitudinal line, which is larger in the upper or anterior side, than in the lower or posterior.

On each side of these two longitudinal lines, there are lines or rugæ obliquely transverse, and disposed like branches, the longitudinal lines representing trunks. Between and round these rugæ, there are small lacunæ, through which a mucilaginous fluid is discharged that closes the orifice of the uterus. We observe likewise in the interstices between the rugæ, several transparent globular corpuscles, which a modern author took for a kind of ova.

Structure of the uterus. The substance of the body of the uterus is spongy and compact, with a copious

intertexture of vessels. Its thickness is nearly equal and uniform in the sides and edges; but the fundus is thicker toward the middle than toward the two angles, where the thickness decreases gradually. The edges are likewise much thinner near these angles, than near the extremity of the neck.

The uterus is covered by a portion of the peritonæum, which serves it for a coat, and is the continuation of that which covers the bladder and intestinum rectum, running up from the lower and posterior part of the bladder, over the anterior part of the uterus, and from thence over the fundus, and down the backside, and afterwards going to the rectum.

On each lateral part or edge of the uterus this portion of the peritonæum forms a broad duplicature, which is extended on each side, more or less directly to the neighbouring lateral parts of the pelvis, forming a kind of membranous septum, between the anterior and posterior halves of the cavity of the pelvis; and it is afterwards continued in a loose manner, with the peritonæum, on the sides of the pelvis.

Broad ligaments of the uterus. These two broad duplicatures have the name of *ligamenta lata*, and *vesper-tilionum alæ*. The upper edge of each is partly double, or folded, forming two small distinct duplicatures, which I term the *pinions of the broad ligaments*. The anterior pinion is more raised than the posterior, and they are both very loose.

The laminæ of all these duplicatures are connected by a cellular substance, in the same manner as the other duplicatures of the peritonæum; and they contain the Fallopian tubes, the ovaria, a part of the spermatic vessels, and of those that go to the body of the uterus; the ropes called the *round ligaments*, the nerves, &c.

Ovaria. The ovaria are two whitish oval, flat, oblong bodies, situated on the sides of the fundus uteri,
to

to which they are fixed by a kind of short round ligament, and inclosed, together with it, in the duplicature of the posterior pinion of the ligamenta lata.

They are composed of a compact spongy substance, and of several little balls, or transparent vesiculæ, which are called *ova*. The spongy substance surrounds each of these vesiculæ very closely, and seems likewise to furnish them with distinct spongy coverings or calices. These vesiculæ are to be carefully distinguished from other preternatural ones, termed *hydatides*.

The ligaments of the ovaria lie in the edges of the posterior pinions of the ligamenta lata, much in the same manner as the umbilical vein, in the anterior or umbilical ligament of the liver. They are round ropes of a filamentary texture, fixed by one extremity to the corner of the fundus uteri, a little above and behind the level of that fundus. They were formerly believed to be hollow, and looked upon as *vasa deferentia*.

Tubæ Fallopianæ. The Fallopian tubes are two flaccid, conical, and vermiform canals, situated more or less transversely on each side of the uterus, between the fundus and the lateral parts of the pelvis, and included in the anterior duplicatures or pinions of the ligamenta lata.

Each of them is fixed by its narrow extremities in the corner of the fundus uteri, into which it opens, though by so narrow a duct, as hardly to admit a large bristle. From thence their diameter augments by degrees all the way to the other extremity, where it is about one-third part of an inch. The body of the tubæ goes in a winding course, and their large extremity is bent toward the ovaria.

These large extremities are irregularly round, and terminate by a narrow orifice, a little plaited and turned toward the ovarium, where it presently expands in form of a membranous fringe, full of plaits and incisures.

These fringes are called the *broad ends of the Fallopian tubes*.

The breadth of the fringe is not equal in all parts. Its circumference is in a manner oval, and the longest segment of the fringe reaches to, and is fixed in the ovary. The folds are disposed like laminæ on the concave side.

These tubes are composed of fleshy fibres, whereof some are longitudinal, and some obliquely circular, with an intertexture of another very fine substance.

The anterior pinions of the ligamentum latum serve for a common or external coat to both tubæ; and also to connect them, in the same manner as the mesentery connects the intestines. From thence the tubæ, and especially their fringes, come to be loose, and their direction to be very imperfectly determined in the greatest part of the figures.

Their cavity is lined by a soft glandular membrane, which is plaited longitudinally, almost like the inner surface of the aspera arteria; and these folds are stronger and broader near the great extremities, than any where else. Their substance seems to be spongy, and the interstices between them are moistened more or less by a fluid, which is continually discharged there.

Blood-vessels. The blood-vessels of these parts are of different kinds, viz. the hypogastric arteries and veins, the ramifications of which belong chiefly to the body of the uterus; the spermatic vessels, and the two vascular ropes, called *ligamenta rotunda*, which might be more properly termed the *vascular ropes of the uterus* or of the *ligamenta lata*.

The hypogastric branches are arterial and venal ramifications, arising from the artery and vein of the same name, which having reached the lateral edges of the uterus, are distributed to all the parts thereof, both internal

ternal and external, forming a great number of incurvations and particular intertextures.

The arteries of one side communicate both upon the uterus, and through its whole substance, with those of the other side, and the arterial ramifications of each side form numerous anastomoses with each other. The veins communicate together on each side in the same manner; and all these blood-vessels communicate likewise with the spermatic vessels, with the vascular ropes of the ligamenta lata, and with the hæmorrhoidales.

These frequent anastomoses may be demonstrated by injecting or blowing into the hypogastric vessels, having first made proper ligatures to prevent the liquor or air from running into other parts. The extremities of these arteries terminate and open into the cavity of the uterus, as has been already said; and there is this peculiar to the veins, that they communicate with the hæmorrhoidales, and consequently with the vena portæ.

The spermatic vessels have nearly the same origin in females as in males, and likewise the same course and intertextures; but they never pass out of the abdomen, being wholly distributed to the ovaria and tubes; and they communicate with the hypogastrics, and with the vascular ropes of the ligamenta lata. The veins are very large in proportion to the arteries; and these vessels send out lateral ramifications, which seem to communicate with the mesaraicæ and vena portæ.

The vascular ropes, commonly called the *round ligaments*, are two long small fasciculi of arteries and veins, interwoven and connected together by a fine cellular substance; and they run in the great duplicature of the ligamenta lata, from each corner of the fundus uteri, as far as the annular openings of the abdominal muscles.

In this course, each rope thrusts outward or raises the anterior lamina of the duplicature, which consequently gives a kind of coat to these vascular fasciculi,

and makes them appear like distinct ropes connected to this foreside of the duplicatures.

They seem to arise from the communication between the vasa spermatica and hypogastrica, and might be reckoned a particular continuation of the spermatic vessels. The disposition of their adhesions to the angles of the fundus uteri, with respect to that of the tubes and ligaments of the ovaria, which lie all near each other, is this: The tubes lie highest, the ligaments of the ovaria most backward, and the vascular ropes forward, and a little lower than the ligaments of the ovaria.

Afterwards they run in a course, nearly resembling that of the spermatic vessels in males, pass out of the abdomen, through the openings of the abdominal muscles, and are lost in the fat of the upper and middle parts of the groins. It may be conjectured, that these vessels furnish the lacunæ; of which hereafter. As they pass out of the abdomen, they are accompanied by a production of the cellular portion of the peritonæum, as the spermatic rope in men, and by a fasciculus of fleshy fibres, representing a kind of cremaster.

Nerves, lymphatics, &c. Besides all the vessels hitherto mentioned, we observe nerves and lymphatics, to which we may add the lactiferous ducts that are seen in an advanced pregnancy. The nerves come from the lumbares, sacri, and sympathetici maximi, in the same manner as in males. The lymphatic vessels run chiefly in the coats continued from the peritonæum. I shall in another place explain the lactiferous ducts, and also the particular fibres which seem to be interwoven in the substance of the uterus in a pregnant woman, the innermost of which being disposed in a vortical or turbinated manner, gave occasion to M. Ruyfch to describe them particularly by the name of *musculus uteri orbicularis*.

Pubis. The pubis is that broad eminence at the lower part of the hypogastricum, between the two inguina, on which the hairs grow at a certain age, called in Latin by

by the same name, and almost of the same kind with those found under the axillæ. This eminence is owing to a particular thickness of the *membrana adiposa* which covers the forepart of the *ossa pubis*, and some small portions of the neighbouring muscles.

Sinus and alæ. The longitudinal cavity which reaches from the middle and lower part of the pubes, within an inch of the anus, was by the ancients termed *sinus*; and they called the lateral parts of the cavity *alæ*, which is a more proper name than that of *labia*, commonly given to them. The places where the *alæ* are joined above and below, are termed *commissures*; and may likewise be called *the extremities or angles of the sinus*.

The *alæ* are more prominent, and thicker above than below, and lie nearer each other below than above. They are chiefly composed of the skin, cellular substance, and fat. The exterior skin is a continuation of that of the pubes and inguina. It is more or less even, and furnished with a great number of glandular corpuscles, from which a whitish ceruminous matter may be expressed; and after a certain age it is likewise covered in the same manner with the pubes.

The inner side of the *alæ* is something like the red portion of the lips of the mouth; and it is distinguished every where from the external side by a kind of line, in the same manner as the red portion of the lips from the rest of the skin; being likewise thinner and smoother than the outward skin. A great number of pores are observable in it, and also numerous glandular corpuscles, which furnish a liquor more or less sebaceous; and these corpuscles are larger near the edges than in the other parts.

Lacuna. Near the inner edge of the inner surfaces of the *alæ*, on each side of the orifice of the canal of the uterus, we find a small hole more visible than the rest. These two holes are termed *lacuna*; and they communicate by two small ducts with the same number of follicular bodies lying in the substance of the *alæ*,

and which may be looked upon as small prostates answering to the glandulæ prostaticæ in males. When compressed, they discharge a viscid liquor.

Above the superior commissure, a thin flat ligament runs down from each small branch of the ossa pubis, which penetrates the fat in the substance of each ala, and is lost therein insensibly near the edge. These may be looked upon as the ligamenta suspensoria of the alæ. The inferior commissure of the alæ is very thin, or like a membranous ligament; and, together with the neighbouring parts of the inner side, it forms a fossula, termed *navicularis*, or *scaphoides*. The space between the inferior commissure and anus, termed *perinaum*, is about a large finger's breadth in length.

The other external parts are situated in the sinus, and hid by the alæ. Directly under the superior commissure, lies the clitoris, with its cover, called *præputium*. A little lower is the orifice of the urethra; and below that is the orifice of the great canal of the uterus. The circumference of this orifice is bordered, either by a membranous circle, called *hymen*, or by fleshy portions, termed *caruncula myrtiformes*. On each side of the clitoris begins a very prominent fold, like a crista, which runs down obliquely on each side of the orifice of the urethra. These folds are termed *nymphæ*, and they might likewise be named *crista clytoridis*. On each side of the great orifice lies the small prostatic hole already described.

Clitoris. The clitoris appears at first sight like a small imperforated glans. Its upper and lateral sides are covered by a kind of præputium, formed by a particular fold of a portion of the inner side of the alæ; which appears to be glandular, and to discharge a certain moisture; and its inside is granulated.

By dissection, we discover in the clitoris a trunk and two branches, as in the penis, made up of a spongy substance, and of very elastic coats, but without any urethra. This substance may be inflated either by air
or

or anatomical injections into the artery, &c. The trunk is divided into two lateral parts by a middle septum, from the bifurcation to the glans, where it is insensibly lost.

The bifurcation of the trunk is on the edge of the cartilaginous arch of the ossa pubis; and the branches, which resemble the roots of the corpora cavernosa, are inserted in the inferior rami of these bones, and in those of the ossa ischium, where they terminate by degrees; but there is sometimes a membranous tube on each side, which reaches to the tuberosity of the ischium.

The trunk of the clitoris is sustained by a ligamentum suspensorium fixed in the symphysis of the ossa pubis, and containing this trunk in its duplicature, nearly as in the other sex.

Four muscles or fasciculi of fleshy fibres are inserted in the trunk of the clitoris, two on each side. One of them runs down on the foreside of the neighbouring corpus cavernosum, and is inserted by a tendinous or aponeurotic portion, partly in the extremity of the corpus cavernosum, and partly in the tuberosity of the ischium. These two muscles are called *erectores*; but the name of *ischio-cavernosi* would be more proper.

The other muscle on each side lies under the former, and runs down on the side of the urethra and great orifice of the uterus all the way to the anus; increasing gradually in breadth in its passage, and terminating partly like that which is called *accelerator* in males.

These two muscles surround very closely the lateral parts of the urethra and of the great orifice. They expand very much as they descend, and are spread on the lower and lateral parts of the great orifice; for which reason several anatomists have looked upon them as muscular sphincters. All these four muscles, and especially the two latter, are oftentimes almost covered with fat.

The blood-vessels of the clitoris come chiefly from the hypogastricæ, and the nerves from the second and third

third pairs of the nervi sacri; by means of which they communicate with the inferior mesenteric plexus, and with the great sympathetici.

Nymphæ. The nymphæ, cristæ clitoridis, or, as they may likewise be termed, *alæ minores sive internæ*, are two prominent folds of the inner skin of the great or external *alæ*, reaching from the præputium of the clitoris to the two sides of the great orifice of the uterus. They begin very narrow; and having increased in breadth in their course downward, they are again contracted at their lower extremity.

They are of a spongy substance, intermixed with glands; several of which may be perceived by the naked eye. Their situation is oblique, their upper extremities lying near each other, and the lower at a much greater distance. In married women they are more or less flaccid and decayed.

Urethra. By the urethra in females, we mean the urinary duct; the orifice of which is between the nymphæ below the glans of the clitoris. The sides of this orifice are a little prominent and wrinkled, and perforated by small lacunæ, from which a viscid or mucilaginous liquor may be squeezed. In time of pregnancy, this orifice is sometimes drawn a little inward.

The body of the urethra is a spongy duct of the same structure as in males, but much more shorter, situated directly under the trunk of the clitoris, and above the great canal of the uterus, adhering to each of these canals between which it lies by membranous filaments. It passes under the cartilaginous arch of the ossa pubis, and terminates by an oblique opening at the neck of the bladder, being bent a little downwards between its two extremities.

The internal membrane of the urethra is a little plaited, and perhaps by small holes, which communicate with folluculi, lying hid in its substance, as in males. If we blow into one of these holes, we observe a small canal to be inflated, which runs from without inwards,
and

and terminates in some places by a kind of sacculus, by compressing which a viscid liquor is discharged.

The continuation of this membrane, which lines the neck of the bladder, forms likewise several rugæ, more or less equal; but that which lines the cavity of the bladder is wrinkled in an irregular manner when the bladder is empty.

The canal of the uterus. The great canal, formerly called the *neck* of the uterus, is situated below the urethra, and above the extremity of the intestinum rectum, a little obliquely, being more raised on the inner and back part than on the outer and fore part.

Its inner or posterior extremity joins the extremity of the body of the uterus, and surrounds its orifice much in the same manner as the duodenum surrounds the pylorus, or as the ileum is surrounded by the cæcum and colon.

The anterior extremity forms the great orifice, which lies under that of the urethra, and above the fossula of the inferior commissure of the alæ.

The body of the canal is chiefly made up of a spongy substance, interwoven with numerous blood-vessels; and it is commonly longer and narrower in virgins than in married women.

Its inner or concave surface has several transverse rugæ, and is covered by a particular membrane. The rugæ are formed by oblong narrow eminences, incurvated like portions of arches, placed very near each other, and disposed in such a manner as to divide the cavity of the canal into an upper and lower side.

By the union of the extremities of the upper and lower rugæ, a kind of raphe or suture is formed on the right and left sides; and both arches are sometimes intersected in the middle, and so form two half arches; but in this there is some variety.

In general, these arches are very considerable in young persons; become gradually more superficial in married women, and are quite lost in time of delivery.

The

The inner or posterior extremity of this great canal surrounds the orifice of the uterus a little obliquely, in such a manner as that the upper side of the canal lies very near the orifice, and the lower side at a greater distance from it; and this makes the extremity of the uterus appear to advance more into the canal on the lower than on the upper part.

Circulus membranofus. The exterior or anterior extremity of the great canal in virgins, and especially before the first eruption of the menses, is commonly bordered by circular membranous fold of different breadths, more or less smooth, and sometimes semilunar; which in some subjects leaves but a very small opening, in others a larger opening; and in all renders the external orifice narrower than the rest of the cavity. This fold, called *hymen*, is formed by the union of the internal membrane of the great canal with that on the inside of the alæ, and represents a membranous circle of different breadths, and sometimes uneven.

Caruncula. This membranous circle is commonly ruptured after the consummation of marriage; is quite lost in delivery, and afterwards only some irregular portions of it remain; which, from their supposed resemblance to myrtle-leaves, have been termed *caruncula myrtiformes*. This circle may likewise suffer some disorder by too great a flux of the menses, by imprudence, levity, and other particular accidents.

Plexus retiformis. Each side of the anterior portion of the great canal is covered exteriorly by a thin, broad, cavernous, and vascular plexus, called the *plexus retiformis* of that canal. These two planes run down on each side of the clitoris behind the nymphæ, and likewise cover the urethra like a collar, before they are spread on the great canal.

This plexus is strictly united to the muscular portions, commonly taken for accelerators or constrictors, lying between these portions and the lateral parts of the urethra and of the great canal.

This

This plexus may be inflated by air like a flaccid spleen, or like the spongy substance of the clitoris, with which it seems to have some communication; and on this account the lateral portions of this reticular plexus have been named the *internal crura* of the clitoris. It is a kind of rete-mirabile, composed of vessels which come chiefly from the hypogastricæ.

It still remains to be observed, that on each side of the bottom of the pelvis, in both sexes, opposite to the lower part of the bladder, there is an aponeurotic or tendinous ligament, which runs over the inner surface of the musculus obturator internus from before backward. The anterior extremity of this ligament is fixed on one side of the middle portion of the symphysis of the ossa pubis, and the posterior extremity to the middle part of the ligamentum sacro-sciaticum, formerly described.

A little above the elongation called the *neck* of the bladder, there is another ligamentary expansion on each side of the bladder; the forepart of which is narrow, and fixed to the anterior extremity of the ligament already mentioned; and the broad posterior part to the side of the bladder. These two lateral expansions may be looked upon as proper ligaments of the bladder, by which it is connected to the inner side of both ossa pubis.

To the anterior portion of each of these ligaments of the bladder is fixed a particular fasciculus of fleshy fibres, which run up obliquely on the foreside of the bladder; on which those of each side meeting together, form a kind of muscular intertexture, and unite with the most transverse fibres of the bladder.

These two muscular fasciculi form a part, and perhaps the principal part, of what is called the *sphincter* of the bladder: but to have a true idea of them, they must be examined *in situ*, without destroying any of their natural connections. When the bladder is removed out of its place, as is done in the common method
of

of dissection, these fasciculi are cut ; and thereby their direction being lost, they appear transverse, and are taken, by those who know no better, for portions of an orbicular sphincter.

In males, these two fasciculi are partly fixed in the prostates ; but in females they are very broad, and appear sometimes to be double on each side, one plane lying above the other. They are to be looked upon as true muscles, fixed by small tendons on the sides of the symphysis of the ossa pubis.

§ 22. *Of the Gravid Uterus.*

ART. I. OF CONCEPTION.

THE theory of conception is as intricate and obscure as the cause of the periodical evacuation of the catamenia : and many circumstances relating to generation will, perhaps, ever remain a mystery. The different hypotheses suggested on the subject may, however, be referred to the following.

I. To those who think that the rudiments of the fœtus are contained in the mother.

II. To those who are of opinion that they exist in the male.

III. To those who imagine the fœtus results from an union of both.

That each of these systems has had its several supporters and antagonists will not be surprising, when we consider the obscurity of the subject, as well as the extent of learning and brilliancy of imagination which have distinguished the several combatants. Harvey, our illustrious countryman, belongs to the first class ; the acute Leeuwenhoek, who perceived living animals, or bodies which resembled them, in the semen masculinum, has added lustre to the second ; and the Count de Buffon, whose ingenuity and acuteness are distin-

distinguishable even in an enlightened nation, is the chief supporter of the third opinion.

But a particular consideration of this subject is foreign to the design of the present work. It may suffice to observe, that the pride of science, and brilliancy of imagination, have been equally unsuccessful. To elude difficulties which they cannot conquer, modern philosophers have endeavoured to transfer the question; and by supposing the animal already to exist complete in its several parts, but of an astonishing minuteness, have rather laboured to show by what means it is animated, and by what assistances evolved.

This view, when extended to successive generations, at first startles the modest inquirer by its apparent absurdity, and perplexes the moderate calculator. It, however, is not more contradictory than many physiological positions which have never been controverted; and it is some addition to its credit, that it is supported by Bonnet and Haller. On this foundation, which is supported also by the authority of Harvey, the principle of animation must be the semen masculinum; and it is not entirely without reason, that Bonnet considers it as the first and chief support of the foetus: but an extensive period is required to evolve the several very intricate organs of which the human frame consists. The embryo is, at first, almost entirely vegetative: it adheres to the fundus uteri, and extracts the fluids of its mother without any exertions that are peculiarly its own. But it soon shows some marks of animation. Its heart is observed to beat: it seems to prepare fluids for its own purposes, and to separate those which are no longer beneficial: in short, it acquires a distinct system; from part of which it is supplied with the original portion of its fluid; and which it, in its turn, supplies with the same fluids more highly elaborated, and more carefully prepared. But this rather belongs to the history of the ovum, which we shall next consider.

ART. II. STRUCTURE of the OVUM in early GESTATION.

WHEN the germ is conveyed into the uterus, impregnation is said to take place. The ovum, soon after its introduction, adheres to some part of the internal surface of the uterus: at first it appears like a small vesicle, slightly attached; and gradually increases in bulk, till it apparently comes in contact with the whole cavity of the fundus.

The embryo, or unformed foetus, with placenta, umbilical cord, membranes, and waters, in early gestation, constitute the ovum; which then appears like a thickened fleshy mass, the more external lamellæ and other parts, which are afterwards separate and distinct, being blended and jumbled in such a manner that they cannot be readily distinguished or traced.

In the progress of gestation, the external lamellæ, or membranous surface, by stretching, grows thinner; the cavity which contains the rudiments of the foetus becomes more apparent; and then a thick vascular part on the outside of the chorion, called *placenta*, can be readily distinguished from the membranous portion of the ovum.

The external membranous part of the ovum (or bag which contains in its cavity the embryo, funis, and watery fluid in which the embryo floats) is originally composed of three coats: the internal lamella, or that next the foetus, is called *amnios*; the next is the *true chorion*; and the external is called the *false or spongy chorion*. But it is supposed to derive an extraordinary lamella immediately from the uterus, which constitutes the external covering of the ovum. This production, which is supposed to be entirely formed by a continuation of the internal membrane of the uterus, is at first loosely spread over the ovum, and afterwards comes in contact with the false chorion. These two lamellæ, which

which form the external vascular surface of the ovum, are much thicker than the internal membranes of the true chorion and amnios; and the proportion which they bear to the other parts is so great, that, in early conception, the mass of the ovum is chiefly composed of them. Dr Ruysch called this exterior coat the *tunica filamentosa*; more modern authors, the *false* or *spongy chorion*. But Dr Hunter has found the spongy chorion to consist of two distinct layers: that which lines the uterus he styles *membrana caduca* or *decidua*, because it is cast off after delivery; the portion which covers the ovum, *decidua reflexa*, because it is reflected from the uterus upon the ovum, forming the connecting medium between them. The portion which covers the ovum is a complete membrane, like the true chorion and amnios: but that which immediately lines the uterus is imperfect or deficient, being perforated with three foramina, viz. two small ones, corresponding with the insertion of the tubes at the fundus uteri; and a larger ragged perforation opposite to the orificium uteri.

Thus, according to Dr Hunter, the embryo, on its first formation in the ovum, and the foetus during the whole time of gestation, is inclosed in four membranes, viz. the double, false, or spongy chorion, called *membrana decidua*, and *decidua reflexa*; the true chorion, and the amnios, which include a fluid called the *liquor amnii*, in which the embryo floats.

The true chorion and the amnios are decidedly organized membranes, containing vessels, and composed of regular layers of fibres. The decidua, and decidua reflexa, differ in appearance, and seem to resemble those inorganic substances which connect inflamed viscera. If they be original membranes, and only visible from their evolution and increase, it is not easy to conceive how the ovum gets behind them, since the Fallopian tubes are not covered by them. We are therefore inclined to adopt an opinion suggested first by Mr Crookshanks,

and rendered probable by the experiments of Signor Scarpa, "That they are entirely composed of an inspissated coagulable lymph."

Between the amnion and chorion, a quantity of gelatinous fluid is contained in the early months; and a small bag, or white speck, is then observed on the amnion, near the insertion of the umbilical cord. It is filled with a white liquor, of a thick milky consistence; and is called *vesicula umbilicalis*, *vesicula alba* or *lactea*: it communicates with the umbilical cord by a small funis, which is made up of an artery and vein. This vesicle, and duct or tube leading from it, are only conspicuous in the early months; and afterwards become transparent, and of consequence invisible. Their use is not yet understood.

Though the bag, or external parts of the conception, at first form a large proportion of the ovum in comparison of the embryo or foetus, in advanced gestation the proportions are reversed. Thus an ovum between the eighth and ninth week after conception, is nearly about the size of a hen's egg, while the embryo scarcely exceeds the weight of a scruple: at three months, the former increases beyond the magnitude of a goose's egg, the weight above eight ounces; but the foetus does not then amount to three ounces: at six months, the foetus weighs twelve or thirteen ounces, and the placenta and membranes only seven or eight: at eight months, the foetus weighs between six and seven pounds, the secundines little more than one pound: at birth, the foetus weighs from ten to fourteen pounds, or more; but the placenta seldom increases much in bulk from between the seventh and eighth month.

Having described the ovum in early gestation, we shall next take a view of the germ; trace the progress of the embryo and foetus; then resume the subject of the ovum, to explain the structure of the membranes, placenta, &c. in advanced gestation, and point out the most

remarkable changes which the uterus suffers during impregnation.

ART. III. EVOLUTION of the FŒTUS.

THERE can be little doubt that all the parts of an animal exist completely in the germ, though their extreme minuteness and fluidity for some time conceal them from our sight. In a state of progression, some of them are much earlier conspicuous than others.

The embryo, in its original state, is probably entirely fibrous and nervous; and these primary parts seem to contain, in a small scale, all the others which are afterwards to be progressively evolved. Of the former, the heart and liver, of the latter, the brain and spinal medulla, first become conspicuous: for the spine or carina of the embryo is formed some time before any vestige of extremities begin to sprout. The encephalon, or head, and its appendages, first appear; then the thoracic viscera; next, the abdominal: at length the extremities gradually shoot out; the superior first, then the inferior: and, by slow and insensible gradation, the beautiful and admirable structure of the whole complicated system is evolved.

As soon as the embryo has acquired sufficient consistence to be the subject of any observation, a little moving point, which is the heart, discovers itself. Nothing, however, but general circumstances relating to the particular order and progress of the successive germination or evolution of the viscera, extremities, vascular system, and other parts of the human foetus, can be ascertained, as it is beyond the power of anatomical investigation.

It is also exceedingly difficult to determine the age or proportional growth of the foetus. The judgment we form will be liable to considerable variation: 1st, From the uncertainty of fixing the period of pregnancy; 2dly, From the difference of a foetus of the same age in

different women, and in the same woman in different pregnancies; and, lastly, Because the foetus is often retained *in utero* for some time after the extinction of its life.

The progress of the foetus appears to be much quicker in the early than latter months: but the proportional increase is attended with difficulty in the calculation; for this, among other reasons, that we have not an opportunity of knowing the magnitude or weight of the same foetus in different months. It will also, probably, be materially influenced by the health, constitution, and mode of life, of the parent.

A foetus of four weeks, is near the size of a common fly; it is soft, mucilaginous, seems to hang by its belly, and its bowels are only covered by a transparent membrane. At six weeks, the consistence is still gelatinous, the size about that of a small bee, the head larger than the rest of the body, and the extremities then begin to shoot out. At twelve weeks, it is near three inches long, and its formation pretty distinct. At four months, the foetus measures above five inches; at five months, between six and seven inches; at six months, the foetus is perfect in all its external parts, and commonly in length about eight, or between eight and nine inches; at seven months, it is between eleven and twelve inches; at eight months about fourteen or fifteen inches; and at full time, from eighteen to twenty-two and twenty-three inches. But these calculations, for the above reasons, must be very uncertain.

ART. IV. CONTENTS of the GRAVID UTERUS in advanced GESTATION.

THESE consist of the foetus, umbilical cord, placenta, membranes, and contained fluid. We have already traced the progress of the foetus; and shall proceed to describe the other parts of the ovum in advanced gestation, as just now enumerated.

Um-

Umbilical cord. The foetus is connected to the placenta by the umbilical cord, or navel-string; which may be defined, “ a long vascular rope, composed of two arteries and a vein, covered with coats derived from the membranes, and distended with a quantity of viscid gelatinous substance, to which the bulk of the cord is chiefly owing.”

The cord always arises from the centre of the child's belly, but its point of insertion in the cake is variable. Its shape is seldom quite cylindrical; and its vessels are sometimes twisted or coiled, sometimes formed into longitudinal fulci. Its diameter is commonly about the thickness of an ordinary finger, and its length sufficient to admit the birth of the child with safety, though the placenta should adhere at the fundus uteri. In length and thickness, however, it is liable to considerable variation. The extremity next the foetus is generally strongest; and is somewhat weaker and more slender next the placenta, according to its place of insertion; which, though commonly not far from the centre, is sometimes towards the very edge. This suggests an important advice to practitioners, to be cautious of pulling the rope to extract the placenta when they feel the sensation of its splitting as it were into two divisions, which will proportionally weaken its resistance, and render it liable to be ruptured with a very slight degree of force in pulling. The use of the cord is to connect the foetus to the cake, to convey the nutritious fluid from the mother to the child, and to return what is not employed.

Placenta. The placenta, cake, or after-birth, is a thick, soft, vascular mass, connected to the foetus by the funis umbilicalis, and to the uterus by means of the spongy chorion, as already explained. It differs in shape and size; it is thickest at the centre, and gradually becomes thinner towards the edges, where the membranes go off all round, making a complete

bag or involucre to surround the waters, funis, and child.

Its substance is chiefly vascular, and probably in some degree glandular. The ramifications of the vessels are very minute, which are unravelled by maceration, and, when injected, exhibit a most beautiful appearance resembling the bushy tops of a tree. It has an external convex, and an internal concave, surface. The former is divided into a number of small lobes and fissures, by means of which its adhesion to the uterus is more firmly secured. This lobulated appearance is most remarkable when the cake has been rashly separated from the uterus; for the membrana decidua, or connecting membrane between it and the uterus, being then torn, the most violent and alarming hæmorrhagies frequently ensue.

The internal concave surface of the placenta is loosely covered with the amnion, and by the chorion more immediately and intimately. From this internal surface arise innumerable ramifications of veins and arteries, which inosculate and anastomose with one another; and at last the different branches unite, and form the funis umbilicalis.

The after-birth adheres to every part of the internal surface of the uterus, as at the posterior and anterior superior parts, laterally; and sometimes, though more rarely, part of the cake extends over the orificium uteri; from whence, when the orifice begins to dilate, the most frightful and dangerous floodings arise. But the most common place of attachment of the cake is from the superior part of the cervix to the fundus.

Twins, triplets, &c. have their placenta, sometimes separate, and sometimes adhering together. When the placentæ adhere, they have generally the chorion in common; but each foetus has its distinct omnion. They are commonly joined together, either by an intervening membrane, or by the surfaces being contiguous to one another; and sometimes the vessels of the one cake anastomose with those of the other.

The

The human placenta, according to Dr Hunter, is similar in structure to that of quadrupeds; and seems to be composed of two distinct systems of parts, a spongy or cellular, and a vascular substance. It has of consequence two distinct sets of vessels. The spongy or cellular part, formed by the decidua, is derived from the mother; and, if filled with injection, will increase the placenta to nearly twice its ordinary thickness; the more internal vascular part belongs entirely to the fœtus, and can only be injected from the cord, as the spongy part by filling the vessels of the uterus. This will be better understood when the mode of circulation between the parent and child is explained.

MEMBRANES. These consist, externally, of two layers of the spongy chorion, called *decidua*, and *decidua reflexa*; internally, of the true chorion and the amnion. They form a pretty strong bag, commencing at the edge of the cake, going round the whole circumference, and lining the internal surface of the womb. When separated from the uterus, this membranous bag is slender and yielding, and its texture readily destroyed by the impulse of the contained fluid, the pressure of the child, or of the finger in touching; but in its natural state, while it lines the womb, and is in close contact with its surface, the membranous bag is so tough and strong as to give a considerable degree of resistance. It is also strengthened in proportion to the different layers of which it is composed, whose structure we shall proceed to explain more particularly.

1. The *membrana decidua*, or that lamella of the spongy false chorion which is in immediate contact with the uterus, is originally very thick and spongy, and exceedingly vascular, particularly where it approaches the placenta. At first it is loosely, as it were, spread over the ovum; and the intervening space is filled with a quantity of gelatinous substance. It gradually becomes more and more attenuated by stretching, and approaches nearer to the interior lamella of the decidua, called *de-*

cidua reflexa ; and about the fifth month the two layers come in contact, and adhere so as to become apparently one membrane.

2. *Decidua reflexa*. In its structure and appearance it is similar to the former, being rough, fleecy, and vascular, on its external surface ; internally, smoother, and perforated with a number of small foramina, which are the orifices of vessels that open into this internal surface. In advanced gestation, it adheres intimately to the former membrane, and is with difficulty separated when the double decidua comes off entire ; but the outer lamella more commonly adheres to the uterus after the placenta and other membranes are expelled, and is afterwards cast off with the cleansings.

The decidua reflexa becomes thicker and more vascular as it approaches the placenta, and is then blended with its substance, constituting the cellular or maternal part of the cake, as it is termed by Dr Hunter. The other or more internal part belongs to the foetus, and is styled the *fetal* part of the placenta.

The double decidua is opaque in comparison of the other membrane ; the blood-vessels are derived from the uterus, and can be readily traced into it. Dr Hunter supposes that the double decidua lines the uterus nearly in the same manner as the peritonæum does the cavity of the abdomen, and that the ovum is inclosed within its duplicature as within a double night-cap. On this supposition the ovum must be placed on the outside of this membrane, which is not very readily to be comprehended ; unless we adopt Signior Scarpa's opinion already mentioned, and suppose it to be originally entirely composed of " an inspissated coagulable lymph."

3. The *true chorion*, or that connected with the amnion, is the firmest, smoothest, and most transparent of all the membranes, except the amnios ; and, when separated from it, has a considerable degree of transparency. It adheres pretty closely to the internal surface

face of the cake, which it covers immediately under the amnios, and gives also a coat to the umbilical cord. It is connected to the amnion by means of a gelatinous substance, and is easily separated from it.

4. The *amnion*, or internal membrane, forms the external coat of the umbilical cord. This internal lamella of the membranous bag is by much the most thin, attenuated, and transparent of the whole; and its vessels are so delicate, that they can hardly be discovered; their diameters are so small, as to be incapable in their natural state of admitting globules of red blood. It is, however, firmer and stronger than the chorion, and gives the greatest resistance in the breaking of the membranes.

The small bag, called *vesicula umbilicalis*, formerly described, and only conspicuous in the early months from its situation, is placed between the amnion and chorion, near the attachment of the cord; and, from the colour of its contents, has been mistaken for the urachus: but there is no allantois in the human subject.

The allantois in quadrupeds is an oblong membranous sac, or pouch, placed between the chorion and amnion. This membrane communicates with the urachus, which in brutes is open, and transmits the urine from the bladder to the allantois.

5. The *waters* are contained within the amnion, and are called the *liquor amnii*. They are purest, clearest, and most limpid in the first months; acquiring a colour, and becoming somewhat ropy, towards the latter end. They vary in different subjects, both in regard to consistence and quantity; and, after a certain period, they proportionally diminish as the woman advances in her pregnancy. This liquor does not, in any respect, resemble the white of an egg; it is generally saltish, and therefore unfit for the nutrition of the child; some of it may perhaps be absorbed by the fœtus, but the child is chiefly nourished by the navel-string.

string. In the early months, the organs are not fit for swallowing; and monsters are sometimes born alive, where such organs are altogether wanting.

Water is sometimes collected between the chorion and amnion, or between the lamellæ of the chorion. This is called the *false water*. It is generally in much smaller quantity than the true water; and, without detriment to the woman, may flow at any time of pregnancy.

Having described the contents of the gravid uterus, let us consider the changes which that organ suffers during the progress of gestation, and explain the manner of circulation between the parent and foetus, and within the body of the foetus; after which we shall enumerate the most remarkable peculiarities of the *non-natus*.

ART. V. CHANGES of the UTERINE SYSTEM from IMPREGNATION.

THOUGH the uterus gradually increases in size from the moment of conception till full time, and although its distention is proportioned to that of the ovum, with regard to its contents, it is, strictly speaking, never completely distended; for in early gestation, they are entirely confined to the fundus; and, at full time, the finger can be passed for some way within the orificium uteri without touching any part of the membranes. Again, though the capacity of the uterus increases, yet it is not mechanically stretched, for the thickness of its sides does not diminish. The increased size seems, therefore, to depend on a proportionable quantity of fluids sent to that part, nearly in the same way the skin of a child, though it suffers so great distention, does not become thinner, but preserves its usual thickness.

This is proved from several instances of extra-uterine foetuses, where the uterus, though there were no contents, was nearly of the same size, from the additional quan-

quantity of fluids transmitted, as if the ovum had been contained within its cavity. Boehmerus relates the same circumstance, without attempting to explain it, in the history of a case of extra-uterine conception in the fifth month. The uterus is painted of a considerable size, though the foetus was contained in the ovarium.

The gravid uterus is of different size in different women; and will vary according to the bulk of the foetus and involucra. The situation also varies according to the increase of its contents, and the position of the body. For the first two or three months, the cavity of the fundus is triangular as before impregnation; but as the uterus stretches, it gradually acquires a more rounded form. In general, the uterus never rises directly upwards, but inclines a little obliquely; most commonly to the right side: its position is never, however, so oblique as to prove the sole cause either of preventing or retarding delivery.

Though considerable changes are occasioned by the gradual distention of the uterus, it is difficult to judge of pregnancy from appearances in the early months. For the first three months, the os tincæ feels smooth and even, and its orifice is nearly as small as in the virgin state. When any difference can be perceived, it will consist in the increased length of the projecting tubercle of the uterus, and the shortening of the vagina from the descent of the fundus uteri through the pelvis. This change in the position of the uterus, by which the projecting tubercle appears to be lengthened, and the vagina proportionally shortened, chiefly happens from the third to the fifth month. From this period the cervix begins to stretch and be distended, first at the upper part; and then the os tincæ begins also to suffer considerable changes in its figure and appearance. The tubercle shortens, and the orifice expands: but during the whole term of gestation, the mouth of the uterus is strongly cemented with a ropy mucus, which lines it and the cervix, and begins to be discharged on the approach

proach of labour. In the last weeks, when the cervix uteri is completely distended, the uterine orifice begins to form an elliptical tube, instead of a fissure; and sometimes, especially when the parietes of the abdomen are relaxed by repeated pregnancy, disappears entirely, and is without the reach of the finger in touching. Hence the os uteri is not placed in the direction of the axis of the womb, as has generally been supposed.

The progressive increase of the abdominal tumour, from the stretching of the fundus, affords a more decisive mark of the existence and period of pregnancy than any others; and the progress is nearly as follows.

About the fourth, or between the fourth and fifth month, the fundus uteri begins to rise above the pubes or brim of the pelvis, and the cervix to be somewhat distended. In the fifth month, the belly swells like a ball with the skin tense, the fundus extends about half way between the pubes and navel, and the neck is sensibly shortened. In the seventh month, the fundus, or superior part of the uterine tumour, advances as far as the umbilicus; and the cervix is then nearly three-fourths distended. In the eighth, it reaches mid-way between the navel and scrobiculus cordis; and in the ninth, to the scrobiculus itself, the neck then being entirely distended; which, with the os tincæ, become the weakest parts of the uterus. Thus at full time the uterus occupies all the umbilical and hypogastric regions: its shape is almost pyriform, that is, more rounded above than below, and having a stricture on that part which is surrounded by the brim of the pelvis.

During the progress of distention, the substance of the uterus becomes much looser, of a softer texture, and more vascular, than before conception; and the diameter of its vein is so much enlarged, that they have acquired the name of *sinuses*. They observe a more direct course than the arteries, which run in a serpentine manner through its whole substance, and anastomose
with

with one another, particularly at that part where the placenta is attached: It is in this part also that the vascular structure is most conspicuous.

The arteries pass from the uterus through the decidua, and open into the substance of the placenta in an oblique direction. The veins also open into the placenta; and by injecting these veins from the uterus with wax, the whole spongy or maternal part of the placenta will be filled.

The muscular structure of the gravid uterus is extremely difficult to be traced with any exactness. In the wombs of women who die in labour, or soon after delivery, fibres running in various directions are observable more or less circular. These seem to arise from three distinct origins, viz. from the place where the placenta adheres, and from the aperture or orifice of each of the tubes: but it is almost impossible to demonstrate regular plans of fibres continued any length without interruption.

The appendages of the uterus suffer also considerable changes; for the tubes, ovaries, and ligaments, gradually go off below the fundus as it stretches, and at full time are almost entirely obliterated. At full time, especially in a first pregnancy, when the womb rises higher than in subsequent impregnations, the ligamenta rotunda are considerably stretched; and to this cause those pains are probably owing which strike from the belly downwards in the direction of these vascular ropes, which are often very painful and distressing towards the latter end of gestation. Again, as the uterus, which is chiefly enlarged towards the fundus, at full time stretches into the cavity of the abdomen without any support, leaving the broad ligaments below the most bulky part, we can readily see, that by pulling at the umbilical cord to deliver the placenta, before the uterus is sufficiently contracted, the fundus may be pulled down through the mouth of the womb, even though no great violence be employed. This is styled the *inversion*

version of the uterus ; and is a very dreadful, and generally fatal, accident. It is the consequence only of ignorance or temerity ; and can scarcely happen but from violence, or from an officious intrusion on the work of nature, by pulling at the rope while the woman is faint or languid, and the uterus in a state of atony.

In some rare instances, the force of labour which propels the child where the cord is short naturally, or rendered so by circumvolutions round the body of the child, may, when the placenta adheres to the fundus uteri, bring it down so near the os tinæ, that little force would afterwards be sufficient to complete the inversion. This suggests a precaution, that in the above circumstances, if strong labour-pains should continue, or a constant bearing down ensue, after the delivery of the child, the practice of pulling by the cord should be carefully avoided, and the hand of the operator be prudently conducted within the uterus, to separate the adhesion of the cake, and guard against the hazard of inversion.

The ovaria also suffer some change from pregnancy.

A roundish figure of a yellow colour appears in one of them, called by anatomists the *corpus luteum* ; and in cases of twins, a corpus luteum often appears in each ovarium. It was imagined to be the calyx ovi ; and is observed to be a gland from whence the female fluid or germ is ejected. In early gestation, this cicatrix is most conspicuous, when a cavity is obvious, which afterwards collapses.

If the ovarium be injected in the latter months, the corpus luteum will appear to be composed chiefly of vessels. A portion of it, however, in the centre, will not be filled ; from which it is, with some reason, suspected that it is a cavity, or that it contains a substance not yet organized.

ART. VI. MANNER of CIRCULATION between the MOTHER and FOETUS.

AFTER many disputes on this subject, it is now generally allowed, that the communication between the parent and child is carried on entirely by means of the placenta, whose spongy surface adheres to the internal surface of the womb, and receives the finer part of the arterial blood of the mother by absorption. No anastomoses of blood-vessels between them have yet been clearly shown by the experiments of any physiologist; nor has any coloured injection been pushed from the uterus into the anterior vascular part of the cake, nor from the foetus or umbilical vessels into the cellular part, except by the force of extravasation. This cellular part of the placenta is probably derived from the decidua; and is not a spongy inorganic substance, merely intended for the attachment of the cake, but probably a regularly constructed and organized part belonging to the mother. The cells, therefore, cannot be filled by injection from the umbilical vessels, though an injection will readily pass from the vessels of the uterus.

We find the same structure obtain in cows, where the cellular can be easily separated from the vascular part, and the distinct property of each ascertained.

As the structure of the cellular part of the placenta is somewhat similar to that of the more simple glands, it may be reasonably inferred, that it is intended for other purposes besides merely absorbing blood, and conveying it to the umbilical vessels of the child. It seems probable, therefore, that an operation similar to secretion is carried on in the placenta; that the veins and arteries of the foetus, in the vascular part of the cake, are continuous; and that absorbents arise in the follicles, which soon terminate in veins. From this view it appears, that the placenta is not only the connecting
me-

medium between the mother and child, intended for conveying and returning the nutritious fluid from the one to the other, but also changes and prepares it, in a particular manner, for circulating through the minute vessels of the delicate foetus.

This mode of circulation is admirably well contrived for the preservation of the child from diseases which would otherwise be communicated from the mother. If the mutual communication were kept up by continuous vessels, the foetus would constantly be in danger of suffering when the mother's circulation was accelerated or otherwise disturbed.

ART. VII. CIRCULATION in the FOETUS.

THE finer part of the arterial blood of the mother, transmitted, in the manner just now mentioned, from the uterus to the placenta, and conveyed along the umbilical cord to the foetus for its support and increase, circulates in the system of the non-natus in the following manner.

The blood passes directly from the placenta into the umbilical vein; which, running along the funis, perforates the belly of the foetus, and enters under the liver, where it divides into two branches, nearly at half a right angle. One of these branches, called the *ductus venosus*, carries part of this liquor immediately to the lower vena cava. The other carries the rest to the vena portarum; where, after circulating through the liver, it also gets into the vena cava, and so to the heart: but the circulation here is carried on without any necessity for the lungs being dilated. For foetuses have an oval hole open between the two auricles of the heart, and a large communicating canal, called *canalis arteriosus*, going between the pulmonary artery and aorta; which two passages allow the rest of this circulating fluid, that returns by the cava superior, to be transmitted to the aorta, without passing through the lungs.

The

The blood is returned from the foetus by the *arteria umbilicales*, which take their rise sometimes from the trunk of the aorta, and sometimes from the iliac arteries of the foetus; and, running by the external sides of the bladder, ascend to go out at the navel.

Thus there are three circulations belonging to the foetus, *viz.* one between the uterus and placenta, by absorption; one between the placenta and foetus, by a continuation of vessels through the cord; and one within the foetus itself.

ART. VIII. POSITION of the FOETUS in UTERO.

THE foetus is commodiously adapted to the cavity of the uterus, and describes an oblong or oval figure; its several parts being collected together in such a manner as to occupy the least possible space. The spine is rounded, the head reclines forward towards the knees, which are drawn up to the belly, while the heels are drawn backwards towards the breech, and the hands and arms are folded round the knees and legs. The head of the child is generally downwards. This does not proceed, as was commonly alleged, from the funis not being exactly in the middle of the child's body, for it is not suspended by the funis: the reason is, because the superior parts are much larger and heavier in proportion than the inferior. When other parts present, it seems owing to the motion of the child altering its figure when the waters are much diminished in quantity, or to circumvolutions of the cord: when the position is once altered, it becomes confined or locked in the uterus, and cannot easily resume its original posture.

As the figure of the foetus is oval, and the head naturally falls to the most depending part of the uterus, the vertex generally points to the os tincæ, with the ears diagonally in the pelvis between the pubes and sacrum. The foetus is mechanically disposed to assume

this position from its peculiar figure and construction, particularly by the bulk of the head and articulation with the neck, by the action of its muscles, and by the shape and construction of the cavity in which it is contained.

ART. IX. PECULIARITIES of the FOETUS.

THE foetus, both in external figure and internal structure, differs materially, in many striking circumstances, from the adult. It is sufficient for our present purpose to mention a few particulars.

The head is very large in proportion to the rest of the body: the cranial bones are soft and yielding, and the sutures not yet united, so that the bulk of the head may be diminished in every direction, and its passage consequently be rendered more commodious. The bones of the trunk and extremities, and all the articulations, are also remarkably flexible. All the apophyses are epiphyses; even the heads and condyles and brims of cavities, instead of bone, are of a soft cartilaginous consistence.

The brain, spinal marrow, and whole glandular as well as nervous and sanguiferous systems, are considerably larger in proportion in the foetus than in the adult. It has a gland situated in the forepart of the chest between the laminæ of the mediastinum, called the *thymus*. The liver and kidneys are much larger in proportion; and the latter are divided into a number of small lobes, as in the brute.

The foetus also differs in several circumstances from a child who has breathed.

The cavity of the thorax is less in proportion than after respiration. The lungs are smaller, more compact, of a red colour like the liver, and will sink in water; but putrefaction, and a particular emphysema, as in diseases of cattle, and blowing into them, will make them swim: which should prevent us from hastily determining,

ning, from this circumstance, whether a child has breathed or not; which we are often called on to do. Neither does their sinking prove that the child never breathed; for a child may die, or be strangled in the birth, or immediately after, before the lungs are fully inflated.

The arterial and venous systems are also different from that of the child. Hence the difference in the manner of circulation already taken notice of.

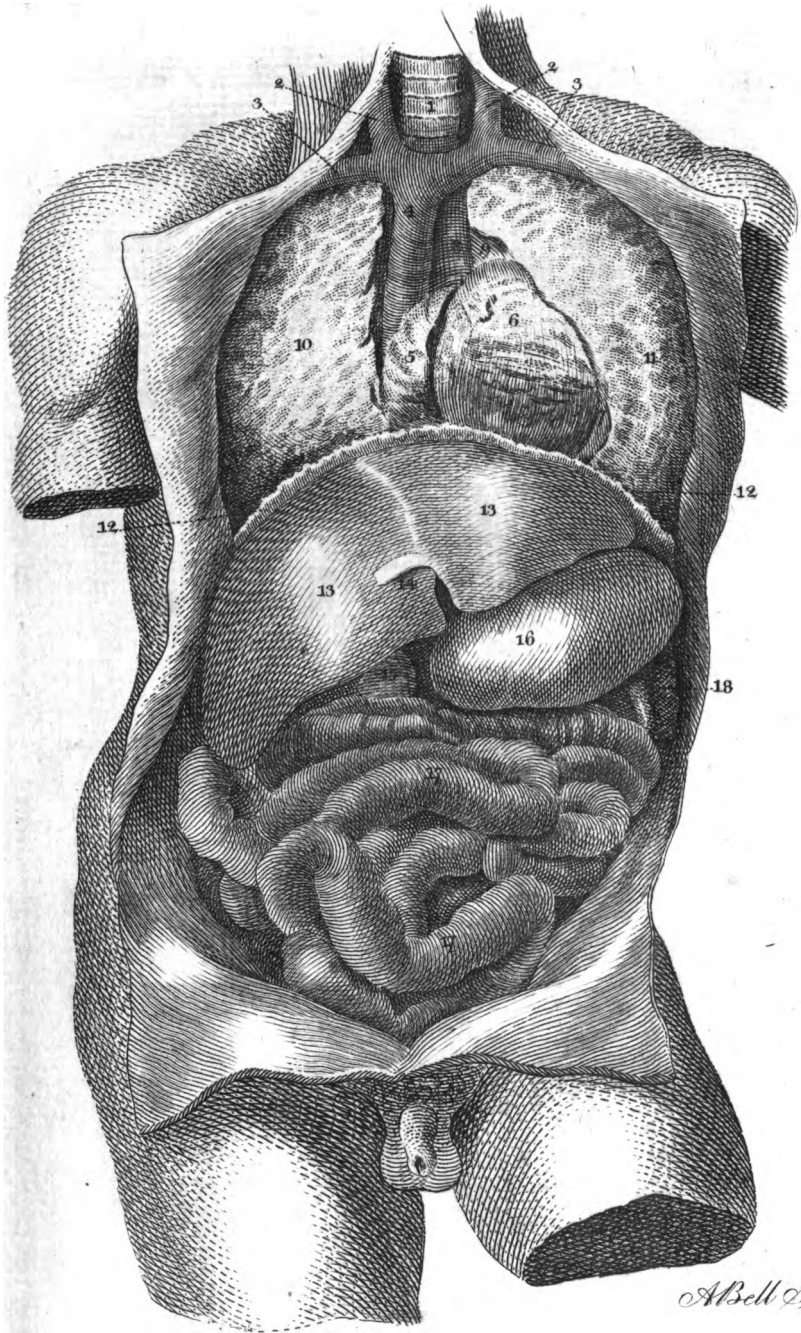
EXPLANATION of TAB. IX.

1. Trachea.
2. The internal jugular vein.
3. The subclavian vein.
4. Vena cava descendens.
5. The right auricle of the heart.
6. The right ventricle, the pericardium being removed.
7. Part of the left ventricle.
8. Aorta ascendens.
9. Arteria pulmonalis.
10. The right lobe of the lungs, part of which is cut off to show the great blood-vessels.
11. The left lobe of the lungs.
12. The diaphragm.
13. The liver.
14. The ligamentum rotundum.
15. The bottom of the gall-bladder projecting beyond the anterior edge of the great lobe of the liver.
16. The stomach, pressed by the liver toward the left-side.
17. The small guts.
18. The spleen.

EXPLANATION of TAB. X.

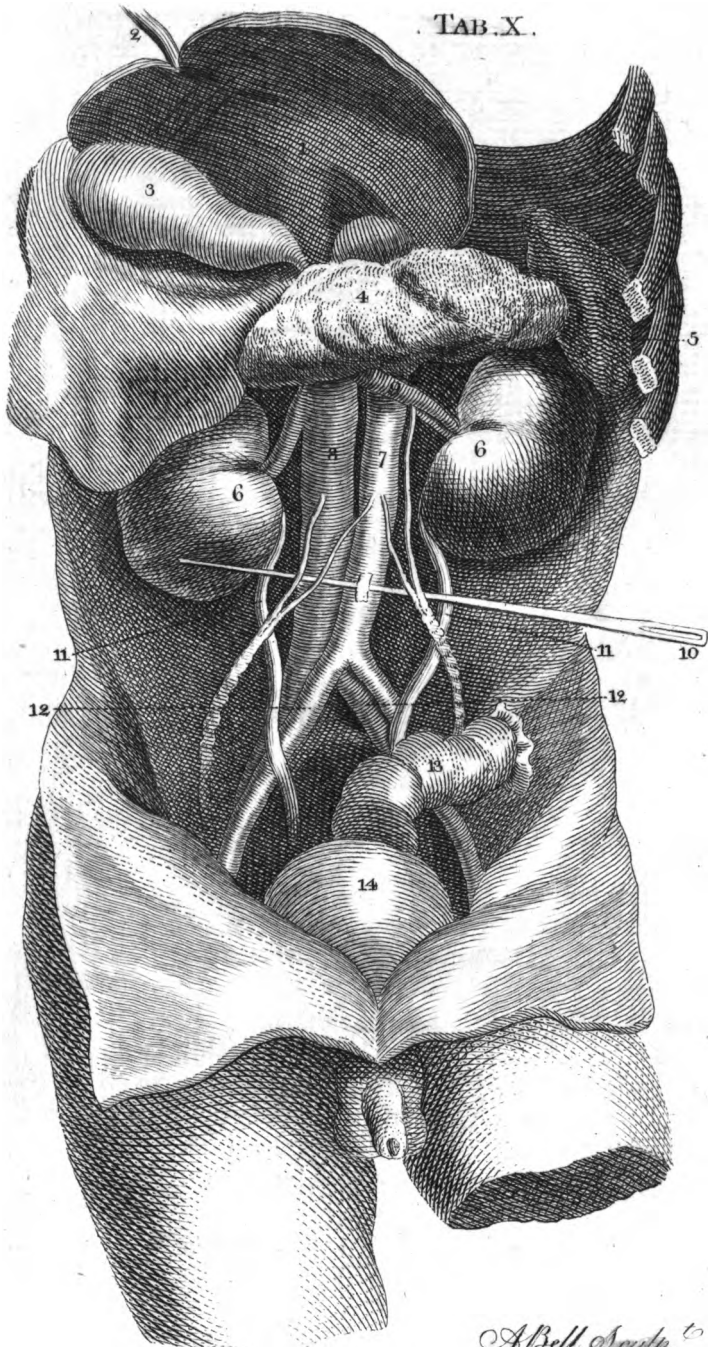
1. The under side of the liver.
2. Ligamentum rotundum.
3. The gall-bladder.
4. The pancreas.
5. The spleen.
6. The kidney.
7. Aorta descendens.
8. Vena cava ascendens.
9. The emulgent vein.
10. A probe under the spermatic vessels and the *arteria mesenterica inferior*, and over the *ureters*.
11. The ureter.
12. The iliac vessels.
13. The rectum intestinum.
14. The bladder of urine.

TAB. IX.

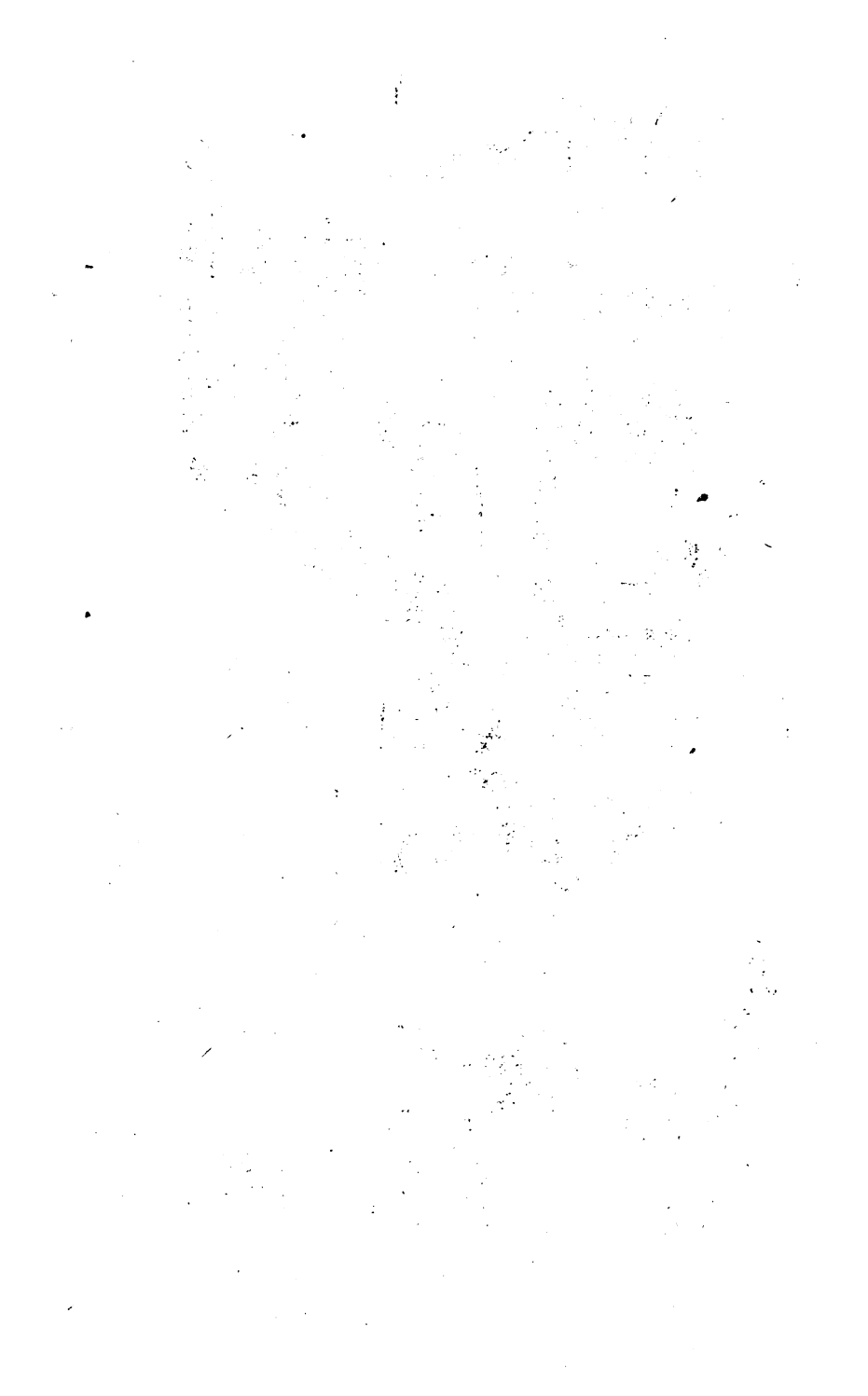




TAB. X.



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SYSTEM OF ANATOMY.

PART VII. OF THE VESSELS.

CHAP. I Of the ARTERIES *.

Introduction. **T**HE heart throws the blood into two great arteries; one of which is named *aorta*, the other *arteria pulmonalis*.

The *aorta* distributes the blood to all the parts of the body, for the nourishment of the parts, and for the secretion of different fluids.

The *arteria pulmonalis* carries the venal blood thro' all the capillary vessels of the lungs.

Both these great or general arteries are subdivided into several branches, and into a great number of ramifications.

The pulmonary artery. "The pulmonary artery goes
Cc 3 out

out from the right ventricle of the heart; and its trunk having run almost directly upward as high as the curvature of the aorta, is divided into two lateral branches, one going to the right side, called the *right pulmonary artery*, the other to the left side, termed the *left pulmonary artery*. The right artery passes under the curvature of the aorta, and is consequently longer than the left. They both run to the lungs, and are dispersed through their whole substance by ramifications nearly like those of the bronchia, and lying in the same directions. From the pulmonary arteries the blood is returned by the veins, which, contrary to the course of the arteries, begin by very minute canals, and gradually become larger, forming at length four large trunks called *pulmonary veins*, which terminate in the left auricle by one common opening, from whence the blood passes into the left ventricle. From this the aorta goes out in a direct course, nearly over-against the fourth vertebra of the back. Its course, I say, is direct with respect to the heart; but with respect to all the rest of the body, it ascends obliquely from the left to the right hand, and from before, backward.

Soon after this, it bends obliquely from the right hand to the left, and from before, backward, reaching as high as the second vertebra of the back; from whence it runs down again in the same direction, forming an oblique arch. The middle of this arch is almost opposite to the right side or edge of the superior portion of the sternum, between the cartilaginous extremities or sternal articulations of the first two ribs.

From thence the aorta descends in a direct course along the anterior part of the vertebræ, all the way to the os sacrum, lying a little toward the left hand; and there it terminates in two subordinate or collateral trunks, called *arteriæ iliacæ*.

General division of the aorta. The aorta is by anatomists generally divided into the aorta ascendens and aorta descendens, though both are but one and the same trunk.

trunk. It is termed *ascendens*, from where it leaves the heart to the extremity of the great curvature or arch. The remaining part of this trunk from the arch to the os sacrum or bifurcation already mentioned, is named *descendens*.

The aorta descendens is further divided into the superior and inferior portions; the first taking in all that lies above the diaphragm; the other, all that lies between the diaphragm and the bifurcation.

The aorta ascendens is chiefly distributed to part of the thorax, to the head and upper extremities. The superior portion of the aorta descendens furnishes the rest of the thorax; the inferior portion furnishes the abdomen and lower extremities.

The great trunk of the aorta, through its whole length, sends off immediately several branches, which are afterwards differently ramified; and these arterial branches may be looked upon as so many trunks with respect to the other ramifications, which again may be considered as small trunks with regard to the ramifications that they send off.

The branches which go out immediately from the trunk of the aorta, may be termed *original* or *capital branches*; and of these some are large, and others very small.

The large capital branches of the aorta are these: two arteriæ subclaviæ; two carotides, one cæliaca, one mesenterica superior, two renales, formerly termed *emulgentes*, one mesenterica inferior, and two iliacæ.

The small capital branches are chiefly the arteriæ coronariæ cordis, bronchiales, œsophagææ, intercostales, diaphragmaticæ inferiores, spermaticæ, lumbares, and farcæ.

These capital branches or arteries are for the most part disposed in pairs; there being none in odd numbers but the cæliaca, the two mesentericæ, some of the œsophagææ, the bronchialis, and sometimes the sacra.

The ramifications of each capital branch are in un-

ven numbers with respect to their particular trunks; but with respect to the ramifications of the like capital trunks on the other side, they are disposed in pairs. Among the branches there are in odd numbers, none but the *arteria sacra* when it is single, and the *œsophagææ*, the ramifications of which are sometimes found in pairs.

Before I enter upon the detail of each of these particular arteries, many of which have proper names; it will be convenient to give a short view of the disposition and distribution of the principal arterial branches, as a general plan to which all the particularities of each distribution may afterwards be referred: for I have found by experience, that the common method of describing the course of all the ramifications of these vessels, without having first given a general idea of the principal branches, is very troublesome to beginners.

General distribution of the branches of the aorta. The aorta gives rise to two small arteries, called *coronariæ cordis*, which go to the heart and its auricles; one of which is situated anteriorly, the other posteriorly, and sometimes they are three in number.

From the upper part of the arch or curvature, the aorta sends out commonly three, sometimes four, large capital branches, their origins being very near each other. When there are four, the two middle branches are termed *arteriæ carotides*; the other two, *subclaviæ*; and both are distinguished into right and left.

When there are but three branches, which is oftenest the case, the first is a short trunk, common to the right subclavian and carotid; the second is the left subclavian; and the third the left carotid. Sometimes, tho' very rarely, these four arteries unite in two trunks.

The origin of the left subclavian terminates the aorta ascendens; but I have sometimes observed four branches, the first three of which were those already mentioned, and the fourth a distinct trunk of the left vertebral artery,

It must be observed, that these large branches which arise from the curvature of the aorta, are situated obliquely; the first, or that which is most on the right hand, lying more forward than the rest, and the last, which is most on the left hand, more backward. The first and second, or middle branches, are generally in the middle of the arch, and the third lower down. Sometimes the first alone is in the middle; all which varieties depend on the obliquity of the arch.

The carotid arteries run up directly to the head, each of them being first divided into two, one external, the other internal. The external artery goes chiefly to the outer parts of the head and dura mater, or first covering of the brain. The internal enters the cranium through the bony canal of the os petrosum; and is distributed through the brain by a great number of ramifications.

The subclavian arteries separate laterally and almost transversely, each toward that side on which it lies, behind and under the claviculæ, from whence they have their name. The left seems to be shorter, and runs more obliquely than the right.

The subclavian on each side terminates at the upper edge of the first rib, between the lower insertions of the first scalenus muscle; and there, as it goes out of the thorax, takes the name of *arteria axillaris*.

During this course of the subclavian artery, taking in the common trunk of the right subclavian, several arteries arise from it, viz. the mammaria interna, mediastina, pericardia, diaphragmatica minor five superior, thymica, and trachealis.

The thymica and trachealis on each side are in some subjects only branches of one small trunk which springs from the common trunk of the right subclavian and carotid.

They are generally small arteries, which run sometimes separate, and sometimes partly separate and partly joined.

The

The subclavian sends off likewise the *mammaria interna*, *vertebrales*, *cervicales*, and sometimes several of the upper *intercostales*.

The axillary artery, which is only a continuation of the subclavian, from where it goes out of the thorax to the axilla, detaches chiefly the *mammaria externa* or *thoracica superior*, *thoracica inferior*, *scapulares externæ*, *scapularis interna*, *humeralis* or *muscularis*, &c. Afterwards it is continued, by different ramifications and under different names, over the whole arm, all the way to the ends of the fingers.

The superior portion of the *aorta descendens* gives off the *arteriæ bronchiales*, which arise sometimes by a small common trunk, sometimes separate, and sometimes do not come immediately from the aorta. It next sends off the *œsophagææ*, which may be looked upon as *mediastinæ posteriores*; and then the *intercostales* from its posterior part, which in some subjects come all from this portion of the aorta, in others only the lowest eight or nine.

The small anterior arteries here mentioned are generally, at their origins, single and in uneven numbers, but they divide soon after toward the right and left.

The inferior portion of the descending aorta, as it passes through the diaphragm, gives off the *diaphragmaticæ inferiores*, or *phrenicæ*, which however do not always come immediately from the aorta. Afterwards it sends off several branches anteriorly, posteriorly, and laterally.

The anterior branches are *cæliaca*, which supply the stomach, liver, spleen, pancreas, &c.; the *mesenterica superior*, which goes chiefly to the mesentery, to the small intestines, and to that part of the great intestines which lies on the right side of the abdomen; the *mesenterica inferior*, which goes to the great intestines on the left side, and produces the *hæmorrhoidalis interna*; and lastly, the right and left *arteriæ spermaticæ*.

The posterior branches are the *arteriæ lumbares*, of which

which there are several pairs, and the sacrae, which do which not always come from the trunk of the aorta.

The lateral branches are the capsulares and adiposae, the origin of which often varies; the renales, formerly termed *emulgentes*, and the iliacae, which terminate the aorta by the bifurcation already mentioned.

The iliac artery on each side is commonly divided into the external or anterior, and internal or posterior.

The internal iliaca is likewise named *arteria hypogastrica*; and its ramifications are distributed to the viscera contained in the pelvis, and to the neighbouring parts, both internal and external.

The iliaca externa, which is the true continuation of the iliac trunk, and alone deserves that name, goes on to the inguen, and then out of the abdomen, under the ligamentum Fallopii; having first detached the *epigastrica*, which goes to the muscoli abdominis recti. Having quitted the abdomen, it commences *arteria cruralis*, which runs down upon the thigh, and is distributed by many branches and ramifications to all the lower extremity.

I shall now go on to examine particularly all the capital or original branches of the aorta, from their origin to the entry of them, and of their ramifications into all the parts of the body, and all the different viscera and organs.

Arteria cardiaca sive coronaria cordis. The cardiac or coronary arteries of the heart, arise from the aorta immediately on its leaving the heart. They are two in number; and, according to the natural situation of the heart, one is rather superior than anterior, the other rather inferior than posterior.

They go out near the two sides of the pulmonary artery; which having first surrounded, they afterwards run upon the basis of the heart in form of a kind of crown or garland, from whence they are called *coronariae*; and then pursue the superficial traces of the union
of

of the two ventricles, from the basis of the heart to the apex.

They send communicating branches to each other, which are afterward lost in the substance of the heart, as shall be shown more particularly in describing that organ.

We sometimes meet with a third coronary artery, which arises from the aorta more backward, and is spent on the posterior or lower side of the heart.

The arteriæ carotides in general. The carotid arteries are commonly demonstrated after the subclavian; but I choose to describe them first, that I may afterwards be able to pursue the arteries of the thorax, arising partly from the subclaviæ, and partly from the aorta descendens, without interruption.

These arteries are two in number, one called the *right carotid*, the other the *left*. They arise near each other, from the curvature or arch of the aorta; the left immediately, the right most commonly, from the trunk of the subclavia on the same side, as has been already observed.

They run upon each side of the trachea arteria, between it and the internal jugular vein, as high as the larynx, without any ramification. During this course, therefore, they may be named *carotid trunks*, or general, common, and original carotids. Each of these trunks is afterwards ramified in the following manner.

The trunk having reached as high as the larynx, is divided into two large branches or particular carotids; one named *external*, the other *internal*; because the first goes chiefly to the external parts of the head, the second enters the cranium, and is distributed to the brain.

The external carotid is anterior, the internal posterior; and the external is even situated more inward and nearer the larynx than the other; but the common
names

names may still be retained, as being taken, not from their situation, but from their distribution.

Arteria carotis externa. The external carotid is the smallest, and yet appears by its direction to be a continuation of the common trunk. It runs insensibly outward, between the external angle of the lower jaw and the parotid gland, which it supplies as it passes. Afterwards it ascends on the fore-side of the ear, and ends in the temples.

In this course it sends off several branches, which may well enough be divided into anterior or internal, and posterior or external; and the principal branches of each kind are these.

The first anterior or internal branch goes out from the very origin of the carotid on the inside; and having presently afterward taken a little turn, and sent off branches to the jugular glands near it to the fat and skin, it runs transversely, and is distributed to the glandulæ thyroidææ, and to the muscles and other parts of the larynx; for which reason I name it *laryngææ*, or *gutturalis superior*. It likewise sends some branches to the pharynx and muscles of the os hyoides.

The second anterior branch passes over the nearest cornu of the os hyoides to the muscles of that bone and of the tongue; and to the glandulæ sublinguales; afterwards passing before the cornu of the os hyoides, it loses itself in the tongue; from whence it has been called *arteria sublingualis*; and it is the same artery which others have named *ranina*.

The third branch, or *arteria maxillaris inferior*, goes to the maxillary gland, to the styloide and mastoide muscles, to the parotid and sublingual glands, to the muscles of the pharynx, and to the small flexors of the head.

The fourth branch, which I name *arteria maxillaris externa*, passes anteriorly on the masseter muscle, and middle of the lower jaw near the chin; from whence it has a denomination, in some languages, which can-

not

not be expressed in English. Afterwards it runs under the musculus depressa angulioris, which it supplies, as well as the buccinator and the depressor labii inferioris.

It sends off a particular branch, very much contorted, which divides at the angular commissure of the lips, and running in the same manner along the superior and inferior portions of the musculus orbicularis, it communicates on both sides with its fellow, and thereby forms a kind of arteria coronaria labiorum.

Afterwards it ascends toward the nares, and is distributed to the muscles, cartilages, and other parts of the nose, sending down some twigs which communicate with the coronary artery of the lips. Lastly, it reaches the great angle of the eye, and is ramified and lost on the musculus orbicularis palpebrarum, superciliaris, and frontalis. Through all this course it is named *arteria angularis*.

The fifth branch arises over-against the condyle of the lower jaw; and as it is very considerable, I call it *maxillaris interna*. It passes behind the condyle; and having given off a twig among the muscoli pterygoidæi, it is divided into three principal branches.

The first branch goes through the inferior orbitary or sphenomaxillary fissure to the orbit, after having supplied the muscles about the uvala, and the glandulous membrane of the posterior nares, through the foramen sphenopalatinum. I name this branch *sphenomaxillaris*.

It sends some very small branches inferiorly and laterally to the parts contained in the orbit, and detaches a small subaltern branch through the extremity of the superior orbitary or sphenoidal fissure, which enters the cranium, and is spent upon the dura mater, communicating there with the other artery of the dura mater, which enters by the foramen spinale of the sphenoidal bone.

It sends off likewise another subaltern branch, which
passes

passes through the posterior opening of the orbital canal; and having furnished the maxillary sinus and the teeth, goes out by the inferior orbital hole, and on the cheek communicates with the angular artery.

The second of the three branches runs through the canal of the lower jaw; and being distributed to the alveoli and teeth, goes out at the hole near the chin, and loses itself in the neighbouring muscles, communicating with the rami of the arteria maxillaris externa.

The third branch of the maxillaris interna runs up between the internal and external carotids, passes thro' the foramen spinale of the sphenoidal bone, and is distributed to the dura mater by several ramifications, which run forward, upward, and backward; the uppermost communicating with those on the other side above the longitudinal sinus of the dura mater.

This artery of the dura mater, which may be termed *spheno-spinalis*, to distinguish it from those that go to the same part by another course, arises sometimes from the trunk of the external carotid, behind the origin of the laryngæa or gutturalis superior, and sometimes from the first ramus of the maxillaris interna, just before it enters the spheno-maxillary fissure.

The sixth anterior or internal branch, which is very small, is spent on the musculus masseter.

The first external or posterior branch is named *arteria occipitalis*. It passes obliquely before the internal jugular vein, and having given twigs to the musculus stylo-hyoidæus, stylo-glossus, and digastricus, it runs between the styloide and mastoide apophyses, along the mastoide groove, and goes to the muscles and integuments which cover the os occipitis, turning several times in an undulating manner as it ascends backwards.

It communicates by a descending branch with the vertebral and cervical arteries, as has been already said, near the top of the head; it communicates likewise with the posterior branches of the temporal artery,

tery, and it sends a branch to the foramen mastoideum.

The second external branch spreads itself on the outward ear, by a great many small twigs on each side, several of which run inward, and furnish the cartilages, meatus auditorius, skin of the tympanum, and internal ear.

The trunk of the external carotid ascends afterward above the zygoma, passing between the angle of the lower jaw and parotid gland, and forms the temporal artery, which divides into an anterior, middle, and posterior branch.

The anterior branch of the temporal artery goes to the musculus frontalis, communicates with the arteria angularis, and sometimes gives off a very small artery, which pierces the internal apophysis of the os malæ all the way to the orbit. The middle branch goes partly to the musculus frontalis, partly to the occipitalis. The posterior branch goes to the occiput, and communicates with the arteria occipitalis. All these branches likewise furnish the integuments.

Arteria carotis interna. The internal carotid artery leaving the general trunk, is at first a little incurvated, appearing as if either it were the only branch of that trunk, or a branch of the trunk of the external carotid. Sometimes the curvature is turned a little outward, and then more or less inward, passing behind the neighbouring external carotid.

It is situated a little more backward than the carotis externa, and generally runs up without any ramification, as high as the lower orifice of the great canal of the apophysis petrosa of the os temporis. It enters this orifice directly from below upward, and afterward makes an angle according to the direction of the canal, the rest of which it passes horizontally, being covered by a production of the dura mater.

At the end of this canal it is again incurvated from below upward, and enters the cranium through a notch

of the sphenoidal bone. Then it bends from behind, forward, and makes a third angle on the side of the sella sphenoidalis; and again a fourth, under the clinoid apophysis of that sella.

As it leaves the bony canal to enter the cranium, it sends off a small branch through the sphenoidal fissure to the orbit and eye; and soon afterward a considerable branch, through the foramen opticum, to supply the contents of the orbit. The continuation of this passes out through the foramen supra orbitarius, to be distributed to the forehead. At the inner angle of the eye it communicates with the angular artery.

Afterwards the internal carotid runs under the basis of the brain to the side of the infundibulum, where it is at a small distance from the internal carotid of the other side, and there it commonly divides into two principal branches, one anterior, and one posterior.

The anterior branch runs forward under the brain, first separating from that on the other side, then coming nearer again, it unites with it by an anastomosis or communication in the interstice between the olfactory nerves. Afterwards, having sent off small arteries, which accompany these nerves, it leaves its fellow, and divides into two or three branches.

The first of these branches goes to the anterior lobe of the brain; the second, which is sometimes double, is inserted on the corpus callosum, to which it gives some ramifications, as also to the falx of the dura mater and middle lobe of the brain. The third, which in some subjects is a distinct branch, in others only a division of the second, goes to the posterior lobe of the brain. This might be looked upon as a third principal branch, lying between the other two.

The posterior branch communicates first of all with the vertebral artery of the same side, and after running between the anterior and lateral lobes of the brain, divides into several rami, which run between its superficial circumvolutions; and are ramified in many different di-

rections on and between these circumvolutions, all the way to the bottom of the sulci.

All these ramifications are covered by the pia mater, in the duplicature of which they are distributed, and form capillary reticular textures in great numbers; and afterwards they are lost in the inner substance of the brain. The anterior and middle branches produce the same kind of ramifications, and the anterior, in particular, sends a twig to the corpus callosum.

Arteria subclavia. The subclavian arteries are named from their situation near the claviculæ, in the transverse direction of which they run. They are two in number, one right, the other left; and they arise from the arch of the aorta, on each side of the left carotid, which commonly lies in the middle between them; but when both carotids go out separately, they both lie between the subclaviæ. These arteries terminate, or rather change their name, above the middle of the two first ribs, between the anterior insertions of the musculi scaleni.

The right subclavian is larger at the beginning than the left, when it produces the right carotid; its origin is likewise more anterior and higher, because of the obliquity of the arch of the aorta; for which reason also the left is shorter than the right, and runs more obliquely. Both of them are distributed much in the same manner; and therefore the description of one may likewise be applied to the other.

The right subclavian, the longest of the two, gives off, first of all, small arteries to the mediastinum, thymus, pericardium, aspera arteria, &c. which are named *mediastinæ, thymicæ, pericardiæ, and tracheales*. These small arteries sometimes go out from the subclavian itself, either separately or by small common trunks; sometimes they are branches of the *mammaria interna*, especially the *mediastina*.

Afterward this right subclavian, at about a finger's breadth from its origin, often produces the common

carotid of the same side; and at a small finger's breadth from the carotid, it gives off commonly three considerable branches, viz. the *mammaria interna*, *cervicalis*, and *vertebralis*, and sometimes an *intercostalis superior*.

Arteria thymica. The *arteria thymica* communicates with the *mammaria interna*, and sometimes arises from the anterior middle part of the common trunk of the *subclavian* and *carotid*. The *thymus* receives likewise some rami from the *mammaria interna* and *intercostalis superior*. The same observation may be applied to the *mediastina* and *pericardia*.

Arteria pericardia. The *pericardia* arises much in the same manner with the *thymica*, and runs down upon the *pericardium* all the way to the *diaphragm*, to which it sends some small ramifications.

Arteria mediastina. The *mediastina* arises sometimes immediately after the *thymica*, and is distributed principally to the *mediastinum*.

Arteria trachealis. The *trachealis*, which may likewise be named *gutturalis inferior*, runs up from the *subclavia*, in a winding course, along the *aspera arteria*, to the *glandulæ thyroïdææ* and *larynx*, detaching small arteries to both sides, one of which runs to the upper part of the *scapula*.

Arteria mammaria interna. The *internal mammary artery* comes from the anterior and lower side of the *subclavia*, near the middle of the *clavicula*, and runs down for about one finger's breadth, behind the cartilages of the true ribs, an inch distant from the *sternum*.

In its passage it sends rami to the *thymus*, *mediastinum*, *pericardium*, *pleura*, and *intercostal muscles*. It likewise detaches other branches, through these muscles and between the cartilages of the ribs, to the *pectoralis major*, and other neighbouring muscular portions, to the *mammæ*, *membrana adiposa*, and *skin*.

Several of these rami communicate, by anastomoses, with the *mammaria externa*, and other arteries of the thorax, especially in the substance of the *pectoralis major*, and likewise with the intercostals. Afterwards it goes out of the thorax on one side of the *appendix eniformis*, and is lost in the *musculus abdominis rectus*, a little below its upper part; communicating, at this place, by several small ramifications with the *arteria epigastrica*; and, in its course, it gives branches to the *peritonæum*, and to the anterior part of the oblique and transverse muscles of the abdomen.

Arteria cervicalis. The cervical artery arises from the upper side of the subclavian, and is presently afterwards divided into two, which come out sometimes separately, sometimes by a small common trunk. The largest of these two arteries is anterior, the other posterior.

The anterior *cervicalis*, running behind the carotid of the same side, is distributed to the *musculus coracohyoidæus*, *mastoidæus*, *cutaneus*, *sterno-hyoidæus*, and *sterno-thyroidæus*, to the jugular glands, the *aspera arteria*, the muscles of the pharynx, bronchia, *oesophagus*, and to the anterior muscles which move the neck and head. This artery has been observed to send out the *intercostalis superior*.

The posterior *cervicalis* arises sometimes a little after the *vertebralis*, and sometimes from that artery. It passes under the transverse apophysis of the last vertebra of the neck; and sometimes through a particular hole in that apophysis; and from thence runs up backward in a winding course, on the vertebral muscles of the neck, and then returns in the same manner.

It communicates with a descending branch of the occipital artery, and with another of the vertebral artery above the second vertebra. It is distributed to the *musculi scaleni*, *angularis scapulæ*, and *trapezius*, and to the jugular glands and integuments.

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Arteria vertebralis. The vertebral artery goes out from the posterior and upper side of the subclavian, almost opposite to the *mammaria interna* and *cervicalis*. It runs up through all the holes in the transverse apophysis of the vertebræ of the neck, and in its passage sends off little twigs through the lateral notches of these vertebræ, to the *medulla spinalis* and its coverings. It also gives arteries to the vertebral muscles, and to other muscles near them.

As it passes through the transverse hole of the second vertebra, it is generally incurvated, to accommodate itself to the particular obliquity of this foramen, mentioned in the description of the skeleton. And between this hole and that in the first vertebra, it takes another larger turn in a contrary direction to the former. Having passed the transverse hole of the first vertebra, it is considerably incurvated a third time, from before backwards, as it goes through the superior and posterior notch in this vertebra.

At this third curvature, it sends off a small branch, which is ramified on the outer and posterior parts of the occiput, and communicates with the cervical and occipital arteries. Having afterwards reached the great foramen of the *os occipitis*, it enters the cranium, and pierces the *dura mater*; and on these accounts it may be named *arteria occipitalis posterior*, to distinguish it from the other, which is lateral.

As soon as it enters the cranium, it sends several small ramifications to the back-part of the *medulla oblongata*, and to the *corpora olivaria* and *pyramidalia*, which are likewise spread on the backsides of the fourth ventricle of the brain, and form the *plexus choroides* of the *cerebellum*.

Afterwards it advances on the *apophysis basilaris* of the *os occipitis*, inclining by small degrees toward the vertebral artery of the other side, all the way to the extremity of that apophysis, where they both join in

one common trunk, which may be named *arteria basilaris*.

Arteria basilaris. The *arteria basilaris* runs forward under the great transverse protuberance of the medulla oblongata, to which it gives ramifications, as well as to the neighbouring parts of the medulla. Sometimes this artery divides again near the extremity of the apophysis basilaris into two lateral branches, which communicate with the posterior branches of the two internal carotides, and are lost in the posterior lobe of the brain.

Arteriæ spinalis. The spinal arteries are two in number, one anterior, and one posterior; both produced by both vertebrales, each of which, as soon as it enters the cranium, sends out a small branch, by the union of which the posterior spinalis is formed. Afterwards the vertebrales advancing on the apophysis basilaris, or production of the occipital bone, detach backward two other small branches, which likewise meet, and by their union form the spinalis anterior. These spinal arteries run down on the fore and back sides of the medulla spinalis, and, by small transverse ramifications, communicate with those which the intercostal and lumbar arteries send to the same part.

Arteria auditoria interna. The internal auditory artery goes off from each side of the *arteria basilaris* to the organ of hearing, accompanying the auditory nerve, having first furnished several small twigs to the *membrana arachnoides*.

Arteria meningæa posterior. The posterior meningeæ arises from the same trunk with the *auditoria interna*, and goes to the back-part of the *dura mater*, on the occipital and temporal bones, and likewise supplies the neighbouring lobes of the brain.

Arteria intercostalis superior. When the superior intercostal artery does not go out from the trunk of the *aorta descendens*, it commonly arises from the lower side of the *subclavian*, and runs down on the inside of the

the two, three, or four, uppermost true ribs, near their heads, and sends off under each rib a branch which runs along the lower edge, and supplies the intercostal muscles and neighbouring parts of the pleura.

These branches or particular intercostal arteries communicate with each other at different distances by small rami, which run upward and downward from one to the other, on the intercostal muscles.

They likewise give branches to the musculi sternohyoidæi, subclavius, vertebrales, and bodies of the vertebræ; and also to the pectoralis major and minor, piercing the intercostal notch; and lastly, they send branches through the muscles of the first four vertebræ to the medulla spinalis and its coverings.

Sometimes the superior common intercostal artery comes from the cervicalis, and not immediately from the subclavia. Sometimes it arises from the aorta descendens, either by small separate arteries, or by a common trunk, which divides as it runs obliquely up upon the ribs. Lastly, it sometimes arises from the nearest bronchialis, or from several bronchiales together.

Ductus arteriosus in ligamentum versus. The ductus arteriosus, which is found only in the fœtus and in very young children, arises from the aorta descendens, immediately below the left subclavian artery. In adults, this duct is shrunk up and closed, and approaches only like a short ligament, adhering by one end to the aorta, and by the other to the pulmonary artery; so that in reality it deserves no other name than that of *ligamentum arteriosum*.

Arteria bronchialis. The bronchial arteries go commonly from the foreside of the superior descending aorta, but sometimes from the first intercostal, and sometimes from the arteria œsophagæa. Sometimes they arise separately from each side, to go to each lung, and sometimes by a small common trunk, which afterwards separates towards the right and left hand, at the bifurca-

tion of the *aspera arteria*, and accompany the ramifications of the bronchia.

The bronchial artery on the left side often comes from the aorta, while the other arises from the superior intercostal on the same side; which variety is owing to the situation of the aorta. Sometimes there is another bronchial artery which goes out from the aorta posteriorly, near the superior intercostal, above the bronchialis anterior.

“ Sometimes there are free communications observed between the branches of the bronchial artery and those of the pulmonary artery: these have been mistaken for direct communications between the bronchial artery and pulmonary vein, *vena azygos*, &c.”

The bronchialis gives a small branch to the neighbouring auricle of the heart, which communicates with the *arteria coronaria*.

Arteriæ œsophagææ. The *œsophagææ* are generally two or three in number, sometimes but one. They arise anteriorly from the *aorta descendens*, and are distributed to the *œsophagus*, &c. Sometimes the uppermost *œsophagæa* produces a bronchial artery.

Arteriæ intercostales inferiores. The inferior intercostals are commonly seven or eight on each side, and sometimes ten, when the superior intercostals arise likewise from the *aorta descendens*; in which case these run obliquely upward, as has been already said.

They arise along the backside of the descending *aorta* in pairs, all the way to the diaphragm, and run transversely towards each side, on the bodies of the *vertebræ*. Those on the right side pass behind the *vena azygos*; and afterwards they all run to the intercostal muscles, along the lower edge of the ribs, all the way to the sternum, or near it.

They send branches to the pleura, to the vertebral muscles, to those muscles which lie on the outsides of the ribs, and to the upper portions of the muscles of the
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abdomen; and they communicate with the arteriæ epigastricæ and lumbares.

Sometimes, instead of going out from the aorta in pairs, they arise by small common trunks, which afterwards divide, and send an artery to each neighbouring rib.

Before they take their course along the ribs, each of them detaches one branch between the transverse apophyses on both sides, to the vertebral muscles, and another which enters the great canal of the spina dorsi. Each of these latter branches divides at least into two small arteries, one of which runs transversely on the anterior side of the canal, the other on the posterior side. Both of them communicate with the like arteries from the other side of the spine, in such a manner as to form a kind of arterial rings, which likewise communicate with each other by other small ramifications. The same is to be observed in the arteriæ lumbares.

Afterwards each intercostal artery having reached the middle of the rib, or a little more, divides into two principal branches, one internal, the other external. Soon after this division, the arteries that run upon the false ribs separate a little from them, being gradually bent downward one after another, and are spread upon the abdominal muscles. They are likewise distributed to other neighbouring muscles, and particularly to those of the diaphragm, almost in the same manner with the arteriæ phrænicæ; they also communicate with the lumbares, and sometimes with branches of the hypogastricæ.

Arteriæ axillares. The subclavian artery having left the thorax immediately above the first rib, in the interstice left between the portions of the scalenus, there receives the name of *axillaris*, because it passes under the axilla.

In this course it gives off from its inside, a small branch to the inside of the first rib; and afterwards
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four or five principal branches, viz. the thoracica superior or mammaria externa, thoracica inferior, muscularis or scapularis externa, scapularis interna, and humeralis.

Arteria thoracica superior. The superior thoracica or external mammary artery, runs down in a winding course on the lateral parts of the thorax, and crosses the ribs. It gives branches to the two pectoral muscles, to the mamma, musculus subclavius, serratus major, latissimus dorsi, and to the upper portions of the coracobrachialis and biceps.

These branches are sometimes separate for some space; and one of them, in particular, runs down between the deltoides and pectoralis major, together with the vena cephalica, to which it adheres very closely, the extremity of it piercing the coat of that vein, as if there were an anastomosis between them. Another sometimes runs between the musculus brachii and anconæus internus, which communicates with a branch of the radial artery.

Arteria thoracica inferior. The inferior thoracic artery runs along the inferior costa of the scapula, to the musculus subscapularis, teres major and minor, infra-spinatus, latissimus dorsi, serratus major, and the neighbouring intercostal muscles, communicating with the arteriæ scapulares.

Arteriæ scapulares. The external scapular artery passes through the notch in the superior costa of the scapula, to the musculus supra-spinatus and infra-spinatus, teres major and minor, and to the articulation of the scapula with the os humeri.

The internal scapularis arises from the axillary artery near the axilla, and runs backward, to be distributed to the subscapularis, giving branches to the serratus major, to the axillary glands, and to the teres major, upon which it is ramified in different manners. It likewise sends rami to the infra-spinatus and upper portion of the anconæi.

Arteria articularis. The articular artery arises from the lower and fore part of the axillaris, and runs backward between the head of the os humeri and teres major, surrounding the articulation till it reaches the posterior part of the deltoides, to which it is distributed.

During this course, it gives several branches to the superior portions of the anconæi, to the capsular ligament of the joint of the shoulder, and to the os humeri itself through several holes immediately below the great tuberosity of the head of that bone. It likewise communicates with the scapular artery.

Opposite to the origin of this articular artery, the axillaris sends off another small branch, which runs in a contrary direction between the head of the os humeri and the common upper part of the biceps and coracobrachialis; and having given branches to the vagina and channel of the biceps, and to the periosteum, afterwards joins the principal humeralis.

Arteria brachialis. The axillary artery having given off these branches, passes immediately behind the tendon of the pectoralis major, where it changes its former name for that of *arteria brachialis*. It runs down on the inside of the arm over the musculus coraco-brachialis and anconæus internus, and along the inner edge of the biceps behind the vena basilica, giving small branches on both sides to the neighbouring muscles, to the periosteum, and to the bone.

Between the axilla and middle of the arm, it is covered only by the skin and fat; but afterwards it is hid under the biceps, and runs obliquely forward as it descends; being at some distance from the internal condyle, but it does not reach the middle of the fold of the arm.

Between the axilla and this place, it sends off many branches to the infra-spinatus, teres major and minor, subscapularis, latissimus dorsi, serratus major, and other neighbouring muscles, to the common integuments, and even

even to the nerves. Below the fold of the arm, it divides into two principal branches, one called *arteria cubitalis*, the other *radialis*.

From its upper and inner part, it sends off a particular branch, which runs obliquely downward and backward over the *anconæi*, and then turns forward again near the external condyle, where it communicates with a branch of the *arteria radialis*.

Immediately below the insertion of the *teres major*, it gives off another branch, which runs from within outwards, and from behind forward, round the *os humeri*; and descends obliquely forward, between the *musculus brachiiæus*, and *anconæus externus*, to both which it is distributed in its passage. Having afterwards reached the external condyle, it unites with the branch last mentioned, and likewise communicates with a branch of the arteries of the fore-arm, so that there is here a triple anastomoses.

About the breadth of a finger below this second branch, the brachial artery sends off a third, which runs down toward the internal condyle, and communicates with other branches of the arteries of the fore-arm, as we shall see hereafter.

About the middle of the arm, or a little lower, much about the place where the brachial artery begins to be covered by the *biceps*, it sends off a branch, which is distributed to the *periosteum*, and penetrates the bone, between the *musculus brachiiæus* and *anconæus internus*.

About an inch lower, it gives off another branch, which having furnished ramifications to the *anconæus internus*, runs over the inner condyle, and likewise communicates with branches of the arteries of the fore-arm.

Having got below the middle of the arm, the brachial artery detaches another branch, which runs behind the inner condyle in company with a considerable nerve; and having passed over the muscles inserted in
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this condyle, it communicates with that branch of the cubital artery which encompasses the fold of the arm.

A little lower it sometimes sends out another branch, which passes on the fore-side of the inner condyle, and then communicates with a branch which runs up from the cubital artery. These three communicating branches are termed *collateral arteries*.

The common trunk of the brachial artery having reached the fold of the arm, runs, together with a vein and a nerve, immediately under the aponeurosis of the biceps, and passes under the vena mediana, detaching branches on each side to the neighbouring muscles.

About a large finger's breadth beyond the fold of the arm, this artery divides into two principal branches; one inner or posterior, named *cubitalis*; the other, outer or anterior, named *radialis*, as has been already said.

From this bifurcation, the brachial artery sends branches on each side, to the supinator longus, pronator teres, fat, and skin. It sometimes, though very rarely, happens, that this artery is divided from its origin into two large branches, which run down on the arm, and afterwards on the fore-arm, where they have the names of *cubitalis* and *radialis*.

Arteria cubitalis. The cubital, or ulnar artery, sinks in between the ulna and the upper parts of the pronator teres, perforatus ulnaris gracilis, and radialis internus; then leaving the bone, it runs down between the perforatus and ulnaris internus, all the way to the carpus and great transverse ligament. In this course it winds and turns several ways, and sends out several branches.

The first is a small artery, which runs inward to the inner condyle, and then turns upward like a kind of recurrent, to communicate by several branches with the collateral arteries of the arm already mentioned, and particularly with the third. A little lower down, another small branch goes off; which having run upward a little way, and almost surrounded the articulation,

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communicates with the second collateral artery of the arm, between the olecranon and inner condyle.

Afterwards, the cubital artery having, in its course between the heads of the ulna and radius, reached the interosseous ligament, sends off two principal branches, one internal, the other external; which I call the *interosseous arteries* of the fore-arm.

The external artery pierces the ligament about three fingers breadth below the articulation; and presently afterwards gives off a branch, which runs up like a recurrent toward the external condyle of the os humeri, under the ulnaris externus, and anconæus minimus, to which it is distributed, as also to the supinator brevis; and it communicates with the collateral arteries of the arm on the same side.

Afterward this external interosseous artery runs down on the outside of the ligament, and is distributed to the ulnaris externus, extensor digitorum communis, and to the extensores pollicis indicis and minimi digiti; communicating with some branches of the internal interosseous artery.

Having reached the lower extremity of the ulna, it unites with a branch of the internal interosseous artery, which at this place runs from within outward, and is distributed together with it on the convex side of the carpus and back of the hand, communicating with the arteria radialis, and with a branch of the cubitalis; which will be mentioned hereafter.

By these communications, this artery forms a sort of irregular arch, from whence branches are detached to the external interosseous muscles, and to the external lateral parts of the fingers.

The internal interosseous artery runs down very close to the ligament, till it reaches below the pronator teres; between which and the pronator quadratus, it perforates the ligament, and goes to the convex side of the carpus and back of the hand, where it communicates

cates with the external interosseous artery, with the radialis and internal branches of the cubitalis.

From the origin of the two interossæ, the cubital artery runs down between the perforatus, perforans, and ulnarius internus, along the ulna, sending branches to the neighbouring parts. Below the internal interossea, it sometimes sends off a branch which runs down between the flexor pollicis, radialis internus, and perforatus; to which it is distributed all the way to the carpus, where it runs under the internal annular ligament, and communicates on the hand with branches of the arteria radialis.

Afterward the cubital artery passes over the internal transverse ligament of the carpus, by the side of the os pisiforme; and having furnished the skin, palmaris brevis, and metacarpus, it slips under the aponeurosis palmaris, giving off one branch to the hypothenar minimi digiti, and another which runs towards the thumb between the tendons of the flexors of the fingers and the bases of the metacarpal bones.

It likewise sends off a branch, which, running between the third and fourth bones of the metacarpus, reaches to the back of the hand, where it communicates with the external interosseous artery. Afterwards, having supplied the interosseous muscles, it communicates with the radialis; and they both form an arterial arch in the hollow of the hand, in the following manner.

The cubitalis having got about two fingers breadth beyond the internal annular ligament of the carpus, forms an arch; the convex side of which is turned to the fingers, and commonly sends off three or four branches. The first goes to the inner and back part of the little finger; and is sometimes a continuation or production of that branch which goes to the muscles on the fore side of the little finger.

The other three branches run in the interstices of the four metacarpal bones; near the heads of which each

each of them is divided into two branches, which pass along the two internal lateral parts of each finger, from the fore-side of the little finger to the posterior side of the index inclusively; and at the ends of the fingers these digital arteries communicate and unite with each other.

Sometimes the arch of the cubital artery terminates by a particular branch in the middle finger; and in that case it communicates with the radial artery, which makes up what the other wants.

This arch sends likewise from its concave side, towards the second phalanx of the thumb, a branch for the lateral internal part thereof; and then ends near the head of the first metacarpal bone, by a communication with the radialis, having first given a branch to the fore-side of the index, and another to the side of the thumb next the former. These communicate at the ends of the fingers with the neighbouring branches as in the other fingers.

This arch sends likewise small twigs to the interosseous muscles, to the lumbricales, palmaris, and to other neighbouring parts; and, lastly, to the integuments.

Arteria radialis. The radial artery begins by detaching a small branch, which runs upwards like a recurrent, toward the fold of the arm, and turns backward round the external condyle, communicating with the neighbouring branches from the trunk of the brachial artery, especially with the first collateral branch on that side.

It runs down along the inside of the radius, between the supinator longus, pronator teres, and the integuments, giving branches to these muscles, and likewise to the perforatus, perforans, and supinator brevis. From thence it runs in a winding course toward the extremity of the radius, supplying the flexors of the thumb and pronator quadratus.

Having reached the extremity of the radius, it runs nearer the skin, especially toward the anterior edge of the bone, being the artery which we there feel when we examine the pulse.

At the end of the radius, it gives off a branch to the abductor pollicis ; and after having communicated with the arch of the cubital artery in the palm of the hand, and sent off some cutaneous branches at that place, it detaches one along the whole internal lateral part of the thumb.

Afterwards it runs between the first phalanx and tendons of the thumb, to the interstice between the basis of this first phalanx and of the first metacarpal bone, where it turns toward the hollow of the hand.

At this turning, it sends off a branch to the external lateral part of the thumb, which, having reached the end thereof, communicates by a small arch with the branch which goes to the internal lateral part.

- It likewise sends branches outward, which run more or less transversely between the first two bones of the metacarpus and the two tendons of the radialis externus ; and it communicates with an opposite branch of the cubitalis ; together with which it furnishes the external interosseous muscles and integuments of the back of the hand and convex side of the carpus.

Lastly, the radial artery terminates, in its passage over the semi-interosseous muscle of the index, near the basis of the first metacarpal bone, and as it runs under the tendons of the flexor muscles of the fingers, where it is joined to the arch of the cubitalis,

It sends off another branch, which runs along the forepart of the first bone of the metacarpus to the convex side of the index, where it is lost in the integuments.

It gives likewise a branch to the internal lateral part of the index ; which, at the end of that finger, joins an opposite branch which comes from the arch of the cubitalis. It also sends off a small branch cross the internal interosseous muscles, where it forms a kind of small irregular arch, which communicates with the great arch by several small arterial rami.

When the arch of the cubitalis ends at the middle

finger, the *radialis* runs along the inner or concave part of the first metacarpal bone; at the head of which it terminates by two branches.

One of these branches runs along the inner and anterior lateral part of the index; the other passes between the flexor tendons of this finger and the metacarpal bone; and having communicated with the cubital branch of the middle finger, it advances on the posterior lateral part of the index all the way to the end of that finger, where it unites again with the first branch.

Arteria diaphragmatica. The left diaphragmatic artery goes out commonly from the aorta descendens as it passes between the crura of the small muscle of the diaphragm. The right diaphragmatic comes sometimes from the nearest lumbar artery, but most commonly from the *cæliaca*. Sometimes both these arteries arise by a small common trunk immediately from the aorta. They likewise have the name of *arteriæ phrenicæ*.

They appear almost always in several ramifications on the concave or lower side of the diaphragm, and seldom on the upper or convex side. They give small branches to the *glandulæ renales*, or *capsulæ atrabiliaræ*, which sometimes communicate with the other arteries that go to the same part.

They send likewise small branches to the fat which lies upon the kidneys, called the *membrana adiposa*, from whence they have the name of *arteriæ adiposæ*; and they sometimes come immediately from the trunk of the aorta on one side of the *mesenterica superior*.

Besides these capital diaphragmatic arteries, there are others of a subordinate class, which come from the *intercostales*, *mammariæ internæ*, *mediastinæ*, *pericardiæ*, and *cæliaca*, as is observed in the description of each of these arteries.

Arteria cæliaca. The *cæliac* artery rises anteriorly and a little to the left hand, from the aorta descendens, immediately after its passage through the small muscle of the diaphragm, nearly opposite to the cartilage between
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tween the last vertebra of the back and first of the loins. The trunk of this artery is very short; and near its origin it sends off from the right side two small diaphragmaticæ, though sometimes there is only one, which goes to the right-hand, and is afterwards distributed both ways; communicating with the other arteries of the same name which come from the intercostales and mammariæ. The left branch sends rami to the superior orifice of the stomach and to the glandula renalis on the same side; the right furnishes the pylorus and the renal gland on the right side.

Immediately after this, the celiaca gives off a considerable branch, named *arteria ventriculi coronaria*, and *gastrica*, or *gastrica superior*; and then it presently divides into two large branches; one toward the right hand, named *arteria hepatica*; the other to the left, called *splénica*, which is larger than the former.

Sometimes this artery is divided into these three branches at the same place, very near its origin; the trunk going out from the aorta almost in a straight line, and the branches from the trunk almost at right angles, like radii from an axis; whence this trunk has been called *axis arteriæ celiacæ*.

Arteria ventriculi coronaria. The coronary artery of the stomach goes first to the left side of that organ, a little beyond the superior orifice; round which orifice it throws branches, and also to every part of the stomach near it: and these branches communicate with those which run along the bottom of the stomach to the pylorus.

Afterwards it runs on the right side of the superior orifice, along the small curvature of the stomach, almost to the pylorus, where it communicates with the *arteria pylorica*; and turning towards the small lobe of the liver, it gives off some branches to it.

Then it advances, under the ductus venosus, to the left lobe of the liver, in which it loses itself near the beginning of the just-mentioned duct, having first gi-

ven off some small branches to the neighbouring parts of the diaphragm and omentum.

Arteria hepatica. As soon as the hepatic artery leaves the cæliaca, it runs to the upper and inner part of the pylorus, in company with the vena portæ, sending off two branches; a small one called *arteria pylorica*, and a large one named *gastrica dextra*, or *gastrica major*.

The pylorica is ramified on the pylorus, from whence it has its name; and having distributed branches to the neighbouring parts of the stomach, which communicate with those of the right gastrica, it terminates on the pylorus, by an anastomosis, with the coronary artery of the stomach.

The right gastric artery having passed behind and beyond the pylorus, sends out a considerable branch, named *arteria duodenalis*, or *intestinalis*; which sometimes comes from the trunk of the hepatica, as we shall see hereafter. Afterwards this gastric artery runs along the right side of the great curvature of the stomach; to the neighbouring parts of which, on both sides, it distributes branches.

These branches communicate with those of the *arteria pylorica*, and of the *coronaria ventriculi*, and with the right *gastro-epiploicæ*, which furnish the nearest parts of the omentum, and communicate with the *mesenterica superior*. After this, the right gastric artery ends in the left, which is a branch of the *splénica*.

The duodenal or intestinal artery runs along the duodenum on the side next the pancreas; to both which it furnishes branches, and also to the neighbouring part of the stomach. Sometimes this artery goes out from the *mesenterica superior*, and sometimes it is double.

The hepatic artery having sent out the pylorica and right gastrica, advances behind the *ductus hepaticus*, toward the *vesicula fellis*, to which it gives two principal branches, called *arteriæ cysticæ*; and another named

med *bilaria*, which is lost in the great lobe of the liver.

Afterwards this artery enters the fissure of the liver, and joins the *vena portæ*, with which it runs within a membranous vagina, called *capsula glissoni*; and accompanies it through the whole substance of the liver by numerous ramifications, which may be termed *arteriæ hepaticæ propriae*.

Before it enters the liver, it gives small branches to the external membrane of this viscus, and to the *capsula glissoni*. The gastric and proper hepatic arteries come sometimes from the *mesenterica superior*, when the ordinary ramifications are wanting.

Arteria splenica. Immediately after the origin of the splenic artery from the *cæliaca*, it runs toward the left hand, under the stomach and pancreas, to the spleen. It adheres closely to the posterior part of the lower side of the pancreas, to which it gives several branches, named *arteriæ pancreaticæ*.

Near the extremity of the pancreas, under the left portion of the stomach, the splenic artery gives off a principal branch, called *gastrica sinistra* or *minor*, which runs from left to right along the left portion of the great curvature of the stomach, giving branches to both sides of this portion, which communicate with those of the *coronaria ventriculi*.

This gastric artery sends likewise another branch at least to the extremity of the pancreas, which communicates with the other pancreatic arteries. It also supplies the omentum with branches, termed *gastro-epiploicæ sinistrae*; and then it communicates with the right *gastrica*; and from this union the *gastro-epiploicæ mediae* are produced.

From this detail we learn, that the *arteria coronaria ventriculi pylorica*, *intestinalis*, both *gastricæ*, *gastro-epiploicæ*, and consequently the *hepatica*, *splenica*, and *mesenterica*, communicate all together.

Afterwards the splenic artery advances towards the
E e 3 spleen.

spleen, in a course more or less contorted ; but before it arrives at that viscus, it gives two or three branches to the large extremity of the stomach, commonly called *vasa brevia* ; and one to the omentum, named *epiploica*.

At the spleen, this artery divides into four or five branches, which enters that viscus, after having given some small twigs to the neighbouring parts of the stomach and omentum.

Arteria mesenterica superior. The superior mesenteric artery arises anteriorly from the lower portion of the descending aorta, a very little way below the cæliaca, going out a little towards the right-hand, but bending immediately afterwards to the left.

Near its origin, it gives off a small branch, which dividing into two, goes to the lower side of the head of the pancreas, and neighbouring part of the duodenum, communicating with the intestinalis by small arches, and areolæ or meshes.

Afterwards it passes over the duodenum, between this intestine and the meseraic vein, between the two laminæ of the mesentery ; and then bending in an oblique direction from left to right, and from above downward, by very small degrees, it advances toward the extremity of the ilium. By this incurvation, it forms a kind of long arch, from the convex side of which a great many branches go out.

These branches are sixteen or eighteen in number, or thereabouts ; and almost all of them are bestowed on the small intestines, from the lower third part of the duodenum to the cæcum and colon. The first branches are very short ; and from thence they increase gradually in length all the way to the middle of the arch ; the rest diminishing again by small degrees.

As they approach the intestines, all these branches communicate, first by reciprocal arches, then by areolæ and meshes of all kinds of figures ; from which is detached an infinite number of small ramifications, which
fur-

surround the intestinal canal, like an annular piece of net-work.

These arches and meshes increase in number proportionably to the length of the branches; and their size diminishes gradually as they approach the intestines.

The first branches from the convex side of the mesenteric arch, which are very short, supply the pancreas and mesocolon, and communicate with the duodenal artery. The last branches go to the appendicula vermiformis, and send a portion of an arch to the beginning of the colon.

The considerable branches from the concave side of the mesenteric arch are seldom above two or three in number; but before they arise, a small ramus goes out to the duodenum, and gives some very small arteries to the pancreas.

The first considerable branch from the concave side of the arch goes into the mesocolon towards the right portion of the colon, being first divided into two rami; the first of which runs along the whole superior part of the colon, where it forms the famous communication with the mesenterica inferior, and might be named *arteria colica superior*. The other ramus of this branch runs down on the right portion of the colon.

The second principal branch having run for some space through the mesentery, divides into three rami; the first of which goes to the lower part of the right portion of the colon, where it communicates with the second ramus of the first branch; the second goes to the beginning of the colon, where it communicates with the first and to the intestinum cæcum.

The third ramus of this second branch having communicated with the second, gives small twigs to the cæcum, appendicula vermiformis, and extremity of the ileum. Afterwards it communicates with the extremity of the arch, or curve trunk of the superior mesenteric.

All these communications are by arches and meshes, as in those branches that come from the convex side of

the arch ; and it is to be observed in general, that all the branches of the *mesenterica superior* are disposed according to the folds of the mesentery and circumvolutions of the intestines ; giving off branches, through their whole course, to the laminæ of the mesentery, its cellular substance, and to the mesenteric glands.

Arteria mesenterica inferior. The lower mesenteric artery goes out anteriorly from the aorta descendens inferior, about a finger's breadth or more above the bifurcation, and below the spermatic arteries ; and having run about the length of an inch, or something more, it is divided into three or four branches, which gradually separate from each other.

The first or superior branch, about an inch from its origin, divides into two rami ; the first of which runs along the left portion of the colon, and forms the communication of the two mesenteric arteries already mentioned. It may be named *arteria colica sinistra*. The second ramus having communicated with the first, runs down upon the same portion of the colon.

The middle branch having run the same length with the first, divides into two rami ; one of which passes upward on the extremity of the colon, communicating by arches with the second ramus of the superior branch ; the other runs down on the extremity of the same intestine.

When there is another middle branch, it goes to the first part of the double curvature of the colon by a like distribution and communication from above downward.

The lower branch goes to the second portion of the colon, or to both, when the second middle branch is wanting, and sends up a ramus, which communicates with the foregoing.

It sends another considerable branch downward, called *arteria hæmorrhoidalis interna*, which runs down behind the *intestinum rectum*, to which it is distributed
by

by several ramifications; and it communicates with the arteriæ hypogastricæ.

Arteriæ renales. The renal arteries, called commonly *emulgentes*, are ordinarily two in number, and go out laterally from the inferior descending aorta, immediately under the mesenterica superior; one to the right hand, the other to the left. The right is situated more backward, and is longer than the left, because of the vena cava, which lies on the right side between the aorta and the kidney.

They run commonly without division, and almost horizontally to the kidneys, into the depressions of which they enter by several branches, which form arches in the inner substance of these viscera.

From these arches, numerous small rami go out toward the circumference or outer surface of the kidneys. Sometimes there is more than one artery on each side; sometimes this augmentation is only on one side, and these supernumerary arteries come sometimes immediately from the aorta, and enter at the upper or lower part of the kidneys.

Ordinarily, the right renal artery passes behind the vena cava and renal vein on the other side; and the left artery, first behind and then before the vein. Sometimes they send branches to the glandulæ renales, membrana adiposa of the kidneys, and even to the diaphragm.

Arteriæ capsulares. The arteries of the renal glands, which may be termed *arteriæ capsulares*, arise sometimes from the aorta above the arteria renalis, and give out the arteriæ adiposæ, which go to the fat of the kidneys. Sometimes they come from the trunk of the cæliacæ. The right capsular artery comes most commonly from the arteria renalis of the same side, near its origin; the left from the aorta above the renalis.

Arteriæ spermaticæ. The spermatic arteries are commonly two in number, sometimes more. They are very small; and go out anteriorly from the aorta descendens

scendens inferior, near each other, about a finger's breadth below the arteriæ renales, more or less, between the two mesentericæ, or between the renales and mesentericæ inferiores. Sometimes one is higher, or placed more laterally than the other.

They send off to the common membrane of the kidneys small branches named *arteriæ adiposæ*; and afterwards they run down upon the psoas muscles, on the foreside of the ureters, between the two laminæ of the peritonæum.

They give several considerable branches to the peritonæum, chiefly to those parts of it which are next the mesentery, and they communicate both with the mesentericæ and adiposæ. They likewise send small arteries to the ureters.

Afterwards they pass, in men, through the tendinous openings of the abdominal muscles in the vagina of the peritonæum, and are distributed to the testicles and epididimis, where they communicate with a branch of the iliaca externa.

In women, they do not go out of the abdomen, but are distributed to the ovaria and uterus, and communicate with branches of the hypogastrica, at the jagged extremities of the tubæ Fallopiæ.

Arteria lumbares. The lumbar arteries go out posteriorly from the inferior descending aorta, in five or six pairs, or more, much in the same manner with the intercostals.

They may be divided into superior and inferior. The superior send small branches to the neighbouring parts of the diaphragm and intercostal muscles, and supply the place of semi-intercostal arteries. Sometimes those pairs go out by a small common trunk, and not separately.

They are distributed on each side to the psoas muscles, to the quadrati lumborum, and to the oblique and transverse muscles of the abdomen; and by perforating the oblique muscles, they become external hypogastric

arteries. They go likewise to the vertebral muscles; and to the bodies of the vertebræ, and enter the spinal canal through the lateral notches, to go to the membranes, &c. forming rings much in the same manner with the intercostals; and they likewise give small twigs to the nerves.

Arteriæ sacrae. The arteria sacra media goes out commonly from the back part of the inferior descending aorta, at the bifurcation. Sometimes it arises higher from the lumbares, and sometimes lower from the iliaca. Sometimes there are two, three, or four, in number. The branches of this artery are ramified on the os sacrum, and on the neighbouring parts of the peritonæum, intestinum rectum, fat, &c.; and enter the canal of that bone through the anterior holes, being there distributed toward each side. They likewise send small arteries to the large fasciculi of nerves which go out through the holes of the os sacrum, and they penetrate the inner substance of that bone. "The os sacrum has also branches spread out upon its surface, and some running through its anterior holes from the hypogastric artery."

Arteriæ iliaca. The inferior descending aorta ends at the last vertebra of the loins, and sometimes higher, in two large lateral branches, one on the right hand, the other on the left, called *arteriæ iliaca*; each of which is a common trunk to two other arteries of the same name. This bifurcation lies on the anterior and left side of that of the vena cava.

The primitive iliac arteries divaricate gradually as they descend, advancing obliquely toward the anterior and lower part of the ossa ilium, without any considerable ramification, for about the breadth of three fingers, except a few very small arteries that go to the os sacrum; some of which enter by the upper holes, and are distributed like the *arteriæ sacrae*, while others emerge again through the posterior holes, and go to the neighbouring muscles, &c. They likewise give small

arte-

arteries to the peritonæum, to the coats of the veins, and to the fat and ureters, behind which the iliac trunks pass.

The right iliac trunk passes first on the foreside of the origin of the left iliac vein, and runs down on the foreside of the right vein, almost to the place where it goes out of the abdomen, its course being there directed more inwardly. The left trunk goes down likewise before the left vein, but lies a little toward the inside as it leaves the abdomen.

About three fingers breadth from their origin, each iliac trunk is divided into two secondary arteries, one external, the other internal. The external artery has no particular name; the internal is termed *hypogastrica*, which often appears to be no more than a branch of the other, in adults; but in young children, and especially in the foetus, the hypogastric artery looks like the trunk, and the other like a branch.

The external iliacs on each side runs down on the iliac muscle to the ligamentum Fallopii, under which it goes out of the abdomen. In this course, it gives off only a few small arteries, to the peritonæum and other parts near it; but as it passes out of the abdomen under the ligament, it detaches two considerable branches, one internal, the other external.

The internal branch is named *arteria epigastrica*, and goes out anteriorly from the external iliac. From thence it runs obliquely upward on the tendon of the transverse muscle toward the posterior part of the rectus, which it reaches about two or three fingers breadth above the os pubis.

Afterwards the epigastric artery runs up along the posterior or inner side of this muscle, sending ramifications to the tendons of the neighbouring muscles, &c.; and then loses itself by a true anastomosis of several ramifications, with the *mammaria interna*. It likewise communicates with the inferior intercostals, which are spread on the abdomen.

It

It sometimes gives out two particular branches, one of which, accompanied by a nerve, goes through the foramen ovale of the pelvis to the triceps muscles, &c. ; the other runs down to the testicles along with the spermatic artery, and there communicates with it.

The external branch of the outer iliac goes off laterally from the outside of that artery under the ligamentum Fallopii, and from thence to the internal labium of the os ilium, where it divides into two, and is ramified on the oblique and transverse muscles of the abdomen, communicating with the arteria lumbaris.

Besides these two branches, the external iliaca gives off a small ramus internally under the ligament, which runs to the vagina of the spermatic rope ; and sometimes another small twig goes from the outside to the os ilium.

The internal iliaca or hypogastrica, having run a little more than a finger's breadth inward and backward, bends by small degrees obliquely forward, and toward the outside ; and, afterwards contracting in its dimensions, it ends in the umbilical artery, which ought to be looked upon as a true continuation of the trunk of the hypogastrica.

This arteria umbilicalis ascends on the side of the bladder, and having detached small rami to that viscus and to the neighbouring parts of the peritonæum, &c. it contracts, and in adults is quite closed up, above the middle of the bladder. It likewise gives branches to the uterus, and to the neighbouring parts in both sexes. Afterwards it ascends in form of a ligament to the umbilicus, where it joins the umbilical artery on the other side ; its name being taken from its use in the foetus.

From the convex side of the curvature of the hypogastric artery, four or five principal branches commonly go out very near each other. Sometimes they all arise separately, sometimes by small common trunks, and what

what is the first branch in some subjects, is only a ramus of another principal branch in others; so much does the number, disposition, origin, and distribution of these branches vary in different subjects. For this reason I think it proper to distinguish them by the following proper names: *iliaca minor*, *glutæa*, *sciatica*, *pudica communis* sive *pudica hypogastrica*, and *obturatrix*.

The *iliaca minor*, the most posterior of these branches, and which is often no more than a ramus of the *glutæa*, passes between the last two lumbar nerves, and divides into two rami, one of which enters the canal of the os sacrum through the lowest large anterior holes; the other passes behind the musculus psoas, to which it gives twigs, and behind the crural nerve; being afterwards distributed to the iliac muscle, and to the middle part of the inside of the os ilium, penetrating into the substance of the bone, sometimes by one hole, sometimes by more.

The *arteria glutæa* is commonly very considerable, and sometimes the largest of all the hypogastric branches. Near its beginning it sometimes sends out the *iliaca minor*, and sometimes the small ramus that goes from that artery to the os sacrum and other parts fixed to that bone. Afterwards this artery goes out of the pelvis in company with the sciatic nerve, through the upper part of the great sinus of the os innominatum, below the musculus pyriformis, and is distributed in a radiated manner to the *glutæus maximus* and *medius*.

In its passage, it gives some branches to the os sacrum, os coccygis, musculus pyriformis, the muscles of the anus, and to the neighbouring parts of the intestinum rectum, forming a particular hæmorrhoidalis interna. It likewise sends twigs to the bladder and parts near it; and detaches a pretty long branch which runs down with the sciatic nerve.

The *arteria sciatica* gives first of all, some branches

to the musculus pyriformis, the quadrigemini, the os sacrum, &c. and even to the inner side of the os ischium. It likewise detaches a branch which runs under the musculus quadratus, to the articulation of the os femoris.

It passes obliquely over the sciatic nerve; and as they both go through the great posterior sinus of the os ilium, it detaches small arteries, which are distributed to the inner substance of that nerve. Afterwards it runs up in a radiated manner on the outside of the os ilium, and is distributed to the inner substance of that bone, and to the muscoli glutæi, especially to the medius and minimus.

The pudica communis, called commonly *pudica interna*, arises sometimes by a trunk common to it and to the glutæa, and gives out two principal branches; the first of which passes through the great sinus of the os ilium in company with the glutæa and sciatica, and then divides into two rami.

The first ramus goes behind the spine of the ischium, between the two ligaments which lie between that bone and the os sacrum; and runs on the inside of the tuberculum ischii, all the way to the origin of the corpus cavernosum penis. There it divides into several arteries, one of which goes to the sphincter ani, under the name of *hemorrhoidalis externa*.

The rest are distributed to the neighbouring integuments, to the bulb of the urethra, and to the corpus cavernosum penis; but the last of these arteries, or rather the extremity of this first ramus, runs from behind forward, over the neck of the os femoris, and communicates with a branch of the arteria cruralis.

The second principal ramus, called commonly *arteria pudica externa*, runs between the bladder and intestinum rectum, and is distributed, in men, to the vesiculæ feminales, neck of the bladder, prostate gland, and neighbouring parts of the rectum.

Afterwards it runs under the os pubis on the side of

a considerable vein, which lies directly under the symphysis; and it runs along the penis between this vein and a nerve, being distributed in its passage to the corpus cavernosum, and communicating with the pudica minor, which comes from the cruralis.

This second branch of the pudica major goes off sometimes separately from the hypogastrica, especially in women; being distributed to the lateral parts of the uterus, where it communicates with the spermatic artery, near the jagged extremity of the tuba Fallopiana; and to the neighbouring parts of the vagina, &c.

The arteria obturatrix perforates the obturator muscles, from whence it has its name, and goes out of the pelvis at the upper part of the ligament of the foramen ovale, having first sent a small branch over the symphysis of the os ilium and os pubis, to the inguinal glands and integuments.

As it passes by the muscles, it divides and is distributed to the pectineus and triceps. It likewise sends out another branch, which communicates with that branch of the sciatica that goes to the articulation of the os femoris, and gives small arteries to the holes of the neck of that bone.

Afterwards the hypogastric artery ends in the umbilicalis, as has been already said.

Arteria crurales. The iliac artery goes out of the abdomen between the ligamentum Fallopii and tendon of the psoas, at the union of the os ilium and os pubis; and there it takes the name of *arteria cruralis*.

It sends off, first of all, three small branches; one of which, called *pudica externa*, goes over the crural vein to the skin and ligament of the penis, and to the inguinal glands, communicating with the pudica interna. The second goes to the musculus pectineus; and the third to the upper part of the sartorius. All these branches furnish likewise the neighbouring anterior integuments.

Afterwards the crural artery runs down on the head of the os femoris; and by taking a particular turn, gets on the inside of the crural vein, about three fingers breadth from where it goes out of the abdomen. From its origin to this place, it is covered only by the skin and fat, and lies on the pectineus and triceps primus.

In changing its situation it sends out three considerable branches, one external, one middle, and one internal. They all go out more or less posteriorly, sometimes by a short common trunk, sometimes by two, &c.

The external branch runs on the upper side of the thigh to the crureus, vastus externus, rectus anterior, musculus fasciæ latæ, and glutæus medius; sending up a ramus to the apex of the great trochanter, which communicates with the first principal ramus of the pudica major and sciatica, as has been already said.

The middle branch runs down on the inside of the thigh between the triceps muscles; to which it gives several rami, one whereof perforates the second muscle, and is distributed to the glutæus maximus, semi-nervosus, semi-membranosus, biceps, and to the neighbouring integuments.

The internal branch runs backward on the quadrigemi, towards the great trochanter; and having detached a ramus which goes into the joint of the os femoris, it runs downward, and gives rami to all the muscles that lie on the backside of that bone, one of which enters the bone itself on one side of the linea aspera.

Having sent off all these three branches, the arteria cruralis runs down between the sartorius, vastus internus, and triceps, giving branches to all the parts near it. It is covered by the sartorius all the way to the lower part of the thigh, where it is inflected backward over the triceps tertius, a little above the internal condyle

of the os femoris. Afterwards continuing its course through the hollow of the ham, it is called *arteria poplitea*, being accompanied by the vein of the same name.

The poplitea, while in the ham, is covered only by the integument, sending off branches toward each side, which run up upon the condyles, and communicate with the lower ramifications of the *arteria cruralis*.

It sends rami to the joint of the knee, one of which at least passes between the crucial ligaments. As it runs down, it sends branches to the *gastrocnemii* and *popliteus*; and having reached the backside of the head of the tibia, it gives off two branches, one to each side.

The first or internal branch surrounds the forepart of the head of the tibia, passing between the bone and internal lateral ligament; and, besides several other ramifications, sends up a small branch which communicates with the arteries that lie round the condyles of the os femoris.

The second or external branch runs over the head of the fibula, and between the head of the tibia and external lateral ligament of the knee, surrounding the articulation all the way to the ligaments of the patella, and communicating with the branches which lie round the condyles of the os femoris, together with a branch of the first or internal ramus.

Immediately after the origin of these two rami, and before the poplitea ends, it sends a small artery down on the backside of the interosseous ligament, very near the tibia, into which it enters by a particular hole a little above the middle portion of the bone.

As the poplitea ends, it divides into two principal branches, one of which runs between the heads of the tibia and fibula, passing from behind forwards on the interosseous ligament, where it takes the name of *arteria tibialis anterior*. The second branch divides into two others;

others; one internal and largest, called *arteria tibialis posterior*; the other posterior and smallest, named *arteria peronæa posterior*.

The tibialis anterior having passed between the heads of the tibia and fibula, sends small branches upward and laterally. The superior branches communicate with those rami of the popliteus which lie round the articulation; and the lateral branches go to the neighbouring parts. Afterwards this tibial artery runs down on the foreside of the interosseous ligament, toward the outside of the tibia, between the musculus tibialis anticus and extensor pollicis.

Having run laterally on the tibia for about two-thirds of the length of that bone, it passes on the foreside under the common annular ligament and extensor pollicis, to the articulation of the foot; giving off several rami both to the right and left hand, which communicate laterally with the tibialis posterior and peronæa posterior, so that these two bones are in a manner surrounded by arteries.

At the joint of the foot, it sends out branches which run between the astragalus and os calcis, being distributed to the articulation and to the bones of the tarsus. The communications are here very numerous on all sides.

Having passed the fold of the foot, it sends off toward both sides other rami, which communicate with the posterior tibialis and peronæa; all these branches making a kind of circles round the tarsus.

Afterwards the anterior tibial artery advances on the convex side of the foot, as far as the interstice between the first and second metatarsal bones; between the heads of which it sends a large branch, which perforates the superior interosseous muscle, and, joining the tibialis posterior, forms an arch on the side of the foot.

It likewise sends two or three considerable branches

over the other metatarsal bones, which go to the rest of the interosseous muscles, integuments, &c. and communicate with each other.

Lastly, this artery terminates by two principal branches, one of which goes to the thenar and inside of the great toe; the other is spent upon the outside of the great toe, and the inside of the second toe.

The tibialis posterior, called likewise *suralis*, runs down between the solei, tibialis posticus, flexor digitorum communis, and flexor pollicis; giving branches to these muscles, to the tibia, and to the marrow of that bone, through a particular canal in its posterior and upper part.

Afterwards it runs behind the inner ankle, communicating with the tibialis anterior, and surrounded by the neighbouring veins; and passes to the sole of the foot between the concave side of the os calcis and the thenar muscle, where it divides into two branches, one large or external, the other small or internal.

The great branch, or arteria plantaris externa, passes on the concave side of the os calcis obliquely under the sole of the foot, to the basis of the fifth metatarsal bone, and from thence runs in a kind of arch toward the great toe, communicating there with the tibialis anterior, which perforates the interosseous muscles in the manner already said.

The convex side of this arch supplies both sides of the last three toes, and the outside of the second toe, forming small communicating arches at the end, and sometimes at the middle of each toe, as in the hand. The concave side of the arch furnishes the neighbouring parts.

The small branch, or arteria plantaris interna, having reached beyond the middle of the sole of the foot, is divided into two; one of which goes to the great toe, communicating with the ramus of the tibialis anterior; the other is distributed to the first phalanges of the other toes,

toes, communicating with the ramifications from the arch already mentioned.

The arteria peronæa runs down on the backside of the fibula, between the soleus and flexor pollicis, to which and to the neighbouring parts it gives rami in its passage.

Having reached to the lower third part of the fibula, it sends off a considerable branch, which runs in between the tibia and that bone, passing between their extremities from behind forward, below the interosseous ligament, and is distributed to the integuments of the tarsus.

Lastly, the peronæa continuing its course downward, on the backside of the fibula, as far as the os calcis, forms an arch with the tibialis posterior, between the astragalus and the tendo achillis.

From thence it runs outward, and a little above the outer ankle communicates with the tibialis anterior by an arch, which sends several small ramifications to the neighbouring parts.

In this description of the arteries, I have said nothing of the cutaneous anastomoses, which are exceedingly beautiful in the foetus; nor of the frequent and considerable communications of small arteries upon the periosteum, which form a delicate kind of net-work, or rete mirabile.

C H A P. II.

Of the VEINS.*

Introduction. **T**HE blood distributed to all parts of the body by two kinds of arteries, the aorta and arteria pulmonaris, returns by three kinds of veins, called by anatomists *vena cava*, *vena portæ*, and *vena pulmonaris*.

The *vena cava* carries back to the right auricle of the heart, the blood conveyed by the aorta to all the parts of the body, except what goes by the arteriæ coronariæ cordis. It receives all this blood from the arterial ramifications in part directly, and in part indirectly.

The *vena portæ* receives the blood carried to the floating viscera of the abdomen by the arteria cæliaca and the two mesentericæ; and conveys it to the *vena hepatica*, and from thence to the *vena cava*.

The *vena pulmonaris* conveys to the pulmonary sinus, or left auricle of the heart, the blood carried to the lungs by the arteria pulmonaris.

To these three veins two others might be added, viz. those which belong particularly to the heart, and to its auricles, and the sinuses of the dura mater.

In describing the general course of the veins, we may either begin by their extremities in all the parts of the body,

* From WINSLOW, with Improvements.

body, and end by the trunks carried all the way to the heart, according to the course of the blood; or we may begin by the great trunks, and end by the ramifications and capillary extremities, according to their several divisions and subdivisions.

“ This last method has been chosen by Winslow; and may be conveniently followed with regard to the great trunks. But in pursuing the rami and ramifications, the other method seems to be the most natural, and is that to which the preference is given by the professor of anatomy in this university. We shall, therefore, in describing the branches, adopt the first method, and, reversing Winslow, trace them, according to the course of the blood, from their extremities to the trunks and heart.”

General division of the vena cava. We commonly talk of the vena cava in general, as if it were but one vein at its origin, or had but one common trunk; whereas it goes out from the right auricle of the heart by two large separate trunks, in a direction almost perpendicularly opposite to each other, one running upward, called *vena cava superior*; the other downward, called *vena cava inferior*.

It may, however, be said, that these two veins have a sort of continuity, or a small portion of a common trunk, fixed to the edges of the right auricle; as if three quarters of the circumference of a large straight tube were cut off, and the edges of a small bladder applied to the edges of the opening thus made in the tube.

The right auricle may also be looked upon as a muscular trunk common to these two large veins, and may be called the *sinus* of the vena cava; but in this respect, the name of *sinus pulmonaris* agrees still better to the left auricle.

The vena cava superior is distributed chiefly to the thorax, head, and upper extremities, and but very little to the parts below the diaphragm.

The vena cava inferior is distributed chiefly to the abdomen and lower extremities, and but very little to the parts above the diaphragm.

The ancients called the superior vena cava, *ascendens*; and the inferior, *descendens*; having regard only to the great tubes, and to their division into trunks and branches. Several moderns have retained these names, but in a contrary signification, to accommodate them to the motion of the blood, which descends by the cava superior, and ascends by the cava inferior.

But, to shun the mistakes that may happen in reports made of wounds or other diseases, and of what is observed in opening dead bodies, and in other cases of these kinds, it is best to retain the distinction of the vena cava superior and inferior.

The trunk of each of these two veins sends off, much in the same manner with the arteries, a certain number of principal or capital branches, which are afterward ramified in different manners. Each trunk terminates afterwards by a bifurcation or a division into two subordinate trunks, each of which gives off other principal branches, ending in a great number of small trunks, rami, and ramifications.

They have likewise this common to them with the arteries, that the greatest part of the capital branches are in pairs; as well as the subordinate trunks. The ramifications of each subaltern trunk, taken by itself, are in uneven numbers; but they make even numbers, with those of the other like trunk. The vena azygos and some other small veins, of which hereafter, are exceptions from this rule.

Before I go on to the particular description of each of these veins, many of which have proper names, I shall give a general idea of their distribution, and an enumeration of their principal ramifications, in the same manner as I did in the description of the arteries, and for the same reason. But I shall say nothing of the vena coronariæ cordis, because they are not immediately
joined

joined to any other vein, as we shall see in describing the parts of the thorax. I begin by the vena cava superior.

Vena cava superior. The superior vena cava runs up from the right auricle of the heart, almost in a direct course, for about two fingers breadth, lying within the pericardium, in the right side of the trunk of the aorta, but a little more anteriorly.

As it goes out of the pericardium, it is inclined a little to the left hand, and then runs up about an inch, that is, as high as the cartilage of the first true rib, and a little higher than the curvature of the aorta. At this place it terminates by a bifurcation or division into two large branches or subordinate trunks, one of which runs toward the left hand, the other toward the right.

These two branches are named *subclavia*, as lying behind, and, in some measure, under the clavicular, both in the same manner. They are of unequal lengths, because the trunk of the vena cava does not lie in the middle of the thorax, but toward the right side, where the left subclavian arises as well as the right, and is consequently longest.

The trunk of the superior cava, from where it leaves the pericardium to the bifurcation, sends out anteriorly several small branches, which sometimes arise separately, and sometimes by small common trunks. These branches are the vena mediastina, pericardica, diaphragmatica superior, thymica, mammaria interna, and trachealis; the last of which go out sometimes behind the bifurcation.

All these small branches from the trunk of the cava superior are termed *dextra*; and their fellows on the other side, called *sinistra*, do not arise from the trunk, because of its lateral situation, but from the left subclavia.

Posteriorly, a little above the pericardium, the trunk of the superior cava sends out a capital branch, called *vena azygos*, or *vena sine pari*, which runs down on the
right

right side of the bodies of the vertebræ dorſi, almoſt to the diaphragm; giving off the greateſt part of the venæ intercoſtales and lumbares ſuperiores.

The two ſubclaviæ run laterally or toward each ſide; and terminate, as they go out of the thorax, between the firſt rib and clavicula, immediately before the anterior inſertion of the muſculus ſcalenus.

The right ſubclavian, which is the ſhorteſt of the two, commonly ſends out four capital branches; the jugularis externa, jugularis interna, vertebralis, and axillaris; which laſt is rather a continuation than a branch of the ſubclavia.

The left ſubclavian being longer than the right, for the reaſon already given, gives off, firſt of all, the ſmall veins on the left ſide, anſwering thoſe on the right ſide that come from the trunk of the ſuperior cava, viz. the mediſtina, pericardia diaphragmatica ſuperior, thymica, mammaria interna, and trachealis.

Next to theſe ſmall veins called *ſiniſtræ*, it detaches another ſmall branch called *intercoſtalis ſuperior ſiniſtra*; and then four large branches like thoſe from the right ſubclavian, viz. the jugularis externa, jugularis interna, vertebralis, and axillaris; which are all termed *ſiniſtræ*.

The external jugular veins are diſtributed chiefly to the outer parts of the throat, neck, and head; and ſend a ſmall vein to the arm, named *cephalica*, which aſſiſts in forming a large one of the ſame name.

The internal jugular veins go to the internal parts of the neck and head, communicating with the ſinufes of the dura mater, and in ſeveral places with the external jugular veins.

The vertebral veins paſs through the holes in the tranſverſe apophyſes of the vertebræ of the neck, ſending branches to the neck and occiput. They form the ſinus venales of theſe vertebræ, and communicate with the ſinufes of the dura mater.

The axillary veins are continuations of the ſubclaviæ,
from

from where these leave the thorax to the axillæ. They produce the *mammariæ internæ*, *thoracicæ*, *scapulares* or *humerales*, and a branch to each arm; which, together with that from the external *jugularis*, forms the *vena cephalica*.

Afterwards the axillary vein terminates in the principal vein of the arm, called *basilica*; which, together with the *cephalica*, is distributed by numerous ramifications to all the parts of the arm, fore-arm, and hand.

Vena cava inferior. The portion of the inferior vena cava, contained in the pericardium, is very small, being scarcely the twelfth part of an inch on the fore-part, and not above a quarter of an inch on the back-part. From thence it immediately perforates the diaphragm, to which it gives the *venæ diaphragmaticæ inferiores* or *phrenicæ*.

It passes next behind the liver, through the great sinus of that viscus, to which it furnishes several branches termed *venæ hepaticæ*.

In this course it inclines a little toward the *spina dorsi* and *aorta inferior*; the trunk and ramifications of which it afterwards accompanies in the abdomen, all the way to the *os sacrum*; the *arteria cæliaca* and the two *mesentericæ* only excepted.

Thus the inferior cava sends out on each side, in the same manner with the *aorta*, the *venæ adiposæ*, *renales*, *spermaticæ*, *lumbares*, and *sacræ*. Having reached to the *os sacrum*, it loses the name of cava; and terminating by a bifurcation, like that of the descending *aorta*, it forms the two *venæ iliacæ*.

These iliac veins having given off the *hypogastricæ*, with all their ramifications, to the viscera of the pelvis, and to some other external and internal neighbouring parts, go out of the abdomen, under the *ligamentum Fallopii*, and there take the name of *venæ crurales*.

Each crural vein sends off numerous ramifications to all the lower extremity; besides the *vena saphena*, which goes out near the origin of the *cruralis*, and, running

running along this whole extremity, detaches many ramifications all the way to the foot, as we shall see more particularly hereafter.

We shall now trace the veins in the course the blood takes to the heart.

§ 1. *Veins of the Head and Neck.*

Vena jugulares externa. These are sometimes double to their very terminations; and when they are single, each of them is formed of two branches; one anterior, and the other posterior or rather superior. The anterior vein comes from the throat and face, running down toward the angle of the lower jaw, and the posterior comes from the temples and occiput.

Each terminates at last into the subclavian on the same side, sometimes into the axillaris, and sometimes into the union of these two veins. The right and left do not always end in the same manner; for sometimes the right goes into the subclavian, and the left into the internal jugular on the same side.

Vena jugularis externa anterior. This often terminates in the jugularis interna, and sometimes in the communications of the two jugulares, in such a manner as that it cannot be said to belong more to the one than to the other. Sometimes, but very rarely, it runs into the vena axillaris.

They run down between the musculus platysma myoides and sterno-mastoidæus, being covered by the former, and crossing over the latter.

The first branch comes along the musculus corrugator supercilii and the upper part of the orbicularis, from the small or external angle of the eye, after communicating with the vena temporalis, and with that vein which runs along the lower part of the orbicular muscle, with which it forms a kind of circle.

The second branch comes from the orbit in a winding course, on one side of the cartilaginous pulley, communicating with the vein of the eye.

The

The third branch is formed of branches from each side, and runs down upon the forehead, by the name of *vena frontalis*, anciently *præparata*, communicating with its fellow, when any such vein is found.

The fourth comes from the root of the nose; and communicating with its fellow from the other side, receives several small veins from the holes of the *ossa nasi*.

At the great or inner angle of the eye, these branches unite to form a trunk, called *vena angularis*; which, running down near the side of the nose, receives a branch from the internal nares, and another which ascends in a winding course from the upper-lip.

Afterwards the *vena angularis* runs down upon the face in a winding manner, receiving branches on each side from the muscles and integuments. It passes next over the lower jaw near the angle of that bone, and forms the anterior external jugular vein.

While this vein lies upon the face, the branches running into it communicate with each other, especially one which passes under the zygoma, behind the *os malæ*, from the inferior orbitary or sphenomaxillary fissure; and another small branch, which runs along the inferior portion of the orbitary muscle, from the small or external angle of the eye, where it communicates with the *rami temporales* and *frontales*.

It runs down from the lateral part of the lower jaw, between the angle and the chin, like a *vena maxillaris*; and receives several branches forwards, backwards, and inwards.

Interiorly, at the same place, it receives a large branch, which comes from the *glandulæ sublinguales*, runs up toward the *cornua* of the *os hyoides*, to communicate with some branches of the *jugularis interna*, and receives several *rami* from the tongue, called *venæ raninæ*. It receives likewise a small branch from the *musculus depressor anguli oris*, the commissure of the lips, and the neighbouring parts.

The same branch which receives the *venæ raninæ* takes

takes in another from the lateral parts of the septum palati, the amygdalæ, and the uvula, and receives rami forward from the membrane which lines the arch of the palate. Another branch comes into it from the pterygoideus internus, and muscles about the palatum molle.

It is here to be observed, that, under the angle of the lower jaw, there is a great variety of communications between the external and internal jugular veins, and also a great variety in the distribution of these veins.

Almost all the ramifications, which at this place go into the external jugular vein, from the upper part of the throat and face in some subjects, terminate in other subjects in the internal jugular; and sometimes, one part of them goes to the external jugular, the rest into the internal.

The trunk of the vein, after receiving these branches, admits another large branch anteriorly from the symphysis of the lower jaw, from the maxillary glands, the digastric muscle, the chin and under-lip.

Opposite to the cartilago thyroides, it receives a transverse branch, which runs on the anterior or lower part of the muscoli sterno-mastoidæi, and communicates with the jugularis of the other side, though not always by a vein of the same kind.

The superior and inferior transverse branches communicate on each side by branches more or less perpendicular, and receive a small branch from the musculus depressor labii inferioris and platysma myoides, and integuments.

Anteriorly, it receives several branches from the muscles of the larynx, sterno-hyoidæi, thyro-hyoidæi, and from the integuments; and below the larynx it receives communicating branches from the jugularis externa anterior of the other side.

Posteriorly, it receives, 1. A large branch on the side of the upper part of the larynx, which communicates with the jugularis interna; and likewise with a
large

large short branch of the *jugularis externa posterior*; of which below. 2. A small branch, which has the same communication, but which is not always to be found. 3. Another small branch a little below the lower jaw, which communicates with the *jugularis externa posterior*.

Vena jugularis externa posterior, five superior. The posterior or superior external jugular vein runs down from the side of the head, &c. receiving considerable branches from neighbouring parts.

This vein is at first formed by a branch called *vena temporalis*, which receives the blood from the temples and lateral parts of the head, likewise from some part of the occiput and forehead. Sometimes the temporal vein has two insertions, whereof one is into the *jugularis interna*.

The temporal vein of one side communicates above, with its fellow on the other side; before, with the *vena frontalis*; and behind, with the *vena occipitalis*. Opposite to the ear, it receives a large branch; one ramus of which runs under the lower edge of the zygoma, and then returning, communicates with another ramus from the same *jugularis*, a little below the condyle of the lower jaw, forming a kind of areola of a roundish form.

Behind this condyle, it receives branches from the temporal muscle, from the neighbouring parts of the upper jaw, and from the inside of the lower jaw, almost in the same manner as the arteries are sent out.

Only one of these branches comes from the *musculus temporalis* and *pterygoidæi*; communicating with a branch from the *masseter*, in its passage.

Having reached as far as the parotid gland, it passes through it, receiving a large branch, which communicates with another branch common to the internal and anterior external jugular veins; it forms communications with the anterior external jugular under the angle of the lower jaw.

Sometimes there are several branches; which having
run

run a very little way, unite together, and represent the short large branch, forming areolæ or meshes, through which the nerves pass.

Backward it receives the vena occipitalis, which comes from the different parts of the occiput, and sometimes runs into the vena vertebralis or axillaris, &c. It likewise receives a small vein, which comes out of the cranium by the posterior mastoide hole from one of the lateral sinuses. This branch goes sometimes into another vein.

At the lower part of the neck it receives the vena cervicalis, which comes from the vertebral muscles of the neck. This vein communicates with the humeralis by several areolæ, or venal meshes; and they are both ramified in different manners.

These ramifications and communications are in part covered by the musculus trapezius, and communicate likewise with some branches of the vena occipitalis, and with a branch of the superior intercostal vein, which perforates the first intercostal muscle.

At its termination, it receives, posteriorly, a principal branch from the muscles which cover the scapula and joint of the humerus, commonly called *vena muscularis*, and which might be named *super-humeralis*.

Vena jugularis interna. The internal jugular vein is the largest of all those that come from the head; tho' not so large as it seems to be when injected.

It is a continuation of the lateral sinus, which, after getting through the foramen lacerum of the basis crani, bends a little, and forms a sort of varix, which fills a thimble-like cavity in the temporal bone. From this it runs along the sides of the vertebræ of the neck, by the edges of the longus colli, and passes behind the sterno mastoidæus and omo-hyoidæus, which it crosses, and ends in the subclavian vein. At the top of the neck it receives small twigs from the pharynx and neighbouring muscles.

Farther down it receives another branch backward, which comes from the occiput. This branch communicates with another of the vertebralis, and, through the posterior mastoide hole, with the lateral sinus of the dura mater. This communication is sometimes by an anastomosis with a branch of the external jugular, or of the cervicalis.

Nearly opposite to the os hyoides, the internal jugular receives another branch, which comes from the parotid gland and angle of the lower jaw, where it communicates by other branches with the two external jugulars. This first branch receives others from the muscles of the os hyoides and neighbouring parts.

About two fingers breadth lower than the former, it receives a middle-sized branch, which comes laterally from the larynx, and may be named *vena gutturalis*.

This guttural vein is formed chiefly of three branches; the lowest of which comes from the thyroide gland and neighbouring muscles; the middle branch from the larynx, muscoli thyroidei, &c; and the third comes downward from the great communication between the two jugulares already mentioned. In this, however, there is some variety; and I have seen the left guttural vein go into the axillaris.

The last branches which it receives are small, and come from the thyroide glands.

Vena vertebralis. The vertebral vein accompanies the artery of the same name, sometimes in one trunk, sometimes in several stems, through all the holes of the transverse apophyses of the vertebræ colli, all the way from the great foramen occipitale, communicating with the occipital veins and small occipital sinuses of the dura mater.

At the top of the neck it receives a branch, which comes through the posterior condyloide hole of the os occipitis from the lateral sinus of the dura mater; but it is not always to be met with.

As this vein runs through the holes in the transverse

apophyses, it receives branches forward from the anterior muscles of the neck, and from the small anterior muscles of the head.

Other branches come likewise from the muscoli transversales and vertebralis colli at the back part of the neck.

It receives also the veins from the vertebral sinuses, which are pretty numerous, and placed one above another all the way to the occiput, communicating freely with each other and with those on the opposite side; and at the great foramen of the os occipitis there is a communication between them and the occipital sinuses of the dura mater.

About the third or fourth vertebra of the neck, the vertebral vein sends off a branch, which passes out between the vertebræ, and carries down part of the blood from the neck: this communicates again with the trunk of the vertebral vein, or with the subclavian.

The trunk of the vein afterwards runs down through the holes in the transverse processes of the vertebræ colli, receiving branches in its passage from the neighbouring muscles. At the under part of the neck it leaves the vertebræ, and ends in the upper and back part of the subclavian vein.

§ 2. *Veins of the Superior Extremities.*

The veins of the extremities run in two sets, one following the arteries, the other running immediately under the skin; we shall trace them from their origins to their terminations in the subclavian vein.

In general, the external or superficial veins of the fore-arm are larger than the internal; but they are accompanied only by small arteries, whereas the deep veins accompany large arteries.

Vena basilica. This vein takes its origin by several branches which come from the convex side of the carpus; one of which, named by the ancients *salvatella*, comes

comes from the side of the little finger next the ring-finger, having first communicated with the cephalica, by means of the venal areolæ conspicuous on the back of the hand. In the other fingers this vein follows nearly the same course with the artery.

After receiving these branches, it runs along the ulna, between the integuments and muscles, a little towards the outside, by the name of *cubitalis externa*, communicating with the veins called *profunda*, *satellites*, and *cephalica*. Near the inner condyle, it receives a branch which runs up along the inside of the fore-arm, near the ulna, communicating with the *mediana major*. Having reached the inner condyle, it receives a vein called *mediana basilica*, which opens into it obliquely.

Afterwards the basilica runs up along the inside of the os humeri, between the muscles and integuments, forming many communications with the vena profunda, satellites, and cephalica, and supplying the muscles and integuments.

Below the neck of the os humeri, near the hollow of the axilla, the basilica receives two or three considerable veins which come up from the sides of the brachial artery.

These veins, which often terminate in the profunda superior, communicate with the basilica and cephalica. They follow the course of the trunks of the arteries, and have the same names. At that part of the elbow where the artery divides they unite, but afterwards separate and reunite several times, surrounding the trunk of the brachial artery at different distances, and communicating freely with each other. These veins might be called *venæ satellites arteriæ brachialis*.

Behind the tendon of the pectoralis major, the basilica receives a considerable branch, which runs up in company with the trunk of the brachial artery from the neighbouring muscles on both sides. This vein is named *profunda brachii*, or *profunda superior*.

It receives at last, under the head of the os humeri,

a pretty large branch, which passes almost transversely round the neck of that bone, from behind inward, and from within forward, coming from the muscles on the outside of the scapula, particularly the deltoides, and communicates with the *venæ scapularis externæ*. This branch may be named *vena sub-humeralis*, or *articularis*, as the artery which lies in the same place; they both having much the same course.

This articular vein receives two principal branches; one of which runs along the inside of the bone, from which, and from the periosteum, it gets small veins. The other lies at the middle of the arm, between the bone and the biceps, and communicates with the *cephalica*.

The basilic vein having reached the side of the head of the *os humeri*, terminates in the trunk of the *vena axillaris*, which may be considered as a continuation of it.

The ancients termed the basilic vein of the right arm the *vein of the liver*, or *vena hepatica brachii*; and that of the left arm, the *vein of the spleen*, or *vena splenica brachii*. It has sometimes a double termination, by a branch of communication with the trunk of the *axillaris*.

Vena cephalica. The *vena cephalica* receives, at the extremity of the radius, branches which correspond with those of the radial artery. These branches form numerous *areolæ*, which communicate freely with each other.

A particular branch comes into it, which runs more or less superficially between the thumb and metacarpus, by the name of *cephalica pollicis*. The *areolæ* receive branches from the interosseous muscles and integuments, and communicate with the *vena salvatella*.

From the under part of the fore-arm the trunk of the vein runs along the radius between the muscles and integuments, receiving branches from both sides, which communicate with other branches of the same vein,
and

and with some of the basilica, forming areolæ much in the same manner as we shall afterwards find the saphe-na does in the lower extremity. That part of the vein which lies on the fore-arm may be looked upon as a *radialis externa*.

Having reached a little above the fold of the arm, it receives a large branch, which may be called *mediana cephalica*. This comes up obliquely from the middle of the fold of the arm, under the integuments, and over the tendon of the biceps, where it joins the *mediana basilica*. These two medianæ are sent off in an angle, the apex of which is turned downward. The *mediana cephalica* sometimes receives a long branch called *radialis interna*, which lies almost parallel to the *radialis externa*.

The two median veins are sent off from a trunk which may be called *mediana major*, or *longa*, to distinguish it from the other two. This trunk runs up from the fore-arm between the cephalic and basilic veins, communicating with both in its passage by many branches. At the part where it splits into the two branches already named, a branch opens into it called *vena cubiti profunda*. This comes from the neighbouring muscles, after having communicated with the other veins of the fore-arm.

A little below the external condyle of the os humeri, it receives a branch from behind, which comes down between the musculus brachialis and the upper portion of the supinator longus, after bending between the os humeri and anconæus externus, and communicating with some branches of the basilica.

The cephalica runs next up along the outer edge of the external portion of the biceps; communicating several times with the vena basilica, and receiving small rami on each side; from the neighbouring muscles, fat, and skin. Some branches go into its upper part, which lower down were sent off from its trunk.

It runs afterwards between the deltoid and large

pectoral muscles, communicating in its passage with a branch called *small cephalic*, and terminates in the *vena axillaris*.

Vena axillaris. This vein, formed by all the veins from the arm, receives, above the axilla, the *venæ thoracicæ*; one of which is superior, called also *mammaria externa*; and the other inferior. It likewise receives rami from the *musculus subscapularis*, *teres major*, *teres minor*, *supra-spinatus*, *latissimus dorsi*, *ferratus major*, *pectoralis minor*, *pectoralis major*, and from the glands of the axilla; and sometimes communicates by a small branch with the *vena basilica*.

The axillary vein, having received the branches already described, passes before the anterior portion of the *musculus scalenus*, and between the first rib and the clavicle, where it gets the name of *subclavianæ*. This receives the branches already described, from the head, neck, and upper part of the thorax; and at last meets with its fellow on the opposite side, to form the *vena cava superior*.

The last veins which it receives are the *musculares*, which come from the middle portion of the *musculus trapezius*, from the *angularis*, *infra-spinatus*, and *subscapularis*; and as some of these branches come from the shoulder exteriorly, others interiorly, the *venæ scapulares* are distinguished into external and internal.

§ 3. *Veins of the Thorax.*

Venæ pectorales internæ. The *pectorales internæ*, are small veins disposed in pairs toward the right and left side, behind the sternum and parts near it, including the *diaphragmaticæ superiores*, or *pericardia diaphragmaticæ*, *mediastinæ*, *mammariæ internæ*, *thymicæ*, *pericardiæ*, and *gutturales* or *tracheales*.

All these small veins are divided into right and left; and these are both distributed much in the same manner; but they differ in their terminations,
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because of the inequality in the bifurcation of the cava superior.

The right vena mediastina opens anteriorly into the trunk of the superior cava, a little above the termination of the azygos; the left goes into the subclavian.

The right superior diaphragmatica, or pericardio-diaphragmatica, goes anteriorly to the union of the two subclavian veins; or beginning of the superior cava; and is formed by several branches from the upper, fore, and back parts of the pericardium, communicating with those of the left diaphragmatica, and accompanying the nerve of the same name. The left superior diaphragmatica goes into the left subclavian a little below the termination of the mammaia.

The right internal mammaia arises from the lower and fore part of the thorax, behind the upper end of the recti muscles of the abdomen; here it communicates with the epigastric vein by several small branches. It passes afterwards into the thorax under the cartilage of the last true rib, and receives small branches from the mediastinum, while others come from the integuments through between the ribs. At the upper surface of the diaphragm it receives a branch which communicates with the diaphragmatic veins. The trunk thus formed, runs up within the thorax, behind the cartilages of the ribs near the edge of the sternum, and in company with the artery of the same name; and terminates at last in the beginning of the vena cava superior, but frequently in the subclavian vein.

The left internal mammaia terminates anteriorly in the left subclavian, opposite to the cartilage or anterior extremity of the first true rib.

The right vena thymica, when it terminates separately, goes into the union of the two subclaviæ; and when it is wanting, the thymus, from whence it takes its name, sends branches to the gutturalis or some other neighbouring vein. The left vein of the same name

goes to the left subclavian, almost opposite to the sternum.

The right pericardia seems to go rather into the termination of the right subclavian, than to the trunk of the superior cava; but in this there are many varieties. It comes from the upper side of the pericardium, and other neighbouring parts. The left pericardia comes sometimes into the left subclavian, before the mamma; and sometimes into the mamma or diaphragmatica superior on the same side.

The right gutturalis or trachealis goes into the upper part of the union of the subclaviæ, above the mamma of the same side, sometimes more backward, and sometimes into the subclavia. It comes from the glandulæ thyroideæ, trachea arteria, musculi sterno-hyoidæi, thymus, and glandulæ bronchiales. It communicates by lateral branches, more or less contorted, with the internal jugular vein; and sometimes, by another branch, with a small vein, which the internal jugular receives from the glandula thyroides. The left gutturalis goes into the upper or posterior part of the left subclavian near its termination.

The smallest internal pectoral veins do not always terminate separately, but have sometimes a small common trunk, especially on the right side; and of all these small veins, the mamma interna is the most considerable.

Vena azygos, and venæ intercostales. The vena azygos, or sine pari, is very considerable, and arises from the lower and left side of the thorax internally.

For at the back part of the diaphragm, it communicates, by a very sensible anastomosis, sometimes with the vena renalis, sometimes with a neighbouring lumbar vein, sometimes immediately with the trunk of the cava inferior, and sometimes otherwise.

I have seen this vein extremely large, resembling the trunk of the inferior cava, from the diaphragm to the origin of the renales; the true cava being through all
this

this space very narrow, or of the size of an ordinary azygos.

From thence it runs across the spine, and afterwards ascends on the right side of the vertebræ dorsi and aorta, and before the intercostal arteries.

At the top of the thorax it is bent forward over the origin of the right lung; forming an arch which surrounds the great pulmonary vessels on that side, as the arch of the aorta does those of the left side, with this difference only, that the curvature of the azygos is almost directly forward, whereas that of the aorta is oblique. It opens posteriorly, a little above the pericardium into the top of the superior cava.

The azygos is formed at first of the left intercostal veins, but seldom the whole number; for the superior veins go often into the left subclavian, by a vein somewhat similar to the azygos, but much smaller. The inferior intercostal veins, to the number of six or seven, sometimes more, sometimes fewer, go commonly into the trunk of the azygos, which runs between the aorta and vertebræ, from the substance of which, and from the œsophagus, it receives capillary twigs, as it passes to the right side of the thorax.

The trunk of the azygos is in some subjects bifurcated upward and downward, as it receives the left intercostals; and in others there are two small trunks.

There is sometimes an entire azygos on the left side, which, after being distributed in the same manner, opens into the ordinary azygos.

The azygos at the under part of the thorax receives a large branch, which perforates the muscles of the abdomen, after having been ramified between their different planes, and communicating with the like ramifications of the last or last two intercostal veins.

Sometimes it takes in the vena diaphragmatica inferior, and also a branch formed by the first venæ lumbares dextræ.

These communications between the last intercostal and

and first lumbar veins are very irregular, being sometimes by a series of opposite angles, sometimes by arcolæ, sometimes by a reticular texture, &c. Sometimes the extremity of the vena azygos communicates either mediately or immediately with the vena adiposa, and even with the vena spermatica.

As the azygos runs up in the right side of the thorax, it receives the inferior intercostal veins on that side, one coming from each series of intercostal muscles. These veins run along the lower edges of the ribs, after having perforated the muscles by branches which come from the posterior and external part of the thorax.

They communicate with the venæ thoracicæ, and most commonly with the mammaria interna; and lastly, more or less with each other, by perpendicular branches, near the posterior extremities of the ribs.

Afterwards the azygos admits into the extremity of the arch which it forms before it terminates, a trunk common to two or three small veins, called *intercostales superiores dextræ*, which bring back the blood from the first three series of intercostal muscles, and from the neighbouring part of the pleura.

These intercostal veins communicate with other branches which come through the intercostal muscles from the serratus superior posticus, serratus major, &c. and they run along the interstices between the ribs, communicating with the venæ mammariæ.

They likewise take in branches from the vertebral muscles and canal of the spine, where they communicate with the venal circles or sinuses, which bring back the blood from the medulla spinalis.

Lastly, the vena azygos receives two or three small veins into the top of the arch, one of which comes from the aspera arteria; the others partly from the aspera arteria, and partly from the bronchia, by the name of *venæ bronchiales*, accompanying the ramifications of the bronchial

chial artery. It opens at last into the back part of the superior cava, a little above the pericardium.

Vena subclaviana. The subclavian vein is formed chiefly by veins from the head, neck, and arms. It passes over the insertion of the anterior scalenus muscle, between the clavicle and first rib.

The right subclavian, which is the shortest of the two, commonly receives four capital branches, viz. the jugularis externa, jugularis interna, vertebralis, and axillaris, of which last the subclavian may be looked upon as a continuation.

The left subclavian being longer than the right, because the vena cava, into which both open, lies in the right side of the thorax, receives first the four capital branches, corresponding with those already mentioned, as going into the right subclavian. Next to these, it receives a vein, somewhat similar to the vena azygos, called *intercostalis superior*, which is formed of branches coming sometimes from five or six of the superior intercostal muscles, &c. these communicate with the other intercostals. The *intercostalis superior* receives the left bronchial vein. It receives also the small veins corresponding with those of the right side, going into the trunk of the superior cava, viz. the mediastina, pericardica, diaphragmatica superior, thymica, mammaria interna, and trachealis. And besides all these, it receives the termination of the thoracic duct, to be afterwards described.

After admitting the branches mentioned above, the two venæ subclavianæ unite at the upper end of the thorax, near the cartilage of the first rib, and form the vena cava superior, which runs down about an inch, somewhat inclining to the right side; at this part it enters the pericardium, and descends about two fingers breadth in an ordinary sized person, being situated on the right side of the aorta, but a little more anteriorly. It opens at last in the upper part of the right auricle.

§ 4. *Veins of the Chylopoietic and assistant Chylopoietic Viscera.*

Vena mesaraica minor, or hæmorrhoidalis interna. The blood sent out by the cæliac and two mesenteric arteries is returned by veins, which, as in other parts of the body, are much larger than the arteries.

A branch runs up from the rectum and left portion of the colon. The beginning of this branch communicates with other hæmorrhoidal veins at the end of the rectum. The beginning of this vein, like the ends of the arteries, forms numerous ramifications which surround the intestines. The left spermatic vein seems to communicate with some of the branches which form the trunk.

This vein has been named *hæmorrhoidalis*, from the tumours called *hæmorrhoides*, which are often found at its beginning next the anus. The word *interna* is added to distinguish this vein from the *hæmorrhoidalis externa*, which comes from the *vena hypogastrica*, and with which this vein communicates by capillary ramifications. The name of *mesaraica minor* agrees to it very well, because of its situation with respect to the inferior mesenteric artery, which is also less than the superior.

After returning the blood from the parts already mentioned, it unites with a branch coming down from the left part of the arch of the colon, where, after many ramifications, it communicates with a branch of the great *mesaraica*, with the ramifications of the *gastro-epiploica sinistra*, and with those of the neighbouring *epiploica*.

At a small distance from its termination, it receives from the duodenum a *vena duodenalis*, which is sometimes more considerable than one which comes from the great trunk of the *vena portæ*.

The internal hæmorrhoidal vein is one of the three great branches of the *vena portæ*, opening ordinarily into

into the termination of the vena splenica, and sometimes into the beginning of the great trunk of the vena portæ.

Vena splenica. The splenic vein is one of the three great branches of the vena portæ, and may be said in some measure to be a subordinate trunk of that vein. It runs transversely from the left to the right side, first along the lower side of the pancreas, near the posterior edge, and then under the duodenum.

In this course it receives several veins, viz. the vena coronaria ventriculi, pancreaticæ, gastrica, or gastro-epiploica sinistra, and epiploica sinistra. It likewise often receives the hæmorrhoidalis interna, the third capital branch of the vena portæ.

The vena splenica begins by branches which run in a winding course, after having run through the whole length of the spleen, almost in the same manner as the splenic artery. It is into the most posterior of these branches that the veins are received from the great extremity of the stomach, formerly known by the name of *vasa brevia*, which communicate with the coronaria ventriculi and gastrica sinistra.

In its passage it receives, at the small extremity of the pancreas, a vein called *epiploica sinistra*, because it comes from the left side of the omentum, where it communicates with the hæmorrhoidalis interna. When this vein is wanting, the branch of the left gastrica, to be afterwards mentioned, supplies its place. It sometimes goes to the most anterior branch, which the splenica receives from the spleen.

The left gastric or gastro-epiploic vein, coming from the convex side of the great extremity of the stomach, goes into the splenica at the left extremity of the pancreas.

In its passage, it receives several branches from both sides of the stomach, which are distributed by numerous ramifications, form many areolæ, and communicate

municate with the branches of the coronaria ventriculi.

The venæ pancreaticæ are several small branches sent into the splenica from the under edge of the pancreas. There are other small pancreatic veins which do not open into the splenica, as will be found in the description of the gastro-colica, one of the branches of the great mesaraic trunk.

The coronaria ventriculi, so called because it surrounds more or less the upper orifice of the stomach, runs along the small arch of that viscus from the pylorus, where it joins and becomes continuous with the vena pylorica. In its passage, it receives several rami from the sides of the stomach, which there form numerous areolæ, and communicate with the veins of the great arch.

It terminates pretty often in the beginning of the splenica, and sometimes in the left side of the beginning of the great trunk of the vena portæ, behind the hepatic artery; and in that case it is the most considerable of all the small veins that go into the great trunk.

Vena mesaraica major. The blood is returned from most of the branches of the superior mesenteric artery by a vein called *mesaraica* or *mesaraica major*. Into the concave side of the mesaraic vein, a branch passes called by Riolan *vena cæcalis*, which runs from the beginning of the colon, crossing one of the branches of the superior mesenteric artery.

This cæcal vein is formed by two arches, the uppermost of which communicates with the lower branch of the vena gastro-colica; the other receives ramifications from the intestinum cæcum and appendicula vermiformis, and communicates below with other branches of the great mesaraic vein.

Afterwards the trunk of the mesaraica passes over the superior mesenteric artery, to which it adheres very closely, and into the convex side of its arch receives several

veral branches almost in the same manner with the artery; but with this difference, that frequently the branches do not end immediately in the vein in so great numbers; and each of them is formed by many more ramifications.

The trunk of the great mesaraic vein receives sometimes opposite to the gastrica, a particular branch from the omentum, called *epiploica dextra*. But almost immediately before it descends over the mesenteric artery, it gets the addition of two large branches very near each other, which pass behind and under the artery, coming from the jejunum and part of the ilium by numerous ramifications, which form arches and areolæ like those of the artery.

The trunk of the great mesaraic vein running farther, receives a vein which may be called *gastro-colica*; this is formed of two branches, one superior, the other inferior.

The superior branch of the vena gastro-colica receives the gastrica, or gastro-epiploica dextra, which comes from the great curvature of the stomach, communicating with the gastrica sinistra. It also admits small veins from the head of the pancreas. In its passage it gets likewise branches from the stomach and omentum, and communicates with the pylorica, coronaria ventriculi, &c. and sometimes it forms the pylorica.

The inferior branch of the vena gastro-colica, which may be called *colica dextra*, comes from the upper part of the colon, and then from the right portion of that intestine, where it is divided archwise, and communicates with the great branch of the colica anterior, and with a branch of the vena cæcalis, as we shall see hereafter.

The last particular branch running into this trunk is called by Riolan *vena colica*. It opens into the anterior part of the trunk, before it joins the artery, and comes directly from the middle of the colon; and here it is
formed

formed of branches from the right and left, which communicate with others by arches. On the left hand, it communicates with the superior or descending branch of the hæmorrhoidalis; and on the right, with the former branch of the mesaraica,

The vein, after having been distributed like the artery, comes from the small intestines, the cæcum and right portion of the colon, and runs through those parts of the mesentery and mesocolon which belong to these intestines; it runs next down over the trunk of the arteries, receiving in its passage the splenic vein, and terminates at last in the vena portæ.

The vena portæ inferior appears to be a continuation of the trunk of the vena mesaraica major. The splenica is a capital branch of that trunk; and the hæmorrhoidalis interna has sometimes a common termination with the splenica, and sometimes is no more than a branch of that vein. In some subjects the mesaraica major and splenica appear to end by an equal union in the trunk of the inferior vena portæ, and in others the hæmorrhoidalis ends in the very angle of that union.

Vena portæ. The inferior vena portæ, after being formed of the splenic and mesenteric veins, receives into its trunk several small rami, which are commonly the venæ cysticæ, hepatica minor, pylorica, duodenalis, and sometimes the gastrica dextra, and coronaria ventriculi.

All these small veins sometimes end separately; and in other subjects, some of them go into it by small common trunks. It sometimes happens that several of them do not go immediately into the trunk of the vena portæ, but into one of its great branches.

The trunk formed by the two mesenterics and splenic veins passing on receives the vena gastrica, or gastro-epiploica dextra, and the coronaria ventriculi, but these go sometimes into the trunk of the vena portæ.

The duodenal vein, commonly called *vena intestinalis*

lis, goes into the great trunk near the cysticæ, and sometimes into the small common trunk of these veins. It comes chiefly from the intestinum duodenum, and receives likewise some rami from the pancreas. There is another vein called also *duodenalis*, which is a branch of the gastrica of the same side.

The vena pylorica terminates in the great trunk, almost opposite to the end of the cysticæ, and sometimes goes into the right gastrica. It passes over the pylorus from the short arch of the stomach, where it is joined by anastomosis with the coronaria ventriculi.

The cystic veins run along the vesicula fellea from its bottom to its neck; and as they are commonly no more than two in number, they are called *cysticæ gemellæ*, a name given likewise to the arteries which accompany them. They go into the right side of the great trunk near its end, sometimes separately, sometimes by a small and very short common trunk.

The small hepatic vein is commonly a branch of one of the cysticæ, or of their common trunk.

The large trunk of the vena portæ inferior or ventralis, is situated under the lower or concave side of the liver, and joined by an anastomosis to the sinus of the vena portæ hepatica, between the middle and right extremity of that sinus, and consequently at a good distance from the left extremity. From thence it runs down a little obliquely from right to left, behind or under the trunk of the arteria hepatica, bending behind the beginning of the duodenum, and under the head of the pancreas; its length being about five fingers breadth.

At the head of the pancreas, this trunk may be said to begin by the three branches already described.

The last portion of this vein may be termed *vena portæ hepatica*, superior or minor, the trunk of which is commonly known by the name of *sinus venæ portarum*. The other portion may be called *vena portæ ventralis*, inferior or major; and this is what I have de-

scribed, referring the distribution of the other to the history of the liver.

The vena portæ running toward the under and back part of the liver divides into two principal branches, which enter the cavity called *porta*; and each of these branches divides into many others, which follow the branches of the hepatic artery throughout the whole substance of the liver.

The vena portæ may be considered as made up of two large veins, joined almost endwise by their trunks, from each of which the branches and ramifications go out in contrary or opposite directions. One of these parts comes from the stomach and intestines, with the spleen and pancreas; the other goes to the liver.

§ 5. *Veins of the Inferior Extremities.*

THE blood is returned from the inferior extremities by a superficial and deep set of veins somewhat in a similar manner to what we have described in the superior extremities. Of the superficial veins we find one, first running up immediately under the skin and getting the name of

Vena saphena. This begins at the great toe, then runs between the first two metatarsal bones irregularly under the skin towards the inner ankle.

At the great toe it receives a kind of transverse arch over the metatarsus, which communicates by several branches with an arch which lies on the joint of the tarsus, and gets others from the toes. This arch receives likewise another branch, which runs down behind the outer ankle, having communicated with the vena tibialis externa.

Under the inner ankle, it receives a branch inward and forward, which runs under, and in some measure accompanies, the anterior tibial artery. Interiorly, it receives another branch at the same place, which passes up from the sole of the foot, communicating with the

external tibial vein by irregular arches. This in its passage receives branches from the toes.

At the lower part of the tibia, the saphena receives a considerable branch, which runs obliquely from the outer ankle, being formed of several rami, which communicate with each other and with the trunk of the saphena.

A little higher, it likewise receives from the fore-part of the tibia some branches coming from the periosteum and bone, and communicating with other branches to be described.

Afterwards the trunk of the great saphena runs up on the inside of the tibia, lying always near the skin; at the middle of the tibia, a vein forms an arch which communicates at both ends with the trunk of the large vein. A branch running up from the outer ankle along the integuments of the tibia, and communicating with the saphena, passes into this arch. At the upper part of the bone, it receives branches forward, outward, and backward.

The anterior branches come from the integuments on the upper part of the leg; the posterior, from those which cover the gastrocnemii, and communicate with the little saphena; and the external branches come from the fat and integuments.

From the leg the saphena passes along the inside of knee, and afterwards along the thigh, as far as the middle of the sartorius muscle; and here it receives from the same side several branches, which in their passage communicate with each other.

The vena saphena passes afterward to the forepart of the thigh, having been covered in all its passage by skin and fat only. At the groin it receives branches from the inguinal glands and neighbouring parts: these form free communications with each other. It opens at last into the top of the femoral vein.

Vena saphena minor. The vena saphena minor returns the blood from the outer side of the foot by many

small branches, which communicate freely with each other. From this part it runs up at the outside of the tendo Achillis; and, next, between the gastrocnemius externus and skin.

Immediately above and below the ham, this vein receives other branches, which likewise communicate with each other, and with the saphena major.

At the ham, a branch forms a communication between it and the crural vein, receiving small anastomosing branches in its ascent. It terminates at last a little above the ham in the trunk of the crural vein.

Vena tibialis anterior. From the extremities of the anterior tibial artery, the corresponding vein returns, first by a number of origins: but these, at the bottom of the leg, unites into one trunk; which, however, soon splits again into two or three branches, that surround the artery at different distances by small communicating circles. A particular branch, which communicates with the vena tibialis posterior, perforates the interosseous ligament from behind forward, and opens into the trunk of the vein at the bottom of the leg.

At the upper end of the leg the vein receives small superficial branches from the head of the tibia and fibula, which come from the joint of the knee, communicating these with lateral branches of the vena poplitea. It there perforates the head of the interosseous ligament, and terminates in the vena poplitea.

Vena tibialis posterior. From the sole of the foot the venæ plantares return after being formed of several transverse arches, which communicate with each other and with the saphena, and receive ramifications from the toes, nearly in the same manner as the arteria plantaris. The deep veins run along with the arteries, and have the same names.

The venæ plantares form a trunk, which passes on the inside of the os calcis, and then behind the inner ankle as high as the ham. At the lower part of the leg, it communicates with a transverse branch of the saphena, and

and with the anterior tibial vein, in the manner already said ; then receives branches from the musculus tibialis posticus and the long flexors of the toes.

Afterward the posterior tibial vein runs up between the soleus and tibialis posticus, receiving branches from each of them. It is formed, somewhat in the same manner as the tibialis anterior, of two or three branches, which, as they run, surround the corresponding artery, by small communicating circles formed at different distances.

It receives near its termination a branch, called *furalis*, from the gastrocnemii and soleus ; and opens at last into the vena poplitea, a little lower than the tibialis anterior.

Vena peronæa. The vena peronæa is likewise double, and sometimes triple. It runs up on the inside of the fibula, almost in the same direction with the arteria peronæa, which it likewise surrounds at different distances, by communicating branches, after the manner of the tibialis posterior, and like it ends in the vena poplitea.

It runs up from the foot to near the joint of the knee, communicating several times with the tibialis posterior, and receiving ramifications from the neighbouring portions of the musculi peronæi and long flexors of the toes.

The first of these communications makes the venæ plantares, in some subjects, to appear rather to go into this vein, than into the tibialis posterior, where they commonly terminate.

Vena poplitea. The vena poplitea, formed of the three large veins last described, but appearing to be a continuation of the tibialis posterior, runs up immediately behind the muscle of the same name ; at the lower part of which it receives several ramifications from each side, which divide and unite again in different ways and degrees before they terminate.

Near the internal condyle of the os femoris, the po-

plitea receives some lateral branches from the extremities of the neighbouring muscles, especially those of the *femi-nervosus*, *femi-membranosus*, &c. A branch which comes off from the trunk a little way below, and runs along the *peronæus longus*, likewise goes into it.

It likewise receives several other branches; one of which comes laterally between the outer condyle and the biceps, having been ramified in the same manner with the artery. Another branch runs up on the back-side of the *gastrocnemii* muscles from the *tendo Achillis*; then it goes forward, receiving ramifications from the beginning of these muscles. Then running up betwixt the two condyles, it receives branches from the flexor muscles of the leg, from the lower and posterior parts of both *vasti*, and from the fat which lies above the interstice of the two condyles. A little above the ham, it gets the name of *crural vein*.

§ 6. *Veins of the Pelvis.*

Vena iliaca externa. After the *crural vein* gets from under the *ligamentum Fallopii*, it is called *vena iliaca externa*; this receives several small rami from the neighbouring lymphatic glands.

To the inside, after it gets into the abdomen, it receives the *vena epigastrica*; which runs down along the inside of the *musculi recti*, from which it chiefly comes; but receives also branches from the broad muscles of the abdomen, which penetrate from without inwards: near its termination, it gets small branches from the conglobate glands.

The beginning of the *vena epigastrica* runs downward, from the ramifications of the *mammaria*, with which it communicates, accompanying the *epigastric artery*. At the inside of the *epigastric vein*, a branch is sometimes received from the *musculus obturator internus*, where a communication is also made with the *vena obturatix*.

Near the end of the former vein, it receives a branch which comes down along the inside of the crista of the os ilium; and admits others on each side, from the lateral and posterior lower portions of the musculi abdominis, from the musculus iliacus, &c. So that the external iliac vein, lying on the psoas and iliac muscles, receives almost the same branches with the artery of the same name, and follows the same course.

After admitting the branches already mentioned, the trunk of the vein joins a large vein from the cavity of the pelvis called *vena iliac interna*.

Vena iliaca interna. The hypogastric or internal iliac vein, runs behind the artery of the same name, making the same kind of arch, into which the following branches open.

Of the branches which form the hypogastric vein, we find first a large branch running from the lower part of the os sacrum, and two or more which come upward through the notch of the os ilium from the buttocks, anus, neighbouring portion of the musculus pectineus, and from the external parts of generation, nearly in the same manner with the artery which accompanies them.

The veins that come from the anus, are termed *hæmorrhoidales externæ*; and those that come from the parts of generation, *pudicæ internæ*. The external hæmorrhoidales communicate with the internal veins of the same name, which go to the small vena mesariaca, one of the branches of the vena portæ.

The hypogastric vein receives branches which come into the pelvis, above the ligament which lies between the inferior lateral part of the os sacrum and spine of the ischium; and before they come in, they are ramified chiefly upward and downward.

Within the pelvis it receives a large branch called *vena obturatricx*, which comes through the foramen thyroideum from the obturator muscles, adductores femoris, and neighbouring parts.

7 The *vena obturatrix*, after it perforates the muscles, receives branches exteriorly from the *musculus iliacus*, the superior part of the *obturator internus*, and from the *os ilium*, near its symphysis with the *os ischium*.

Interiorly, the same *obturator vein* receives another branch, which comes from the ureters, bladder, and internal parts of generation in both sexes. It communicates with the *spermatic veins*, and is more considerable in women than in men.

Into the posterior or convex part of the arch, the iliac vein receives a branch from the superior lateral part of the *os sacrum*, which comes from the *musculus facer* or *transverso-spinalis lumborum*, and other muscles thereabouts, and from the cavity of the bone, passing through the first great hole.

A little lower, on the same side, it receives another, which comes much in the same manner with the former, through the second hole.

Into the external lateral part of the same arch, a little anteriorly, it receives a large branch, which runs behind the great sciatic sinus, and comes from the *musculi glutæi*, *pyriformis*, and *gemelli*. After receiving these different branches, it joins the external iliac vein.

Vena iliaca communis. The *hypogastric vein*, running up in the pelvis, joins the external iliac to form the common iliac vein, in the same manner that the iliac arteries are connected with the aorta; but the union is about a finger's breadth lower than the bifurcation of the aorta.

One of these trunks is named *vena iliaca externa*, or *anterior*; the other *interna*, or *posterior*. The external vein is likewise named simply *iliaca*; and the internal, *hypogastrica*. The external vein seems to be in a line with the common iliac, and the *hypogastrica* only a branch. I here speak of adult bodies, because in the foetus there is a considerable variation.

These veins follow nearly the course and distribution of the iliac arteries, except that the *hypogastric vein* does

does not send off the vena umbilicalis. The external iliac veins lie more or less on the inside of the arteries, in the manner already said; but the hypogastric veins, in the bottom of the pelvis, lie almost behind the arteries on the same side.

To the common trunk of the iliac veins, and sometimes to the origin of the iliaca externa, a particular branch comes in from the musculus psoas, iliacus, and quadratus lumborum; some of which communicate with the last lumbar vein.

§ 7. *Veins on the Back-part of the Abdomen and Loins.*

THE two common iliac veins unite to form the vena cava. Into this union, and often into the end of the left iliaca, the vena sacra goes in, having accompanied the artery of the same name in its distribution to the os sacrum, to the nerves which lie there, and to the membranes which cover both sides of that bone.

The extremity of the trunk of the vena cava, lies in some subjects behind the origin of the right iliac artery; in others, it is the left iliac vein which passes there, and consequently crosses the right iliac artery. The cava passes up through the abdomen on the forepart of the lumbar vertebræ, and on the right side of the aorta.

It receives posteriorly the venæ lumbares; which commonly end in pairs, in the same manner as the arteries of the same name go out from the aorta. These may be divided into superior and inferior veins.

Their terminations vary in different manners. Sometimes the cava receives a branch from each side below the first vertebra of the loins, which, like a common trunk, receives the lumbar veins. This branch communicates with the azygos.

Sometimes a considerable branch comes into the lower extremity of the cava, near the union chiefly on
the

the right side; which, having run down between the bodies and transverse apophyses of the vertebræ, receives the *venæ lumbares*, and communicates with the *azygos*.

Sometimes a like branch goes to the beginning of the left *vena iliaca*; and having run down on that side in the same manner, admits the *lumbares*. This branch likewise communicates with the *azygos*, and with the superior or descending *ramus lumbaris*.

The *venæ lumbares* on one side, communicate by transverse branches with those of the other side, and likewise with each other by branches more or less longitudinal. The first and second often go to the *azygos*, and thereby they communicate with the intercostal veins.

The lumbar veins receive capillaries, in their passage, from the substance of the bodies of the vertebræ; and they come from the muscles of the abdomen, *quadratus lumborum*, *psoas*, *iliacus*, &c. They get branches forward from the neighbouring vertebral muscles, and from the canal of the spine, and communicate with the venal sinuses in the same manner as the intercostals.

Having got as high as the *arteriæ renales*, the *vena cava* receives the veins of the same name, termed formerly *venæ emulgentes*, and which are the largest of all the veins that go to the *cava inferior*, from the beginning to the part where it runs behind the liver.

The right renal vein is the shortest, and runs up a little obliquely because of the situation of the kidney. The left vein, which is the longest, crosses on the fore-side of the trunk of the aorta, immediately above the superior mesenteric artery, and both veins accompany the renal arteries.

They receive the *venæ capsulares* which come from the *glandulæ renales*, and branches from the *venæ ad-
neys*;

posæ which come from the fatty covering of the kidneys; and ordinarily the left renal vein receives the left spermatic vein.

A little below the renal veins, the trunk of the cava receives anteriorly the right vena spermatica. The left spermatic vein goes commonly, though not always, to the left renales. Both veins accompany the corresponding arteries.

In their passage, they receive several small branches on each side, from the peritonæum and mesentery; where they seem to be joined by anastomoses with the venæ mesaraicæ, and consequently with the vena portæ.

They sometimes bring a considerable branch over the iliac muscle, which is formed of two others; one ramus runs down from the membrana adiposa of the kidneys, the other runs up on the last mentioned muscle.

About the same height with the spermatic vein, the inferior cava receives posteriorly, in some subjects, a branch which runs downward, communicating with the vena azygos. Sometimes this branch goes into one or other of the renales, and appears to be a true continuation of the extremity of the azygos.

Behind the liver the vena cava receives the venæ diaphragmaticæ or phrenicæ, which come from the diaphragm, and appear chiefly on its lower side, one towards the right hand, and one towards the left. The right vein is more backward and lower than the left. The left comes partly from the pericardium, and partly from the diaphragm; and sometimes they receive rami from the capsulæ renales, much in the same manner as the arteriæ phrenicæ.

The inferior cava passes next thro' the posterior part of the great fissure of the liver, penetrating a little into the substance of that viscus, between the great lobe and the lobulus Spigelii; being, however, covered,

but

but very little, on the backside, by the substance of the liver, after it reaches the lobulus.

In its passage, it receives commonly three large branches, called *venæ hepaticæ*, which are ramified in the liver. Sometimes there are only two, and sometimes four.

Besides these large branches, it receives some other small ones, either before or immediately after it enters the liver; which, according to some anatomists, answer to the branches of the hepatic artery, as the large branches do to those of the *vena portæ*.

In the fœtus, as the *vena cava* passes by the liver, it receives the *ductus venosus*, which communicates with the sinus of the *vena portæ*, and in adults is changed to a flat ligament.

The *vena cava* having received these branches, perforates the tendinous portion of the diaphragm and the pericardium; and upon running a quarter of an inch or so within the pericardium, opens into the under part of the right auricle.

EXPLANATION of TABLES XI. and XII.

TAB. XI. *Represents the Heart and Blood-vessels.*

A, The heart.

B, The aorta ascendens.

C, A trunk from which the right subclavian and right carotid arteries are sent off. (Those on the left side come off separately.) The subclavian artery passes over to the arm behind the subclavian vein. The carotid artery runs up to the head, partly covered by the internal jugular vein.

D, The facial artery, which sends off the coronary arteries of the lips.

E, The

E, The deep temporal artery.

F, The descending aorta.

G, The right common iliac artery, which divides into the external and internal iliacs.

H, The femoral artery, which is a continuation of the external iliac artery.

I, The anterior tibial artery, sending branches to the forepart of the leg and upper part of the foot.

1, The frontal vein running down to form

2, The facial vein.

3, Deep temporal vein.

4, Occipital vein.

5, The external jugular vein.

6, The internal jugular vein, lying on the outer and fore part of the common carotid artery.

7, An arch on the palm of the hand, which runs partly to

8, The radial vein, and partly to

9, The ulnar vein. The two last veins run close by the sides of their corresponding arteries.

10, The cephalic vein.

11, The basilic vein cut. On the left side it is entire.

12, Branches running up to form

13, The humeral vein.

14, The external thoracic veins running along with their arteries. [N. B. In many parts, the vessels are so small, that one trunk must represent both artery and vein.]

15, The axillary vein.

16, The subclavian vein, receiving the jugular and other veins from the head and neck.

17, The vena cava superior.

18, Veins from the upper part of the foot, forming

19, The anterior tibial vein, which lies close by the side of the corresponding artery.

20, The venæ profundæ femoris.

21, The upper part of the vena saphena.

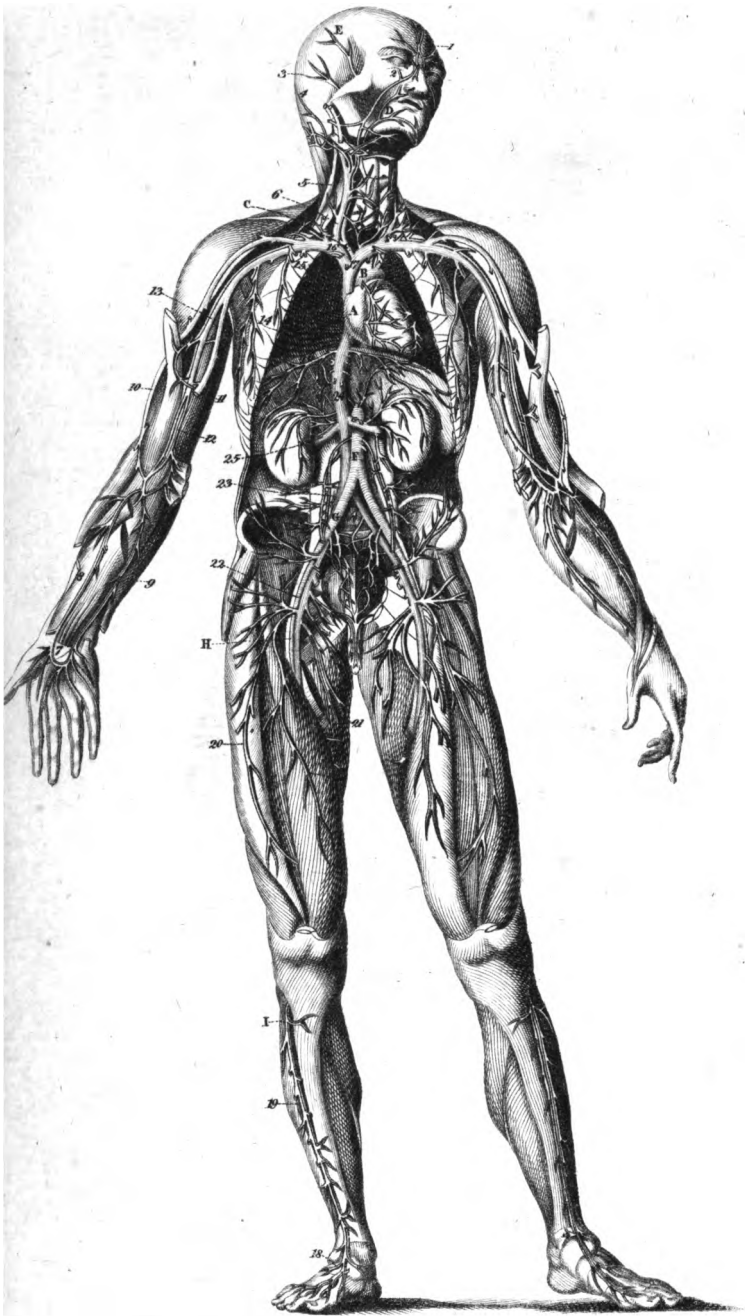
22, The femoral vein.

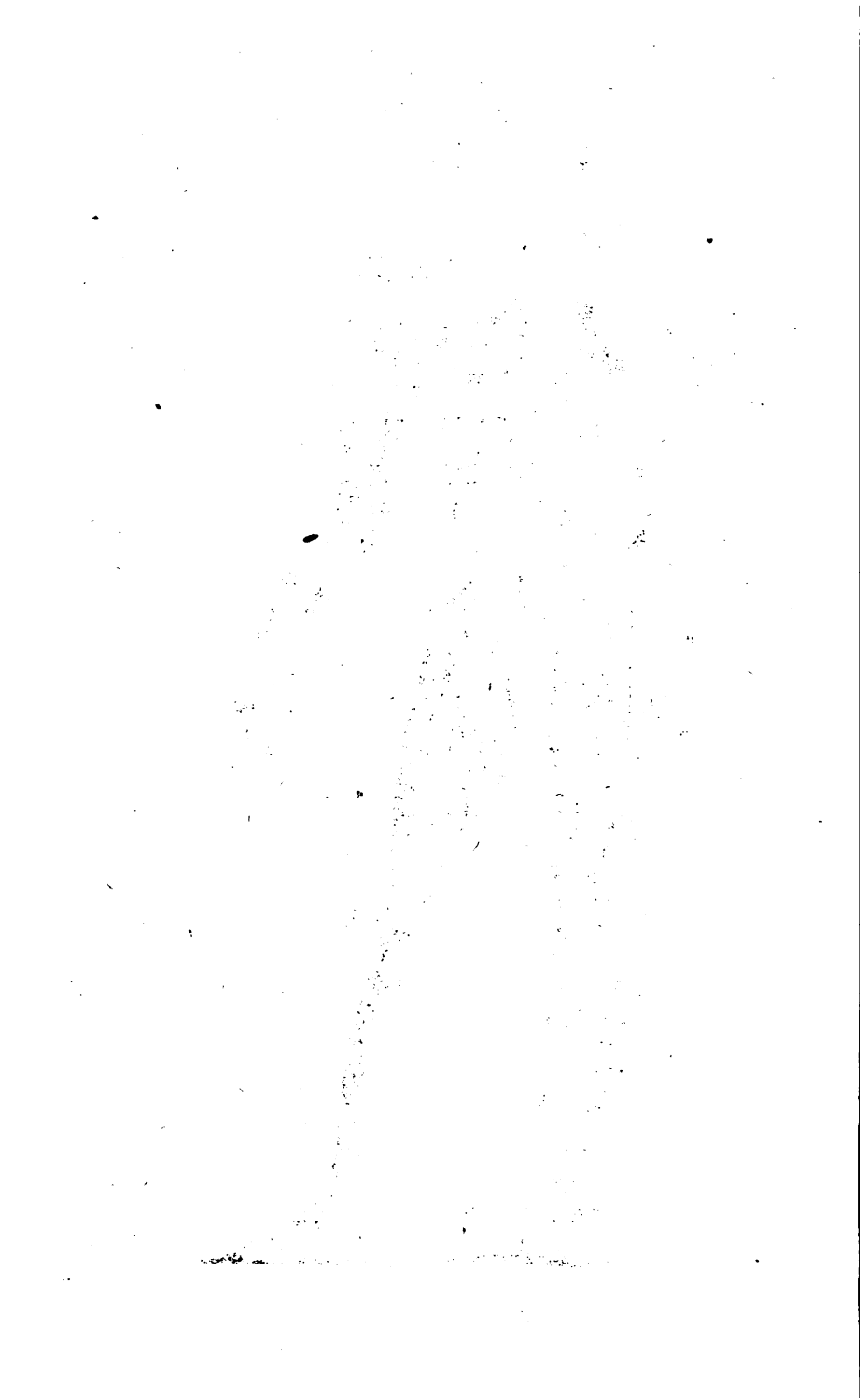
23, The

- 23, The common iliac veins, formed of the external and internal iliacs.
- 24, Vena cava inferior.
- 25, The renal veins covering the arteries.
- 26, The diaphragmatic veins.

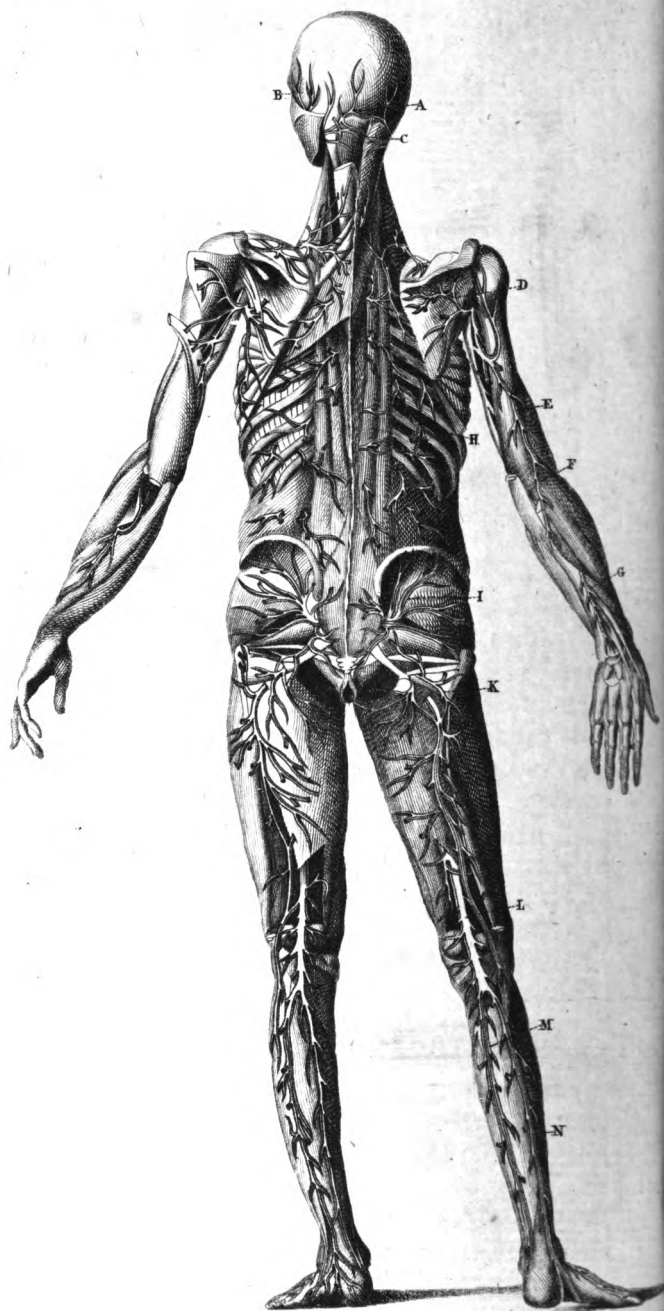
TAB. XII. *Exhibits a Back-view of the Blood-vessels.*

- A*, The occipital vessels.
 - B*, The deep temporal vessels.
 - C*, The cervical vessels.
 - D*, The scapular vessels.
 - E, F*, Deep humeral branches communicating with others at the elbow.
 - G*, The posterior interosseous vessels.
 - H*, Intercostal vessels.
 - I*, Arteriæ and venæ gluteæ.
 - K*, Sciatic vessels.
 - L*, Arteria et vena poplitea.
 - M*, Posterior tibial vessels.
 - N*, Fibular vessels.
- N. B.* The vessels being so small, both vein and artery are represented by one trunk.





Handwritten text, mostly illegible due to extreme fading and bleed-through. The text appears to be organized into several paragraphs, with some lines being more distinct than others. The handwriting is cursive and somewhat slanted.



C H A P. III.

Of the ABSORBENT SYSTEM.

FOR the discovery of the principal parts of this system, we are chiefly indebted to Asellius, Pecquet, Rudbeck, Jolyffe, and Bartholine. Some of the vessels of which it consists had been indeed seen and mentioned by their predecessors, but it was in too cursory a manner to give them any title to the discovery. Thus the lacteals had been seen in kids by Erasistratus, who calls them *arteries*, as we are informed by Galen: And the thoracic duct had been seen by Eustachius, who speaks of it as a vein of a particular kind; (see Eustachius *de Vena sine Pari.*)

In 1622, Asellius discovered those vessels on the mesentery, which, from their carrying a milk-like fluid, he denominated *lacteals*. This discovery being made by opening a living dog, anatomists were thence encouraged to make experiments on living animals; and Pecquet, on opening a dog in the year 1651, found a white fluid mixed with the blood in the right auricle of the heart. Suspecting this fluid to be chyle, he endeavoured to determine how it got from the lacteals into the heart: this he found was by means of the ductus

ductus thoracicus, which he traced from the lacteals to the subclavian vein; and thus he clearly proved the existence of that duct which we now consider as the trunk of the system. Just before his time the lacteals had been supposed to terminate in the liver; conformably to the idea which the physiologists of that period had adopted about the use of this organ, which, from the authority of the older anatomists, they believed was the viscus hæmatopoeticum, or received the chyle from the intestines to convert it into blood.

In the years 1651 and 1652, Rudbeck, Jolyffe, and Bartholin, discovered the other parts of this system, which, from their carrying a transparent and colourless fluid, are called the *lymphatic vessels*. Thus there was proved to exist in an animal body a system of small vessels containing fluids very different from the blood, and opening into the sanguiferous vessels at the union of the left subclavian vein.

After this period, Nuck added to our knowledge of this system, by his injections of the lymphatic glands; Ruyfch, by his description of the valves of the lymphatic vessels; and Dr Meckel, by his accurate account of the whole system, and by tracing those vessels in many parts where they had not before been described.

Besides these authors, Drs Hunter and Monro have called the attention of the public to this part of anatomy, in their controversy concerning the discovery of the office of the lymphatics.

When the lymphatic vessels were first seen and traced into the thoracic duct, it was natural for anatomists to suspect, that as the lacteals absorbed from the cavity of the intestines, the lymphatics, which are similar in figure and structure, might possibly do the same office with respect to other parts of the body: and accordingly, Dr Glisson, who wrote in 1654, supposes these vessels arose from cavities, and that their use was

to absorb; and Frederic Hoffman has very explicitly laid down the doctrine of the lymphatic vessels being a system of absorbents. But anatomists in general have been of a contrary opinion; for from experiments, particularly such as were made by injections, they have been persuaded, that the lymphatic vessels did not arise from cavities, and did not absorb, but were merely continuations from small arteries. The doctrine, therefore, that the lymphatics, like the lacteals, were absorbents, as had been suggested by Glisson and by Hoffman, has been revived by Dr Hunter and Dr Monro, who have controverted the experiments of their predecessors in anatomy, and have endeavoured to prove that the lymphatic vessels are not continued from arteries, but are absorbents.

To this doctrine, however, several objections have been started, particularly by Haller, (*Elem. Phys.* l. 24. § 2, 3.); and it has been found, that before the doctrine of the lymphatics being a system of absorbents can be established, it must first be determined, whether this system is to be found in other animals, besides man and quadrupeds. Mr Hewson claims the merit of having proved the affirmative of this question, by discovering the lymphatic system in birds, fish, and amphibious animals. See *Phil. Trans.* vol. 58. and 59.

Section I. *Of the Absorbent System in general.*

THE absorbent system consists of the lacteals, the lymphatic vessels, their common trunk, the thoracic duct, and the glands called *conglobate*.

The lacteals begin from the intestinal tube, and can for the most part be seen in a dog or other large quadruped that is killed two or three hours after eating, when they appear filled with a white chyle: but they do not always convey a fluid of this colour; for, even in a dog, if opened long after a meal, they are found distended with a liquor that is transparent and colourless like the

lymph; and in birds the chyle is never found white, but always transparent, these vessels, therefore, might, with as much propriety, be called the *lymphatics of the intestines*.

The lymphatic vessels are small pellucid tubes that have now been discovered in most parts of the human body: the fluid they contain is generally as colourless as water; a circumstance which procured them at first the name of *ductus aquosi*, and afterwards that of *vasa lymphatica*. The course of the lymph, like that of the chyle, is from the extreme parts of the body towards the centre, and the lymphatic vessels commonly lie close to the large blood-vessels. If therefore a ligature be thrown round the large blood-vessels of the extremities of a living animal, or of one just dead, that ligature, by embracing the lymphatics, will stop the course of the lymph, which by distending the vessels will make them visible below the ligature.

All the lacteals, and most of the lymphatic vessels, open into the thoracic duct, which lies upon the spine, and runs up towards the neck of the animal, where it commonly opens into the angle between the internal jugular and subclavian veins of the left side; and thus both the chyle and lymph are mixed with the blood. If therefore a ligature be thrown round the thoracic duct immediately after killing an animal, not only the lacteal, but also the lymphatic vessels, in the abdomen and lower extremities, become distended with their natural fluids; the course of those fluids being stopped by the ligature.

The lacteals, the lymphatics, and the thoracic duct, all agree in having their coats thinner and more pellucid than those of the blood-vessels. But although their coats are so thin, they are very strong, as we daily see on injecting them with mercury, since they resist a column of that fluid, whose weight would make it burst through blood-vessels, the coats of which are many times thicker than those of the lymphatic system.

The

The thinness of the coats prevents our dividing them from one another, and thereby ascertaining their number as we do those of the blood-vessels. But as the blood-vessels have a dense internal coat to prevent transudation, we have reason to believe the lymphatics have the same. And as the blood-vessels have a muscular coat, which assists in the circulation; so may the lymphatics. This is rendered probable from what Dr Haller says of his having found them irritable in his experiments, and also from what is observed on seeing them in living animals distended with their lymph, in which case they appear of a considerable size; but upon emptying them of their contents, they contract so much as not to be easily distinguished. This experiment, Mr Hewson informs us, he frequently made in the trunk of the lacteals in a goose, and on the lymphatic vessels on its neck; both of which, when distended with their natural fluids, are as large as a crow-quill; but, upon emptying them in the living animal, he has seen them contract so much that it was with the greatest difficulty he could distinguish them from the fibres.

The coats of lymphatic vessels have, in common with all other parts of the body, arterics, and veins, for their nourishment. This is rendered probable by their being susceptible of inflammation; for they are frequently found in the form of a cord, painful to the touch, and extending from an ulcer to the next lymphatic gland. These painful swellings of lymphatic vessels likewise show that their coats have sensibility, and therefore that they have nerves as well as arteries and veins. Besides, we can clearly trace in different parts of the body blood-vessels running along their surfaces.

The lymphatic system in most animals, but particularly in man and quadrupeds, is full of valves. These valves have been painted by the celebrated Nuck, Ruysch, and others, and are much more frequent than in the common veins, and thence these lymphatics have sometimes been distinguished by the name of *valvular*

lymphatic vessels. Those valves are generally two in number, are of a semilunar shape, and the one is sometimes much larger than the other. In most parts of the body these valves are so numerous, that there are three or four pair in an inch of space, but sometimes there is no more than one pair. They are less numerous in the thoracic duct than in the branches of the system; thence it might be supposed, that in proportion as we go from the trunk to the branches, we should find them thicker set: but this is not always true, for Mr. Hewson observed them more numerous in the lymphatic vessels of the thigh, than on those of the leg. When the vessels are distended with lymph, they appear larger where the valves are; which sometimes gives a lymphatic vessel an appearance of being made of a chain of vesicles: as such they are represented by some authors; but it is an appearance that very seldom occurs.

Lastly, the lymphatic system, in different parts of its course, has the glands called *conglobate* or *lymphatic*. These glands are so placed, that the vessels come in on one side, and pass out on the other, in their way to the thoracic duct. Before the discovery of the lymphatic vessels in birds, fish, and turtle, some anatomists have considered these glands as so essentially necessary to the lymphatic system, that they have generally set about discovering the vessels by first looking for those glands: and wherever they found glands, they pronounced that there must be vessels; and when no glands could be seen, they thought it as certain a proof of there being no vessels. But that they are wanting in some animals, is now generally known.

Section II. *A particular Description of the Absorbent System in the Human Body.*

THE absorbent system, besides the glands, is divided into three parts, viz. The lacteals, the lymphatic vessels, and the thoracic duct. The lacteals belong to the
in-

intestinal tube ; the lymphatics, to all the other parts of the body ; and the thoracic duct is the common trunk which receives both the lacteals and the lymphatics. We shall give a particular description of these, chiefly from the late ingenious Mr Hewson, by whom this part of anatomy, both human and comparative, has been so greatly illustrated, beginning with the lymphatics of the lower extremities.

§ 1. *Lymphatic Vessels of the Lower Extremities.*

THESE may be divided into two sets, viz. a superficial, and a deep-seated.

The superficial set of lymphatics consists of a considerable number of vessels that lie between the skin and the muscles, and belong to the surface of the body or the skin, and to the cellular membrane which lies immediately under it. Of these there are two large branches that can be readily enough discovered in the limbs of dropical subjects. One of these runs upon the top of the foot, as is represented Plate XIII. fig. i. (10) another is generally to be found just under the inner ankle ; pipes have been introduced into both of them, whereby they have been filled the whole length of the lower extremity, as is seen in this figure.

The lymphatic (10) which belongs to the toes, runs up on the outside of the tendon of the tibialis anticus (9), till it has got above the ankle ; and it divides at (11) and again at (12, 12, 12) forming a plexus, which runs over the shin-bone (8), and ascends in the cellular membrane immediately under the shin between that bone and the internal belly of the gastrocnemius (7) to the inside of the knee (6), where in this figure it disappears, but may be seen in fig. ii. This plexus, having passed the inside of the knee, appears upon the thigh immediately under the skin, and over all the muscles, as is seen in fig. i. (14), from which it passes to the groin ; where these vessels enter the lymphatic glands.

The lymphatic glands of the groin are six, seven, or

eight in number ; of these, some lie in the very angle between the thigh and the abdomen, and others lie a few inches down on the fore-part of the thigh. The lymphatic vessels, above described, enter the lowermost of these glands, which in the subject of this figure, are four in number, viz. (15 15, 16 16). One branch, however, avoids these glands, as at (17); which afterwards bends over at (18) to the gland (19); from which go vessels to the other lymphatic glands (20, 20) that lie in the angle between the thigh and the abdomen. It is into these upper glands alone that the lymphatic vessels of the genitals enter, so that the venereal bubo which arises in consequence of an absorption of matter from these organs, is always seated in those upper glands, and the lower glands (15 15, 16 16) are never affected, except by the regurgitation of the matter, or from their vicinity to the glands first diseased, which very seldom happens. And, as it is the upper glands that are affected by the absorption of matter from the genitals, so it is the lower which are commonly first affected from the absorption of the acrid matter of an ulcer, diseased joint, or carious bone, (in the parts below these glands); a circumstance that may assist us in the diagnosis of those two kinds of buboes: Remembering, however, that this rule may be liable to an exception from one of the lymphatic vessels passing the lower glands, and only entering the upper, as is seen at (17) in the same figure.

The lymphatic vessels of the genitals having joined those of the thigh, a network is formed, which enters the abdomen under the edge of the tendon of the external oblique muscle, called *Poupart's ligament*: one of these vessels is seen in Tab. XIV. (26). This plexus on the inside of Poupart's ligament consists of many branches; some of which embrace the iliac artery, of which one is seen in (27) *ibid.* but the greatest number of them pass up in the inside of the artery, as is seen at (21, 22) Tab. XIII. fig. i. and at (27) Tab. XIV.

These

These superficial lymphatics, small as they are, * probably are the trunks of those vessels which absorb from the skin and the cellular membrane immediately under it; and as no considerable branches can be distinguished on the outside of the leg or thigh, it is probable that all the lymphatic vessels of those parts bend towards the inside, and open into the trunks that are here represented.

Upon these vessels, from the foot to the groin, there is commonly not one lymphatic gland. But this rule has likewise some exceptions: for, even at the lower part of the leg, there is a very small one in the subject from which this plate was taken, as represented at (13), Tab. XIII. fig. i. and in another subject our author saw a small lymphatic gland near (14); from which it may be concluded, that the lymphatic glands, even in the human body, are in number and situation a little different in different subjects.

Besides these superficial lymphatic vessels which lie above all the muscles, or in the cellular membrane under the skin, there is a set deeper seated that lie amongst the muscles, and accompany the crural artery. Of these the principal trunk can be discovered by cutting down to the posterior tibial artery, near the inner ankle. By introducing a pipe into it at this part, it may be injected; as has been done in several subjects, one of which is represented Tab. XIII. fig. ii.

From the inner ankle at (13) *ibid.* this vessel passes up along with the posterior tibial artery, being hid amongst the muscles on the back part of the tibia. About the middle of the leg it enters a small gland at (15), which there is reason to believe will be found in most subjects. Having passed through this gland, the lymphatic runs up to the back part of the ham, still lying close

I i 4

to

* Here it is necessary to observe, that as the artist could not express the lymphatic vessels to the same scale with that of the limb; so all of them appear larger than they ought to be in proportion to the magnitude of the part to which they belong.

to the artery, and in the ham it passes through three glands, viz. (18, 19, 20) But Mr Hewson having seen a subject in which he could find only two glands, it is probable that the number varies. Hitherto this lymphatic has been a single trunk; but after it has passed these glands, it commonly divides into two or three branches, which still accompany the crural artery, and pass with it through the perforation in the triceps muscle. This muscle is divided in the preparation from which this figure was taken, in order to give a better view of the lymphatics; and the cut ends of the muscle appear at (6, 6) though not very distinctly, from their being shrunk by drying. The lymphatic vessels having perforated the triceps, pass up with the artery, as is seen at (22, 23) and enter a gland (24), which is deeper seated than those which appear in the groin: from this gland they pass into the superficial glands, represented at (15 15, 16 16) where the lymph of the deep-seated and of the superficial lymphatics is mixed, and is conveyed into the body by the vessels seen just above in the same figure. At this part likewise the lymph from the genitals is mixed with that brought by the two sets of lymphatics from the lower extremities; and the whole enters the abdomen by the plexus of vessels represented fig. i. at (21), and a part of it at Tab. XIV. (27).

Tab. XIII. fig. i represents the lower extremity, with its more superficial lymphatic vessels. N (1) is the spine of the os ilium, (2) the os pubis, (3) the iliac artery, (4) the knee. The other references have been explained in the course of the description.

Fig. ii. gives a back view of the lower extremity, dissected so as to show the deeper seated lymphatic vessels which accompany the arteries. (1) The os pubis. (2) The tuberosity of the ischium. (3) That part of the os ilium which was articulated with the os sacrum. (4) The extremity of the iliac artery appearing above the groin. (5) The knee. (6, 6) The two cut surfaces of the

the triceps muscle, which was divided to show the lymphatic vessels that pass through its perforation along with the crural artery. (7) The edge of the musculus gracilis. (8) The gastrocnemius and soleus, much shrunk by being dried, and by the soleus being separated from the tibia to expose the vessels. (9) The heel. (10) The sole of the foot. (11) The superficial lymphatic vessels passing over the knee, to get to the thigh. (12) The posterior tibial artery. (13) A lymphatic vessel accompanying the posterior tibial artery. (14) The same vessel crossing the artery. (15) A small lymphatic gland, through which this deep-seated lymphatic vessel passes. (16) The lymphatic vessel passing under a small part to the soleus, which is left attached to the bone, the rest being removed. (17) The lymphatic vessel crossing the popliteal artery. (18,) (19) (20) Lymphatic glands in the ham, through which the lymphatic vessel passes. (21) The lymphatic vessel passing with the crural artery through the perforation of the triceps muscle. (22) The lymphatic vessel, after it has passed the perforation of the triceps, dividing into branches which embrace the artery (23.) (24) A lymphatic gland belonging to the deep-seated lymphatic vessel. At this place these vessels pass to the fore part of the groin, where they communicate with the superficial lymphatic vessels. (25) A part of the superficial lymphatic vessels appearing on the brim of the pelvis.

2. *Absorbent Vessels of the Trunk.*

THE lymphatics of the lower extremities having now reached the trunk of the body, and having passed under Poupart's ligament, appear upon the sides of the ossa pubis near the pelvis at (27,27) Tab. XIV. A part of them passes up along with the iliac artery upon the brim of the pelvis; and another part dips down into the cavity of the pelvis, and joins the internal iliac artery near the sciatic notch. At this place they are joined

ed by the lymphatics from the contents of the pelvis, particularly from the bladder and the vesiculæ seminales in the male, and from the uterus in the female ; and there are likewise a few branches which pass thro' the sciatic notch from the neighbourhood of the glutei muscles. The lymphatic vessels of the uterus, like its blood-vessels, are much enlarged, and therefore easily distinguished, in the pregnant state of that organ. At this part, where so many lymphatic vessels join, there is commonly one or two glands.

Besides those lymphatic vessels which dip down into the cavity of the pelvis on the inside of the external iliac artery at (27, 27), there are others which keep on the outside of that artery upon the psoas muscle, some of which are seen on the left side in the same plate at (28). Of these, one part passes up to the loins at (32), and goes under the aorta in different branches, getting from the left side to the right, and joining the thoracic duct. Another part passes under the iliac arteries, and appears upon the os sacrum at (30), making a beautiful network, joining the lymphatics of the right side, and passing under the iliac artery, to form the network (31) upon the upper part of the right psoas muscle. In different parts of this course from Poupart's ligament to the loins, and also in the loins themselves, there are, in most subjects, many lymphatic glands ; none of which were filled in the subject from which this plate was made.

The lymphatic vessels of the right side, joined by some from the left, having now reached the right lumbar region, appear there in the form of a plexus of large vessels, and pass through several glands, which occupied the spaces (33, 33, 33), but not being injected in the subject are not represented. At this part likewise they receive large branches, under the aorta, from the plexus on the left side of the loins, as is mentioned before ; and having at last got up as high as the second lumbar vertebra, they all join, and form a single trunk
called

called the *thoracic duct*, which is seen at (36). At this part they are likewise joined by the lacteals, which shall be next described.

The lacteal vessels, so called from their commonly conveying a fluid that is of the colour of milk, begin from the inner surface of the intestines, where they have patulous orifices destined to imbibe the nutritious fluid or chyle : From the cavity of the intestines these vessels pass obliquely through their coats, uniting as they go, so as to form larger branches. These branches run on the outside of the gut to get to that part which is next the mesentery ; and, whilst they are yet upon the gut, they are sometimes of a size sufficient to admit a small pipe, so that they have been injected with mercury even in the human subject.

From the intestines they run along the mesentery and mesocolon, towards the spine ; passing through in their way the conglobate or mesenteric glands. These glands divide the lacteals into two regions : from the intestines to the glands these vessels are called *lactea primi generis* ; and from the glands to the thoracic duct, *lactea secundi generis*.

The lacteals of the small intestines, as they run upon the mesentery, commonly accompany the superior mesenteric artery, and unite, as they proceed, into larger branches ; so that by the time they arrive at the root of the mesentery, they are of a considerable size, as may be seen at (34). From the mesenteric artery they descend by the sides of the aorta, and open into the thoracic duct (36) : whilst the lacteals, or rather the lymphatics of the large intestines, accompany the inferior mesenteric artery, and communicate with the large lymphatic vessels near its root.

Into the thoracic duct at (36), likewise enters the lymph of the other abdominal viscera. This is brought by a number of vessels ; a plexus of which may be traced from each kidney, lying principally behind the emulgent artery, and opening into large lymphatic vessels
near

near the aorta : with these likewise go the lymphatics of the *glandulæ renales*, or renal capsulæ.

The lymphatic vessels of the spleen pass from the concave side of that viscus, along with the splenic artery in the sinuosity of the pancreas, by the lymphatic vessels of which they probably are joined.

To the stomach belong two sets of lymphatic vessels, the one running upon its lesser, and the other upon its greater curvature. Of these, the former accompanies the coronary artery, and passes through some lymphatic glands that lie by its sides. The other set passes from the great curvature of the stomach, through some lymphatic glands that lie close to the *arteria gastrica dextra*. Descending by the pylorus, it meets the plexus that accompanied the coronary artery ; and near the lesser curvature of the duodenum, forms a considerable network. Into this not only the lymphatics from the spleen enter, but likewise those from the gall-bladder, together with those of the liver, which are very numerous both in its convex and on its concave side. Several branches proceed from this network, some running under the duodenum, and others over it ; which all open into the thoracic duct, near the termination of the large trunk of the lacteals, as seen at (36). The thoracic duct therefore is the common trunk which receives the absorbent vessels of the lower extremities, the lacteals, and the lymphatics of the abdominal viscera.

As to the lymphatics of the larger viscera, (such as the liver, the spleen, and the kidneys), they are generally in two sets ; one which lies upon the surface of the organ, and the other which accompanies the large blood-vessels in its centre. In the liver these two sets have been found to communicate with each other ; so that, by injecting mercury into the lymphatic vessels which lie upon its convex surface, Mr Hewson has filled those which accompany the *pori bilarii* and *vena portarum* in its centre. Most of the lymphatic vessels which lie upon the convex surface of the liver, run towards its falciform ligament, and pass down by the side

of the vena cava. But some of them run towards the right ligament of the liver, where they pass down upon the diaphragm to get to the thoracic duct. The lymphatics on the concave surface run towards the portæ, where they join those which come from the centre of the liver along with its large blood-vessels. It is remarkable of those lymphatic vessels which run upon the surface of the liver, that their valves can readily be made to give way, so that they may be injected from their trunks to their branches, and to great minuteness.

It has been suggested by Dr Meckel, that the lymphatics of the stomach do not open into the thoracic duct like those of the other viscera, but only open into the sanguiferous veins of the stomach: but from repeated dissections of the human subject, Mr Hewson has been convinced of the contrary; and likewise from the analogy with other animals, particularly fish, whose lymphatic vessels either have no valves, or the valves readily give way, so that he has repeatedly pushed injections from the thoracic duct into the lymphatics of their stomachs, as he has also done into the lymphatics of the other viscera contained in the cavity of their abdomen.

The thoracic duct, which receives all the vessels that we have yet described, differs in its size in different subjects, but is always smaller in its middle than at its beginning, as is seen in the plate. Sometimes its lower part (36) is still larger in proportion than is there represented; and that enlargement has been called the *receptaculum chyli*, and is considerable in some quadrupeds, in turtle, and in fish: but many anatomists have denied that there is any part of the thoracic duct in the human subject that deserves the name of *receptaculum*, having never seen any thing like a pyriform bag, as it has been described, but merely an enlargement not unlike a varix, and that only in few subjects; for that commonly it appears only a little larger than at its middle. This lower extremity of the thoracic duct is formed by the union of two, three,

three, or four very large trunks of lymphatic vessels : These large vessels unite so as to form the duct about the lower part of the first, or the upper part of the second vertebra lumborum, reckoning downwards.

These large lymphatic trunks which form the thoracic duct are spread out upon the spine, those of the right side lying below the right crus diaphragmatis, and those of the left passing between the aorta and the spine; whilst the thoracic duct itself lies on the right side of the aorta, between that artery and the right crus diaphragmatis, and behind the emulgent artery of the right side, as at (37). From this part it passes upwards, being at first discovered by the crus diaphragmatis, and afterwards appears at (38) in the thorax, upon the spine between the aorta and the vena azygos. In the thorax it receives some lymphatics from the intercostal spaces; a few of which are seen at (39), and afterwards it receives vessels from the lungs.

The lymphatics of the lungs are in two sets. One set passes on the posterior part of each lobe by its root, into the thoracic duct, near the middle of the thorax; the other passes from the forepart of each lobe up towards the jugular and subclavian veins. Some of the lymphatics on the posterior part of the left lobe pass under the aorta to get to the thoracic duct.

At the root of the lungs, where the large blood-vessels enter, are many glands called *bronchial*. They are generally of a blackish colour in the human subject, and have been suspected to secrete the mucus which is spit up from the trachea; but Mr Hewson having more than once distinctly filled them with mercury by injecting the lymphatic vessels of the lungs, thinks it evident that they are not mucous but lymphatic glands.

The lymphatic vessels from the anterior part of the left lobe of the lungs pass into the angle between the jugular and subclavian vein of the same side, joining the thoracic duct at its termination; whilst those from the forepart of the right lobe do not communicate with
the

the thoracic duct, but pass into the angle between the right jugular and the right subclavian vein. These lymphatics from the anterior parts of the lungs are probably accompanied by those of the heart, which are represented by the accurate Nuck in his *Adenographia*, fig. 41.

The thoracic duct, after receiving the vessels before-mentioned, passes behind the ascending aorta, and goes to the left side, terminating in the angle between the jugular and the subclavian vein. But, just before its termination, it generally goes higher up than the angle, and then bends down towards it; see Tab. XIV. n° 42, 43. Sometimes, though rarely, there are two thoracic ducts instead of one. Sometimes the duct splits near the upper part of the thorax; and the two branches, after spreading out from one another, commonly unite again at their termination in the angle between the jugular vein and subclavian veins.

To the preceding account, it may not be improper to add the description given of the *Lacteal Sac and Duct* by the late Dr Alexander Monro.

“ The receptaculum chyli of Pecquet, or saccus lacteus of Van Horne, is a membranous somewhat pyriform bag, two-thirds of an inch long, one-third of an inch over in its largest part when collapsed; situated on the first vertebra of the loins to the right of the aorta, a little higher than the right emulgent artery, behind the right inferior muscle of the diaphragm: it is formed by the union of three tubes, one from under the aorta, the second from the interstice of the aorta and cava, the third from under the emulgents of the right side.

“ The lacteal sac, becoming gradually smaller towards its upper part, is contracted into a slender membranous pipe, of about a line diameter, which is generally named the *thoracic duct*. This passes betwixt the
mus-

muscular appendices or inferior muscles of the diaphragm, on the right of, and somewhat behind, the aorta: then, being lodged in the cellular substance behind the pleura, it mounts between the aorta and the vena azygos as far as the fifth vertebra of the thorax, where it is hid by the azygos, as this vein rises forwards to join the descending or superior cava; after which the duct passes obliquely over to the left side behind the œsophagus, aorta descendens, and the great curvature of the aorta, until it reaches the left carotid artery; behind which, on the left side of the œsophagus, it runs to the interstice of the first and second vertebræ of the thorax, where it begins to separate from the carotid, stretching farther towards the left internal jugular vein by a circular turn, whose convex part is uppermost. At the top of this arch it splits into two for a line and an half; the superior branch receiving into it a large lymphatic vessel from the cervical glands. This lymphatic appears, by blowing air and injecting liquors into it, to have few valves. When the two branches are again united, the duct continues its course towards the internal jugular vein, behind which it descends, and, immediately at the left side of the insertion of this vein, enters the superior posterior part of the left subclavian vein, whose internal membrane duplicated, forms a semilunar valve that is convex externally, and covers two-thirds of the orifice of the duct; immediately below this orifice, a cervical vein from the muscoli scaleni enters the subclavian.

“The coats of the sac and duct are thin transparent membranes; from the inside of which, in the duct, small semilunar valves are produced, most commonly in pairs; which are so situated as to allow the passage of liquors upwards, but oppose their return in an opposite course. The number of these is generally ten or twelve.

“This is the most simple and common course, situation, and structure of the receptaculum, chyli, and tho-

thoracic duct; but having had occasion to observe a variety in these parts, of different subjects, I shall set down the most remarkable of them.

“ The sac is sometimes situated lower down than in the former description; is not always of the same dimensions; is not composed of the same number of ducts; and frequently appears to consist of several small cells or ducts, instead of being one simple cavity.

“ The diameter of the duct is various in most bodies, and is seldom uniform in the same subject; but frequently sudden enlargements or sacculi of it are observable.—The divisions which authors mention of this duct are very uncertain. I have seen it divided into two, whereof one branch climbed over the forepart of the aorta at the eight vertebra of the thorax, and at the fifth slipped behind that artery, to join the other branch which continued in the ordinary course.—The precise vertebra, where it begins to turn to the left side, is also uncertain.—Frequently it does not split at its superior arch; in which case a large sac is found near its aperture into the subclavian vein.—Generally it has but one orifice; though I have seen two in one body, and three in another: Nay, sometimes it divides into two, under the curvature of the great artery; one goes to the right, another to the left subclavian vein; and I have found this duct discharging itself entirely into the right subclavian.—The lymphatic vessel which enters its superior arch, is often sent from the thyroid gland.

“ Whether is not the situation of the receptaculum chyli so much nearer the muscular appendices of the diaphragm in men than in brutes, designed to supply the disadvantageous course the chyle must otherwise have in our erect posture?

“ Does not the descent of the end of the duct to the subclavian vein, and the opening of the lymphatic into the top of the arch, contribute to the ready admission of the chyle into that vein?”

IN the description of the lymphatic vessels which lie near the spine, only a few glands have been mentioned; and in the figure where those vessels are exhibited no glands are represented. For the lymphatic glands not being constant either in number or situation, the describing them particularly in any one subject appeared less necessary, since we cannot be sure of finding them exactly the same in any other. It may, however, be necessary to mention where they are commonly seen.

The mesentery of the human subject is well known to contain a considerable number of them; they are likewise found in the mesocolon, where the lymphatics of the large intestines pass through them. The stomach has also several glands which belong to its lymphatic vessels, and lie near the arteria coronaria and the gastrica dextra. There are likewise a few upon the omentum in some subjects; and there are also many by the sides of the pancreas, particularly near the lesser lobe of that viscus, close to the duodenum.

Besides these glands which belong to the intestinal tube, there are many more in the cavity of the abdomen, and a few in the cavity of the pelvis, which belong to the lymphatic vessels of the other organs.

There is commonly a pretty considerable gland seen just on the inside of the edge of the tendon of the external oblique muscle, called *Poupart's ligament*, on the outside of the iliac artery; and there are others near that artery, where it lies upon the psoas muscle. There are likewise commonly one or two near the internal iliac artery in the cavity of the pelvis; and there is a considerable number generally met with by the sides, and upon the lumbar vertebræ.

Near the spleen, liver, kidneys, and renal capsulæ, there are also lymphatic glands which belong to the lymphatic vessels of these organs.

There are likewise lymphatic glands sometimes observed by the sides of the thoracic duct, particularly about

about the middle of the thorax, which glands belong principally to the vessels of the lungs.

There also many lymphatic glands (called *bronchial*) near the root of the lungs : these glands are placed upon the lymphatic vessels, just where they quit the lungs. But no lymphatic glands have yet been observed in the substance of the lungs ; and the tubercles, which some suspect to be obstructed lymphatic glands, seem to have a different origin. There are likewise some glands seen on the lymphatic vessels which lie near the subclavian veins at the upper part of the thorax, and which belong to the forepart of the lungs.

Besides these there are some lymphatic glands upon the aorta near the œsophagus, and there are also others occasionally met with in the intercostal spaces, and there are generally two or three contiguous to the thoracic duct at the lower part of the neck and upper part of the thorax, near the termination of that duct, in the angle between the left jugular and the left subclavian vein.

§ 3. *Lymphatics of the Head and Neck.*

By the side of each internal jugular vein is a large lymphatic vessel, which is the trunk of those of one side of the head and neck ; that of the right side is shown Tab. XIV. n° 48. Smaller lymphatics are seen near the branches of the external carotid artery. There are also lymphatic glands by the sides of the parotid and maxillary glands, by the sides of the large artery where it lies upon the chin, and by the side of the occipital artery ; and Mr Hewson saw one upon the root of the mastoid process of the os temporis. Those glands, which accompany the lower part of the artery that runs upon the face, are sometimes swelled in consequence of absorption from the lips and the parts adjacent, and also from gum-boils ; and those which accompany the occipital artery are frequently enlarged in consequence

of the absorption of matter from wounds of the scalp; from which facts it is evident that the external parts of the head are supplied with lymphatic vessels. In quadrupeds those vessels may be distinctly seen, particularly in a dog or an ass, by passing a ligature round the large blood-vessels of their necks immediately after killing those animals. Mr Hewson made some experiments of this kind with a view to determine whether the brain had lymphatic vessels: but he informs us he was never able to see any on that organ; neither when he tied up the lymphatics on the necks of those animals, and thereby stopped the course of the lymph; nor when he dissected the human brain, with a view to discover those vessels, although he particularly sought for them in the plexus choroides, where they have been suspected to be seen, and near the glandula pituitaria.

But although lymphatic vessels have not yet been demonstrated in the brain, it is probable from analogy, that this organ is not destitute of them.

The small lymphatics which accompany the branches of the external carotid artery unite upon the neck, and form a large trunk, which accompanies the internal jugular vein, passing through some lymphatic glands, near the termination of this trunk in the angle between the jugular and subclavian veins; there are likewise some glands on the outside of this angle, which seem to belong to the lymphatics from the back of the neck, and of the shoulder.

The glandula thyroidea has many lymphatic vessels, which can sometimes be inflated by blowing air into the cells of the gland: these vessels pass on each side of the trachea, one part going into the angle of the right subclavian and jugular, and the other joining the thoracic duct upon the left side.

In Tab. XIV. which exhibits the trunk so prepared as to show the lymphatics and the thoracic duct, (1) is the neck. (2) The shoulder. (3) The arm. (4) The out end of the clavicle. (5) The extremity of the first rib.

rib. (6) The subclavian muscle. (7) The rib. (8) The trachea. (9) The aorta ascendens. (10) The spine. (11) Vena azygos. (12) The aorta descendens. (13) The cæliac artery. (14) The superior mesenteric artery. (15) The right crus diaphragmatis. (16) The kidney. (17) The right emulgent artery. (18) The common iliac artery. (19) The division of the common iliac into the external and internal iliac arteries. (20) The cavity of the pelvis. (21) The spine of the os ilium. (22) The groin. (23) A lymphatic gland in the groin, into which lymphatic vessels from the lower extremity are seen to enter. (26) The psoas muscle with lymphatic vessels lying upon its inside. (27) A plexus of lymphatics, which having passed over the brim of the pelvis at (25), having entered the cavity of the pelvis, and received the lymphatic vessels belonging to the viscera contained in that cavity, next ascends, and passes behind the iliac artery to (29). (29) The right psoas, with a large plexus of lymphatics lying on its inside. (30, 30,) The plexus lying on each side of the spine. (31, 31, 31) Spaces occupied by the lymphatic glands; which are not here represented, not having been injected in the subject. (32) The trunk of the lacteals lying on the under side of the superior mesenteric artery. (33) The same dividing into two branches; one of which passes on each side of the aorta, that of the right side being seen to enter the thoracic duct at (34.) (34) The thoracic duct beginning from the large lymphatics. (38) The thoracic duct passing under the curvature of the aorta to get to the left subclavian vein. (39) A plexus of lymphatic vessels passing upon the trachea from the thyroid gland to the thoracic duct. (40) The upper part of the thoracic duct lying between the left carotid and the left jugular vein, and passing behind that veing downwards and outwards towards the angle between the left jugular and the left subclavian. (41) The extremity of the thoracic duct entering the

angle between the left jugular and the left subclavian vein. (46) That network passing under the right subclavian vein, and under the subclavian muscle, the clavicle being removed.

N. B. The other n^{os} are explained in the course of the descriptions.

§ 4. *Lymphatics of the Upper Extremities.*

LIKE the leg, each arm has two sets of lymphatic vessels. One set, which lies immediately under the integuments, belongs to the skin and the cellular membrane, connecting it to the muscles; the other accompanies the large arteries, and belongs to the parts deeper seated.

The superficial set of lymphatic vessels may be discovered in emaciated dropical subjects, by a careful dissection on the fore and back part of the arm. In Tab. XIII. fig. iii. they are seen running on the back part of the fore arm at (6, 6) most of them passing on its outside, and twisting to the fore part, near the head of the radius, as at (7). But in this representation, there is a vessel which passes towards the inside, under the inner condyle of the os humeri at (8), and sends a branch amongst the muscles; which branch perforates the interosseous ligament, getting between the radius and ulna to the forepart, where it joins a deep-seated one that had accompanied the radial artery.

In this figure, which exhibits a back-view of the forearm and hand, (1) Is the hand. (2) The lower extremity of the radius. (3) The lower extremity of the ulna. (4) The muscles on the back of the fore-arm turned aside to exhibit a deep-seated lymphatic vessel, which perforates the interosseous ligament to get to the fore part. (5) The olecranon.—The vessels have been already referred to.

In Tab. XIII. fig. iv. the lymphatic vessels are seen on the fore part of the upper extremity; those superficial

cial branches which passed on the outside of the back of the fore-arm appearing now on the forepart at (8); and ascending under the skin that covers the supinator longus and the biceps, they enter some glands in the axilla at (12, 12), whilst that vessel which passed on the inside of the back of the fore-arm under the internal condyle, appears on the fore part at (9), and just above the condyle enters a gland (10), and then passes up on the inside of the arm, communicating with a lymphatic from the forepart of the wrist, and passing to the axillary glands.

A superficial lymphatic is seen under the skin, on the forepart of this extremity just above the wrist; a pipe was introduced at (7), and the vessel thereby injected with mercury. Passing under the integuments over all the muscles, this vessel joins the lymphatic from the back part of the fore-arm at (11), and there forms a plexus which passes under the integuments, on the inside of the arm, to the axillary glands at (12).

Besides these superficial lymphatics upon the upper extremity, our author traced a deeper seated one near the radial artery, and injected it from a pipe fixed at (13). This vessel accompanies the radial artery, and passes (14) first under the interosseous, and then under the ulnar artery, which in this subject runs over the muscles. Near the part where it passes under the interosseous artery, it receives the branch from the back of the fore-arm. After passing under these arteries, this lymphatic appears on the inside of the brachial artery at (15), where it is deep seated. Ascending close to that artery, and near the middle of the arm, it passes through the two glands (16, 16); after which it appears considerably enlarged, goes under one of the arteriæ anastomaticæ at (17, 18), and then ascends to the lymphatic glands in the axilla (19, 19).

In the above figure, which exhibits a fore view of the upper extremity, (1) is the scapula, (2) the clavicle, (3) the extremity of the brachial artery, (4) the mus-

cles lying on the inside of the arm, (5) the inner condyle of the os humeri, (6) the lower extremity of the radius. N. B. The subsequent nos denoting the vessels have been explained in the description.

These vessels, however, as they here appear, although represented from an uncommonly successful injection, are only a part of the larger lymphatic vessels of the arm; as there are probably some accompanying ulnar and interosseous arteries, although not here injected. They should moreover be considered as only the trunks of the lymphatics; since it is probable, that every (even the smallest) part of this, as well as all other parts of the body, has one of these vessels adapted for absorption. That this is the case, seems to be proved by the experiments made with the variolous matter; for at what part soever of the arm that matter is inserted, the lymphatic vessels take it up and carry it into the blood, as can be traced by its inflaming the conglobate glands through which these vessels pass.

In Tab. XIV. the termination of all these lymphatic vessels is exhibited. Two of the trunks of those of the left arm are seen at (42, 42). They pass under the clavicle, whose cut end is seen at (4); and under the subclavian vein. Here, having joined, they form the large trunk (43), which appears just above the left subclavian vein, and joins the extremity of the thoracic duct at its entrance into the angle between that vein and the jugular.

The thoracic duct is not only joined by this trunk of the lymphatics of the left arm, but also by the lymphatic vessels of the left side of the thyroide gland, and by the trunk of the lymphatics of the left side of the head and neck, and also by those from the forepart of the lungs of the same side.

The lymphatic vessels of the right side are commonly seen to terminate in the angle between the jugular vein and the subclavian. When seen to enter the subclavian

FIG. 1.



Fig. II.



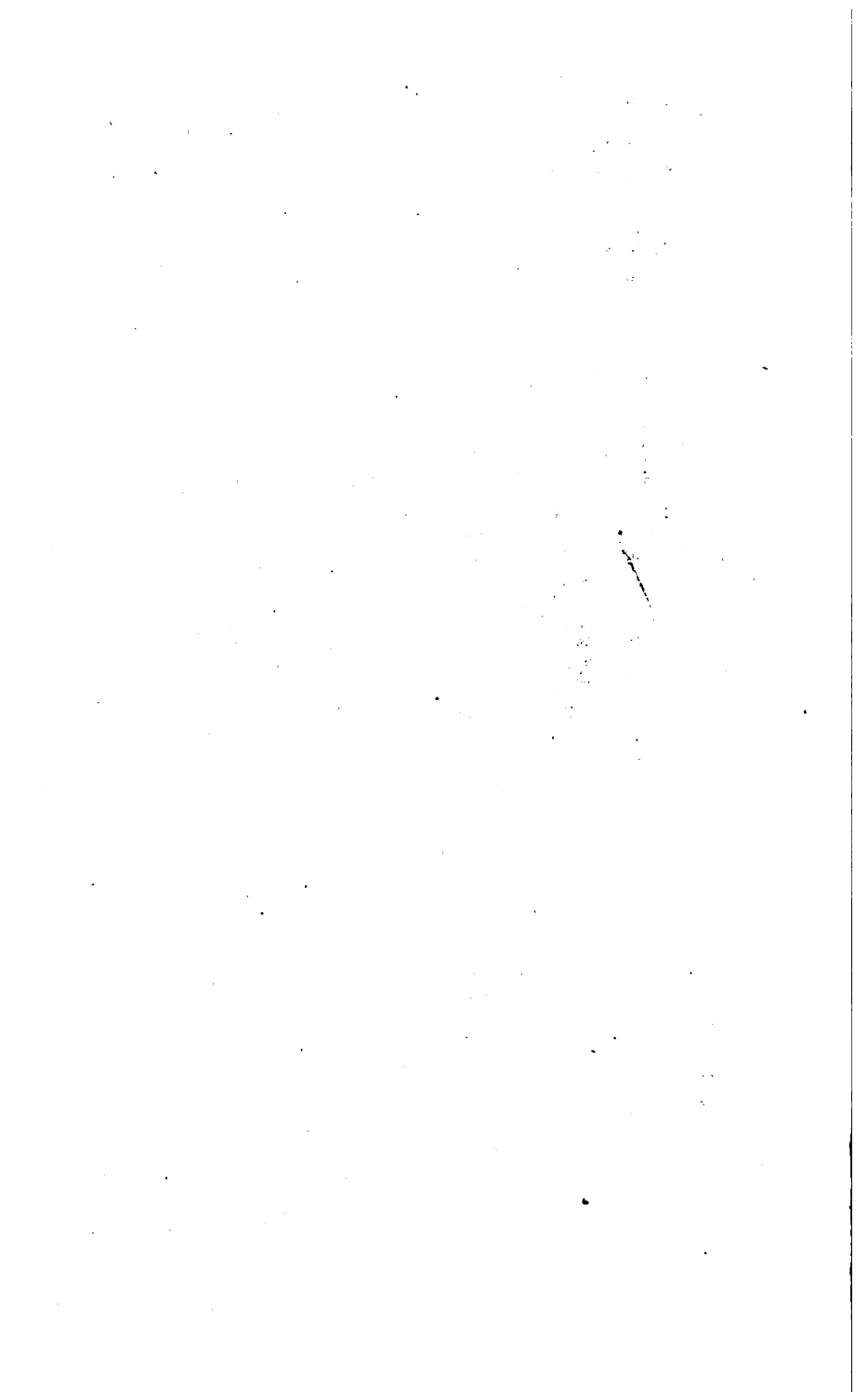
FIG. III.



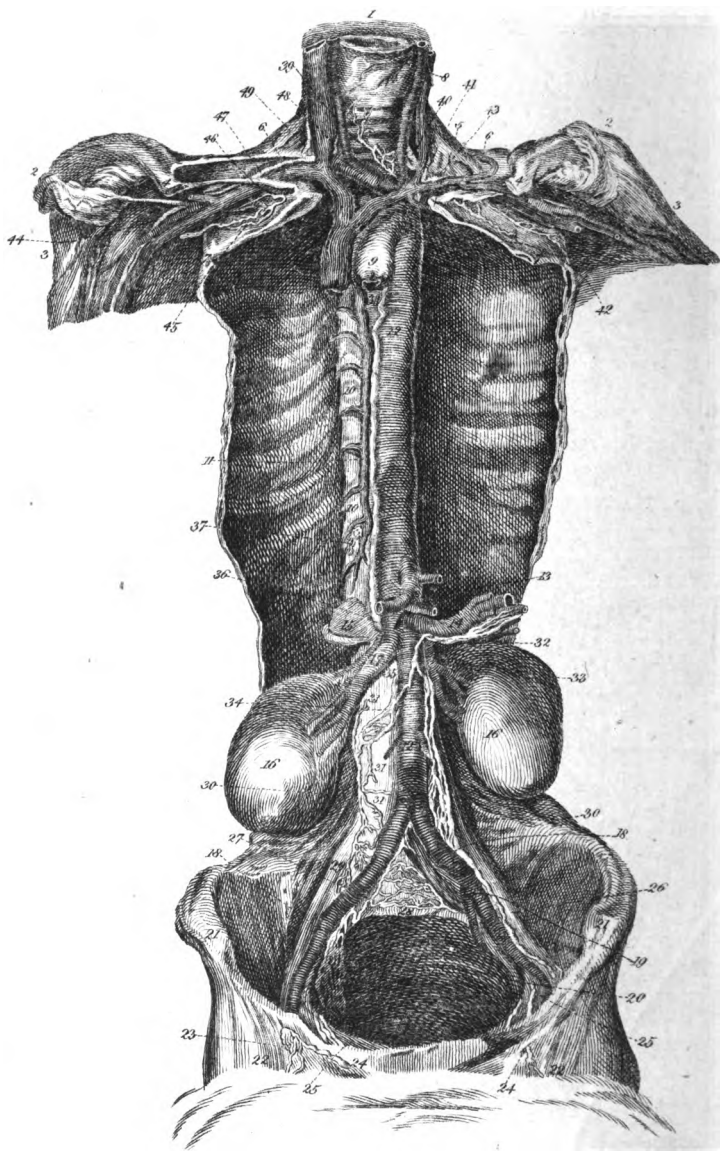
FIG. IV.



D. LIZARS SCULPT



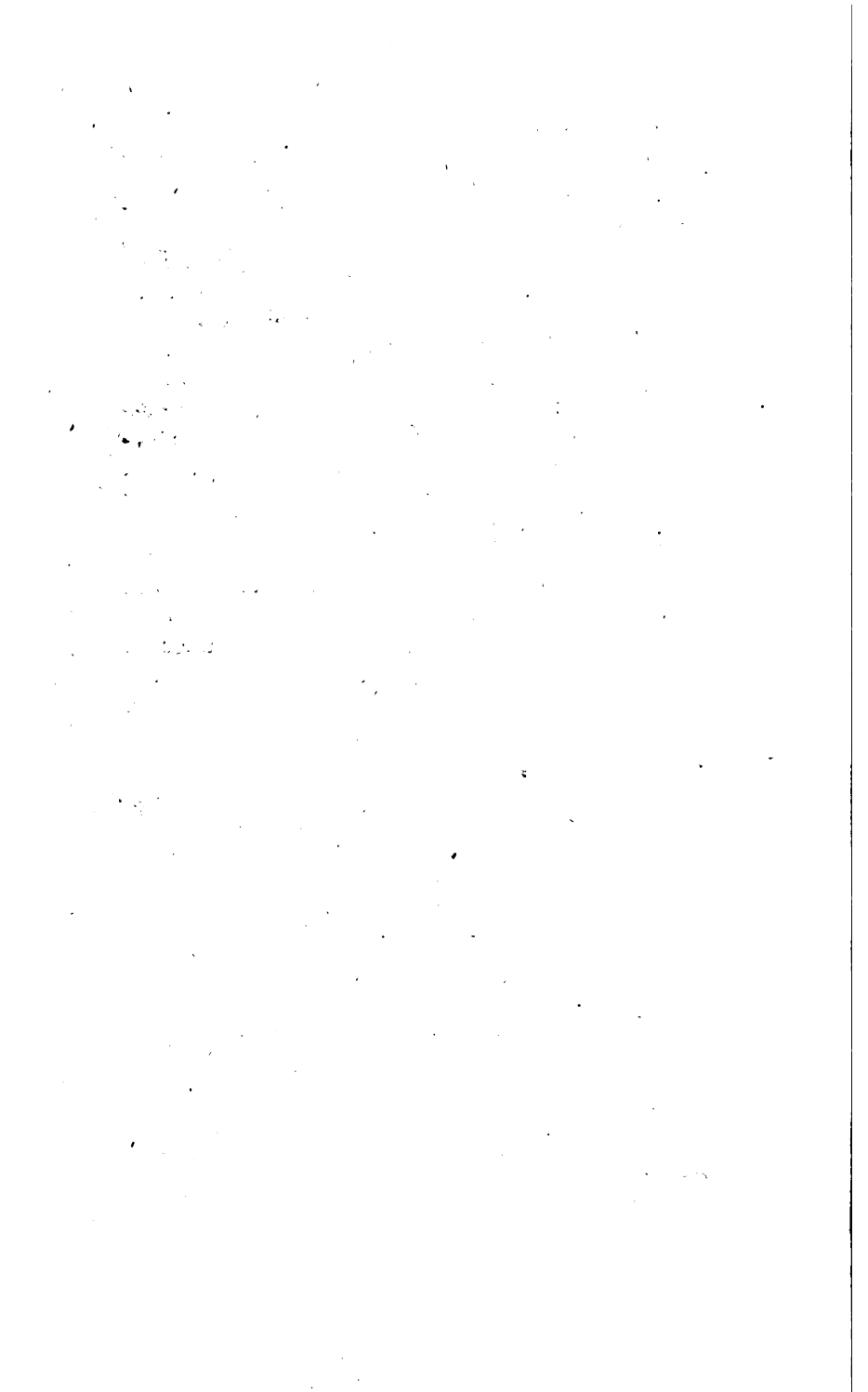




D. Linear Sculpt.

vian vein at any other part, Mr Hewson is inclined to conclude it as only an accidental variety.

These lymphatic vessels of the right side form four considerable trunks, which join near their termination. These trunks are, 1. One from the upper extremity, which appears at (47), lying above the clavicle between the subclavian artery and vein: This trunk is formed by the lymphatic (44), which comes up with the brachial artery, and the plexus (45), which likewise belongs to the arm, and passes under the subclavian vein. 2. The trunk of the lymphatic vessels of the right side of the head and neck, which passes down on the outside of the jugular vein, as is shown at (48). 3. A lymphatic from the thyroide gland. This vessel is seen at (49), passing under the right jugular vein to get to the others. 4. A trunk from the fore part of the lungs of the right side: This trunk is distinctly traced under the subclavian vein to its termination, in common with the others, at the union of the jugular and subclavian veins.



A

SYSTEM OF ANATOMY.

PART VIII. OF THE HUMAN NERVES.

By the late DR ALEX. MONRO,
With CORRECTIONS.

CHAP. I.

Of the NERVES in General.

1. **T**HE numerous turns which the carotid and vertebral arteries make before they pass thro' the dura mater, these arteries having neither swelling muscles nor pressure of the atmosphere to assist the course of the blood in them after they enter the skull, and their division into innumerable communicating branches in the pia mater, and its processes, show, that the liquors must move more slowly and equally in them than in most other parts of the body.

2. By the assistance of injections and microscopes, the very minute branches of these vessels are discovered to go from the pia mater, into the cortex, cineritious, or ashy-coloured part of the cerebrum, cerebellum, and spinal marrow; whereas we can only see longitudinal vessels, without numerous ramifications or reticular plexuses, in the white medullary substance of these parts.

3. The continuity of the cortex with the medulla of
the

the encephalon and spinal marrow is observable with the naked eye, and is more distinctly seen with the assistance of a microscope.

4. In dissecting the brain and cerebellum, we see the small beginnings of the medulla proceeding from the cortex, and can trace its gradual increase by the addition of more such white substance coming from the cortex.

5. Both these substances are very succulent; for being exposed to the air to dry, they lose more of their weight than most other parts of the body do.

6. In several places we can observe the medulla to be composed of fibres laid at each others sides.

7. The medullary substance is employed in forming the white fibrous cords, which have now the name of *nerves* appropriated to them. Within the skull we see the nerves to be the medullary substance continued; and the spinal marrow is all employed in forming nerves.

8. The common opinion concerning the rise of the nerves, founded on a superficial inspection of those parts, is, that the nerves are propagated from that side of the encephalon, at which they go out of the skull. But it having been remarked, after a more strict inquiry, and preparing the parts by maceration in water, that the medullary fibres decussate or cross each other in some parts of the medulla; as for example, at the corpus annulare, and beginning of the spinal marrow: and practical observers having related several examples of people whose brain was hurt on one side, while the morbid symptom, palsy, appeared on the other side of the body, of which I have seen some instances; and experiments made on brutes having confirmed these observations; it has been thought, that the nerves had their rise from that side of the encephalon, which is opposite to their egress from the skull. It may, however, still be said, that this last opinion is not fully demonstrated, because a decussation in some parts is not a proof that it obtains universally; and if there are examples of palsy

fy of the side opposite to where the lesion of the brain was, there are also others, where the injury done to the brain and the palsy were both on the same side.

9. The nerves are composed of a great many threads lying parallel to each other, or nearly so, at their exit from the medulla.

This fibrous texture is evident at the origin of most of the nerves within the skull; and in the cauda equina of the spinal marrow, we can divide them into such small threads, that a very good eye can scarce perceive them; but these threads, when looked at with a microscope, appear each to be composed of a great number of smaller threads.

10. How small one of these fibrils of the nerves is, we know not; but when we consider that every, even the most minute part of the body is sensible, and that this must depend on the nerves (which, all conjoined, would not make a cord of an inch diameter) being divided into branches or filaments to be dispersed through all these minute parts, we must be convinced, that the nervous fibrils are very small. From the examination of the minimum visible, it is demonstrated, that each fibre in the retina of the eye, or expanded optic nerve, cannot exceed the size of the $\frac{1}{32,400}$ part of a hair.

11. The medullary substance, of which the nervous fibrils are composed, is very tender, and would not be able to resist forces as the nerves are exposed to within the bones, nor even the common force of the circulating fluids, were not the pia mater and tunica arachnoides continued upon them; the former giving them firmness and strength, and the latter furnishing a cellular coat to connect the threads of the nerves, to let them lie soft and moist, and to support the vessels which go with them.

It is this cellular substance that is distended when air is forced through a blow-pipe thrust into a nerve, and that makes a nerve appear all spongy, after being distended with air till it dries; the proper nervous fibrils
thrivelling

shrivelling so in drying, that they scarce can be observed.

12. These coats (§ 11.) would not make the nerves strong enough to bear the stretching and pressure they are exposed to in their course to the different parts of the body; and therefore, where the nerves go out at the holes in the cranium and spine, the dura mater is generally wrapped closely round them, to collect their disgregated fibres into tight firm cords; and that the tension which they may happen to be exposed to may not injure them before they have got this additional coat, it is firmly fixed to the sides of the holes in the bones through which they pass.

13. The nervous cords, thus composed of nervous fibrils, cellular coat, pia and dura mater, have such numerous blood-vessels, that after their arteries only are injected, the whole cord is tinged of the colour of the injected liquor; and if the injection is pushed violently, the cellular substance of the nerves is at last distended with it.

14. A nervous cord, such as has been just now described, has very little elasticity, compared with several other parts of the body. When cut out of the body, it does not become observably shorter, while the blood-vessels contract three-eighths of their length.

15. Nerves are generally lodged in a cellular or fatty substance, and have their course in the interstices of muscles and other active organs, where they are guarded from pressure; but in several parts they are so placed, as if it was intended that they should there suffer the vibrating force of arteries, or the pressure of the contracting fibres of muscles.

16. The larger cords of the nerves divide into branches as they go off to the different parts; the branches being smaller than the trunk from which they come, and making generally an acute angle where they separate.

17. In several places, different nerves unite into one
cord,

cord, which is commonly larger than any of the nerves which form it.

18. Several nerves, particularly those which are distributed to the bowels, after such union, suddenly form a hard knot considerably larger than all the nerves of which it is made. These knots were called *corpora olivaria*, and are now generally named *ganglions*.

19. The ganglions have thicker coats, more numerous, and larger blood-vessels, than the nerves; so that they appear more red and muscular. On dissecting the ganglions, fibres are seen running longitudinally in their axes, and other fibres are derived from their sides in an oblique direction to the longitudinal ones.

20. Commonly numerous small nerves, which conjunctly are not equal to the size of the ganglion, are sent out from it, but with a structure no way different from that of other nerves.

21. The nerves sent to the organs of the senses, lose there their firm coats, and terminate in a pulpy substance. The optic nerves are expanded into the soft tender webs, the retinae. The auditory nerve has scarce the consistence of mucus in the vestibulum, cochlea, and semi-circular canals of each ear. The papillae of the nose, tongue, and skin, are very soft.

22. The nerves of muscles can likewise be traced till they seem to lose their coats by becoming very soft; from which, and what we observed of the sensory nerves (§ 21.), there is reason to conclude, that the muscular nerves are also pulpy at their terminations, which we cannot indeed prosecute by dissection.

23. It would seem necessary that the extremities of the nerves should continue in this soft flexible state, in order to perform their functions right: for, in proportion as parts become rigid and firm by age, or any other cause, they lose of their sensibility, and the motions are more difficultly performed.

24. Tho' the fibres in a nervous coat are firmly connected, and frequently different nerves join into one trunk,

trunk, or into the same ganglion; yet the sensation of each part of the body is so very distinct, and we have so much the power of moving the muscles separately, that, if the nerves are principal agents into these two functions, which I shall endeavour to prove they are, we have reason to believe that there is no union, confusion, or immediate communication of the proper nervous fibrils, but that each fibre remains distinct from its origin to its termination.

25. Changes produced any way upon the coats of the nerves, cannot, however, miss to affect the nervous fibrils. The cellular substance may be too full of liquor, or may not supply enough; the liquor may not be of a due consistence, or it may be preternaturally obstructed and collected. The pia or dura mater may be too tense, or too lax; their vessels may be obstructed; their proper nerves may be violently irritated, or lose their power of acting; and a great many other such changes may happen, which will not only occasion disorders in particular nerves, but may be a cause of the sympathy so frequently observed among the nerves; which is so necessary to be attentively regarded in a great many diseases, in order to discover their true state and nature, that, without this knowledge, very dangerous mistakes in the practice of physic and surgery may be committed.

26. Many experiments and observations concur in proving, that when nerves are compressed, cut, or any other way destroyed, the parts served by such nerves, farther from the head or spine than where the injuring cause has been applied, have their sensations, motions, and nourishment weakened or lost; while no such effects are seen in the parts nearer to the origin of those nerves: and in such experiments where the cause impeding the nerves to exert themselves could be removed, and the structure of the nerves not injured, as for example when a ligature made upon a nerve and stopping its influence has been taken away, the motion
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and sensation of the parts soon were restored. From which it would appear, that the nerves are principal instruments in our sensations, motions, and nourishment; and that this influence of the nerves is not inherent in them, unless the communication between these cords and their origin is preserved.

This conclusion is just, notwithstanding that sometimes, upon cutting a nerve, the effects above-mentioned have been felt for a short time, but afterwards the person was sensible of no numbness or immobility: for wherever this is said to have happened, the cut nerve was only one of several which were sent to the member; the want of whose influence was felt no longer, than till the habit was acquired of performing the functions easily by the other nerves.

Nor is it of greater weight as an objection, that sometimes when a ligature is drawn very hard upon a nerve, and then is taken away, the nerve never again recovers its influence upon the parts it is distributed to beyond the ligature, but is of as little effect as if it had been cut through; which is to say, that its texture has been altered beyond recovery. The same thing is to be seen by tying a thread tight round a tender twig of any vegetable; it decays.

27. Experiments and observations show, too, that when parts of the encephalon or spinal marrow have been irritated, compressed, or destroyed, the parts of the body, whose nerves had their origin from such affected parts of the encephalon or spinal marrow, became convulsed, paralytic, insensible, or wasted; and in such cases where the injuring cause could be removed from the origin of the nerves, the morbid symptoms observed in the parts to which these nerves were distributed, went off upon the removal of that cause. From which it is thought reasonable to conclude, that the nerves must not only have a communication with their origin, but that the influence they have upon the parts

they are distributed to depends on the influence which they derive from the medulla encephali and spinalis.

28. Tho' the spinal marrow has its own vessels and nutritious substance, which assists to form its medulla; yet a very large share of the medullary substance within the spine is derived from the encephalon, whose medulla oblongata descends from the head; and the influence of the spinal marrow on its nerves depends in a great measure on this medulla oblongata of the head. Hence an injury done to any part of the spinal marrow, immediately affects all the parts whose nerves have their origin below where the injuring cause is applied. A laxation of a vertebra in the loins makes the lower extremities soon paralytic; a transverse section of the medulla at the first vertebra of the neck, soon puts an end to life.

29. If such causes produce constantly such effects (§ 26, 27, 28.) in us and other creatures living in nearly the same circumstances as we do, the conclusions already made must be good, notwithstanding examples of children and other creatures being born without brains or spinal marrow; or notwithstanding that the brains of adult creatures can be much changed in their texture by diseases; and that tortoises, and some other animals, continue to move a considerable time after their heads are cut off. We may be ignorant of the particular circumstances requisite or necessary to the being or well-being of this or that particular creature; and we may be unable to account for a great many phenomena: but we must believe our eyes in the examination of facts; and if we see constantly such consequences from such actions, we cannot but conclude the one to be the cause and the other the effect. It would be as unjust to deny the conclusions made in the three preceding articles, because of the seemingly preternatural phenomena mentioned at the beginning of this, as it would be to deny the necessity of the circulation of the blood in us and most quadrupeds, because a frog

frog can jump about, or a tortoise can walk long after all the bowels of its thorax and abdomen are taken out, or because the different parts of a worm crawl after it has been cut into a great many pieces. It is therefore almost universally allowed, that the nerves are principal instruments in our sensations, motion, and nourishment; and that the influence which they have is communicated from their origin, the encephalon and medulla spinalis. But authors are far from agreeing about the manner in which this influence is communicated, or in what way nerves act to produce these effects.

30. Some alledge, that the nervous fibres are all solid cords acting by elasticity or vibration; others maintain, that those fibres are small pipes conveying liquors, by means of which their effects are produced.

31. The gentlemen, who think the nervous fibres solid, raise several objections to the other doctrine; which I shall consider afterwards; and endeavour to show the fitness of their own doctrine to account for the effects commonly observed to be produced by the nerves.

The objects of the senses plainly (say they) make impulses on the nerves of the proper organs, which must shake the nervous fibrils: and this vibration must be propagated along the whole cord to its other extremity or origin, as happens in other tense strings; and these vibrations being differently modified, according to the difference of the object, and its different application, produce the different ideas we have of objects.

32. To this account of sensation, it is objected, first, That nerves are unfit for vibrations, because their extremities, where objects are applied to them, are quite soft and pappy (§ 21.), and therefore not susceptible of the vibrations supposed; and if there could be any little tremor made here by the impulse of objects, it could not be continued along the nervous cord, because the cellular substance by which each particular fibre is connected to the neighbouring ones (§ 11.),

and the fatty substance in which the nervous cord is immersed (§ 15.); would soon stifle any such vibratory motion.

A second objection to this doctrine is, That supposing the nerves capable of vibrations by the impressions of objects, these vibrations would not answer the design. For if what we know of other vibrating strings, to wit, that their tone remains the same, unless their texture, length, or tension is altered, and that different substances striking them do no more than make the sound higher or lower; if these properties are to be applied to nerves, then it will follow, that the same nerve would constantly convey the same idea, with no other variety than of its being weaker and stronger, whatever different objects were applied to it; unless we supposed the nerve changed in its texture, length, or tension, each time a different object is applied; which, it is presumed, nobody will undertake to prove does happen.

Nay, 3dly, If ever such a variety of vibrations could be made, our sensations would notwithstanding be confused and indistinct; because the tremulous nervous fibre being firmly connected and contiguous to several other fibres of the same cord, would necessarily shake them too, by which we should have the notion of the object as applied at all the different parts where the extremities of these fibres terminate.

33. In whatever way the favourers of the doctrine of solid nerves please to apply the elasticity of nerves to the contraction of muscles, their adversaries insist that nerves are too weak to resist such weights as the muscles sustain; they would surely break, especially as they are, in a great measure, if not wholly, deprived of their strong coats before they come to the part of the muscle they are immediately to act upon (§ 22.)—The nerves being found to have little or no elasticity to shorten themselves (§ 14.) shows them altogether unfit for such an office as this of contracting muscles in the way proposed

posed of their acting by elasticity; and when a nerve is viewed with a microscope while the muscles it serves are in action, no contraction or motion is observed in it.—Nay, if they were elastic, they would equally exert their power of contracting muscles nearer to their origin as well as farther from it, when they were put into contraction or vibration, by irritation of any part of them. The former, however, does not happen.

34. As a further objection against either motion or sensation being owing to the elasticity of the nerves, it is said, that if this doctrine was true, the sensations would be more acute, and the contractions of muscles would be greater and stronger, when the parts become firmer and more rigid by age; for then their elasticity is increased: Whereas, on the contrary, it appears (§ 23.) that then the sensations are blunted, and muscular contraction becomes less and weaker.

35. If the nerves were granted to be elastic, and to communicate a springy force to all the parts they are distributed to, they might appear necessary in this view to assist the application of the nutritious particles of the fluids to the sides of the vessels which these particles were to repair; and so far might well enough account for the share which nerves are thought to have in nutrition: But if we cannot make use of elasticity in the other two functions, sensation and motion, we must also endeavour to find out some other way for the nerves to act in nutrition; which will be done afterwards.

36. Having thus stated the reasons for and against the nerves acting as solid strings, let us likewise relate the arguments for nerves being pipes, and the objections to this doctrine.

A great argument of those who think the nerves to be tubes conveying liquors, is the strong analogy of the brain and nerves to other glands of the body and their excretories, where a manifest secretion of liquor is made in the glands, to be conveyed by the excretories to the proper places in which it ought to be deposited:

they think that the vascular texture of the cortex of the encephalon and spinal marrow (§ 2.) the continuation of the cortex in forming the medullary substance (3, 4.) the fibrous texture (§ 5.) and succulent state of this medulla (§ 6.) and its being wholly employed to form the nerves (§ 7.) where the fibrous texture is evident (§ 9.); all these things, say they, conspire to show such a strong analogy between these parts and the other glands of the body, as carries a conviction that there is a liquor secreted in the encephalon and spinal marrow, to be sent out by the nerves to the different parts of the body.

37. The following objections are raised to this argument in favour of liquor conveyed in the nerves from the analogy of the glands. 1st, Other glands, it is said, have their excretories collected into a few large pipes, and not continued in such a great number of separate pipes, as far as the places where the liquors are deposited; which last must be the case, if the nerves are the excretories of the glandular brain. 2^{dly}, We see the cavities, and can examine the liquors in the excretories of other glands much smaller than the brain; which cannot be done in the nerves. 3^{dly}, If the nerves were pipes, they would be so small, that the attraction of the liquors to their sides would prevent that celerity in the motion of the liquors, which is requisite to sensations and motions. 4^{thly}, If the nerves were pipes, they would be cylindrical ones, and consequently not subject to diseases; or at least we could have no comprehension of the diseases in them.

38. The answer to the 1st of these objections is, That there are other glands where there is a manifest secretion, and in which the disposition of the excretories is in much the same way as in the encephalon: the kidneys, for example, have a reticulated cortex of vessels, from which the Eustachian or Bellinian medulla, consisting of longitudinal fibres and a few blood-vessels in the same direction, proceeds; and this medulla is collected into ten, twelve, or more papillæ, each of which

is formed of numerous small separate pipes, which singly discharge the urine into the large membranous tubes; and these united form the pelvis. Upon comparing this texture of the kidneys with that of the encephalon (§ 2, 3, 4, 5, 6, 7, 9.) the analogy will be found very strong.

39. In answer to the 2^d objection, in § 37. it is granted, that microscopes, injections, and all the other arts hitherto employed, have not shown the cavities of the nervous fibrils, or the liquors contained in them; and from what was said (§ 10.) of the smallness of the nervous fibrils, it is not to be expected that ever they should be seen. But so long as such a number of little animals can every hour be brought to the objectors, in which they can as little demonstrate the vessels or contained fluids, it will not be allowed to be conclusive reasoning, that because ocular demonstration cannot be given of either the tubes or their contents, therefore they do not exist. For if we have any notion of an animal, it is its being an hydraulic machine, which has liquors moving in it as long as it has life. If therefore such little animals have vessels and liquors which we cannot see, why may not some of the vessels and liquors of the human body be also invisible to us?

To avoid this answer to the objection, it is further urged, That though we might not see the nervous tubes or the liquors they contain as they naturally flow; yet if such liquors really exist, they ought to discover themselves, either by a nerve's swelling when it is firmly tied; or that, however subtle their fluids are, they might be collected in some drops, at least, when the cut end of a nerve of a living animal is kept some time in the exhausted receiver of an air-pump. It is affirmed, that neither did the tied nerve swell between the brain and ligature, nor was there any liquor collected in the receiver of the air-pump; from which it is concluded, that there is no liquor in the nerves.

Some, who say they have tried these experiments, affirm, that in young animals the nerve does swell

above the ligature, and that a liquor does drill out upon cutting a nerve.—Whether swelling or liquor is seen or is not seen in these experiments, no conclusion for or against a nervous fluid can be made from them; for the swelling of the nerve after it is tied, or the efflux of liquors from its extremity, will never prove either to be the effect of the fluid in the proper nervous fibrils, so long as they might be occasioned by the liquors in the larger vessels of the cellular substance of the nerves; and if these same vessels of the coats of the nerves do not discover their liquors by these experiments, it is far less to be expected that the much more subtle nerves will discover theirs.

40. The 3^d objection to the doctrine of the brain being a gland, and the nerves its excretories, supposes a more rapid motion necessary in the fluid of the nerves than what most of the defenders of the nervous fluid will now allow; and is afterwards to be considered particularly in a more proper place.

41. The 4th objection being, That if nerves are excretories of a gland, they must be cylindrical pipes, in which no obstructions or diseases would happen; but since we daily see diseases in the nerves, they must therefore not be such excretories. The answer is, That diseases happen often in the excretories of other glands, as of the liver, kidneys, &c. notwithstanding their cylindrical form, and their much shorter and less exposed course. When we consider the very tender substance of the brain, the vast complication of vessels there, the prodigious smallness of the pipes going out from it, the many moving powers which the nerves are to undergo the shock of, and the many chances which the vessels, membranes, and cellular substance accompanying the nerves, have of being disordered, and then affecting the nervous fibrils, we have very great reason to be surprised, that these cylindrical pipes are not much more frequently put out of order, by too great or too small a quantity of liquors; by too viscid or too thin fluids; by
liquors

liquors consisting of too mild and sluggish particles, or of too acrid pungent ones; by too great or too little motion given to the liquors; by the diameters of the pipes being too much straitened, or too much enlarged; and by a great many other varieties of circumstances which might be thought capable of disturbing the functions of the nerves, supposing them to be cylindrical excretories of the gland, the brain.

42. The numerous vessels of the encephalon have brought some of the gentlemen who assert the nerves to be solid, to acknowledge, that there is a liquor secreted in the brain: but then they will not allow that this liquor is sent out by the proper nervous fibrils, but that it is poured into the cellular substance in which the nerves lie, to keep them moist and supple, and therefore fit for exerting their elasticity, vibration, &c. by which, in their opinion, the effects commonly ascribed to nerves are produced.

43. Besides the objections already mentioned (§ 32, 33.) against the nerves acting as elastic strings, this opinion has some other difficulties which may be objected to it: for instance, there is not one analogous example in the whole body of liquors secreted in a large gland, to be poured into a cellular substance, as is here supposed; the liquors in the cells of the tela cellularis of other parts are separated from the little arteries which are distributed to these cells.

Further, it cannot be imagined, how a liquor secreted in the cortex of the brain should make its way thro' the medulla, to come out into the cellular membranes on the surface of that medulla.

Lastly, A very simple experiment, of injecting water by the artery of any member, and thereby filling the cellular substance of the nerves of that member, shows evidently, that the liquor of the cellular substance of the nerves has the same fountain as the liquor has in the tela cellularis any where else, that is, from the little arteries dispersed upon it.

44. The doctrine of a fluid in the nerves, is not only thus supported by the analogy of the brain and nerves to the other glands and their excretories, but those who maintain this doctrine mention an experiment which they think directly proves a fluid in the nerves. It is this: After opening the thorax of a living dog, catch hold of and press one or both the phrenic nerves with the fingers, the diaphragm immediately ceases to contract; cease to compress the nerves, and the muscle acts again: a second time, lay hold of the nerve or nerves some way above the diaphragm, its motion stops. Keep firm the hold of the nerve, and with the fingers of the other hand strip it down from the fingers which make the compression towards the diaphragm, and it again contracts: a repetition of this part of the experiment three or four times, is always attended with the same effects; but it then contracts no more, strip as you will, unless you remove the pressure to take hold of the nerves above the place first pinched; when the muscle may again be made to contract, by stripping the nerve down towards it. This experiment I have done with the success here mentioned. Let any one try if he can imagine any other reasonable account of these appearances, than that the pressure by the fingers stopped the course of a fluid in the nerve; that so much of this fluid as remained in the nerve, betwixt the fingers and diaphragm, was forced into that muscle by stripping; and when it was all pressed away, the fingers above preventing a supply, the muscle contracted no more till the fingers were removed, and a fresh flow by that means was received from the spinal marrow, or from that part of the nerve which had not yet been so stripped.

It has been objected to the conclusions from this experiment, 1. That the diaphragm is set in motion by stripping the nerve from, as well as towards, this muscle; and this may be well expected; for a liquor in such small pipes hindered to flow backwards by ligature, pinching fingers, or even the flow of their liquors from
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the fountain, will regurgitate forewards with velocity when pressed backwards. We see it happen in the stalks of tender succulent plants.

2. It is said, that muscles cease to act when their veins are tied, as well as when their arteries or nerves are tied or cut, but that muscles continue to act when their veins are cut: by which it would appear, that the overloading of the vessels is an impediment to the action of muscles; and therefore the ceasing of their action, when their arteries or nerves are tied or cut, may also be owing to the liquor in the branches of these pipes of muscles stagnating when it is not propelled by the flow of more liquor from their trunks, and not to any influence or moving power, which now ceases to be conveyed to them.

It is to be observed, in making the experiments just now mentioned, that the contraction of the muscles ceases soonest when the nerves, and latest when the veins are tied.—That when veins are tied, not only are the vessels overloaded, but all the cellular substance of the muscles is filled with coagulated blood; whereas when the arteries and nerves are tied, the reverse is seen, the muscles are lax, and of less bulk. So that in these cases, the ceasing of the contraction of the muscles seems to depend on very different causes, to wit, a deprivation of necessary liquors in the one, and a redundancy of superfluous blood in the other. An elastic stick may be deprived of its elasticity, by being made either too dry or too wet.

45. Some gentlemen, convinced of the reasonableness of the secretion of a liquor in the brain to be sent out by the nerves, but not comprehending how a fluid could have such a rapid retrograde motion as they imagined was necessary for conveying the impressions of objects made on the extremities of nerves to the sensorium, supposed two sorts of nerves; one that conveyed a liquor for muscular motion and nutrition; the other composed of solid nerves, that were to serve for
organs

organs of the senses, to convey the vibrations communicated from objects to the sensorium.

46. To this opinion (§ 45.) the objections against the sensory nerves acting by vibration (§ 32.) may be made; and there is so little reason to suspect any difference in the texture of the different parts of the brain or nerves, that, on the contrary, the structure is every where similar, and branches of the same nerve often serve both for sensation and motion.

How little necessity there is for supposing extremely rapid motions of the nervous fluid, is to be examined soon.

47. The hypothesis of great celerity in the motion of the fluid of the nerves being necessary, gave also rise to another division of the nerves, into arterious or effluent, and venous or refluxent. It was said, that muscular motion and nutrition depended on the arterious nerves; and that the sensations depended on an accelerated motion of the nervous fluid towards the brain, by the impressions which the objects of the senses make upon the venous nerves. By this supposition, the absurdity of rapid fluxes and refluxes in the same canal was prevented; and an advantage was thought to be gained by it, of saving too great a waste of the fluid of the nerves, which otherwise the encephalon and spinal marrow could not supply in sufficient quantity to answer all the exigencies of life.

48. To this opinion (§ 47.) it has been objected, 1st, That there is no example in the body, of a secreted liquor being returned immediately and unmixed to the gland by which it was originally separated from the mass of blood; which would be the case were there venous nerves. 2^{dly}, There is no occasion for saving the fluid of the nerves in the way proposed; the organs for secreting that fluid being large enough to supply all that is necessary of it in the common functions of life. 3^{dly}, If the fluid of the nerves was to be thus kept in a perpetual circulation, it would soon become too acrid for

for continuing with safety in such sensible tender vessels as the brain and nerves are composed of. *4thly*, This hypothesis will not answer the design for which it was proposed : for though the momentary application of an object might cause an acceleration in the fluid of venous nerves, yet if the object was kept applied to the nerves, it would stop their fluid, so that it could not go forward to the brain ; and therefore, according to this doctrine, we should be sensible of no objects, except those whose application to the organs of the senses was momentary.

49. Let us now suppose it probable, that the encephalon and spinal marrow secern a liquor from the blood which is sent into all the nerves, and that by the means of this liquor the nerves perform the offices commonly assigned to them ; it is next necessary to inquire what kind of liquor this is, and how it moves, in order to determine how well its nature and motion are fitted for performing what is expected from it.

50. The liquor of the nerves has been fancied by some to be of a very strong acid or alkaline nature : But since none of our juices appear to be of this sort, and since such liquors irritate and destroy the parts of the body which they are applied to, we cannot conceive how the brain can separate, or the nerves could bear any thing of such an acrid nature. This tenderness and sensibility of these organs must hinder us absolutely from supposing that the liquor of the nerves can be acrid or pungent, or of the nature of spirit of wine, hartshorn, &c.

51. Some have imagined the liquor of the nerves to be capable of vast explosion like gun-powder, or of violent sudden rarefaction like air, or of strong ebullition like boiling water, or the mixture of acids with alkaline liquors. But as the mass of blood from which this fluid is derived, is not possessed of any such properties, we cannot suppose the blood to furnish what it has not in itself. Besides, all these operations are too

violent for the brain or nerves to bear ; and when once they are begun, they are not so quickly controlled or restrained, as experience teaches us the nerves can be made to cease from acting.

52. We are not sufficiently acquainted with the properties of an æther, or electrical effluvia, pervading every thing, to apply them justly in the animal œconomy ; and it is as difficult to conceive how they should be retained or conducted in a long nervous cord. These are difficulties not to be surmounted.

53. The surest way of judging what kind of liquor this of the nerves must be, is to examine the liquors of similar parts of the body. All the glands separate liquors from the blood much thinner than the compound mass itself ; such is the liquor poured into the cavity of the abdomen, thorax, ventricles of the brain, the saliva, pancreatic juice, lymph, &c. Wherever there is occasion for secreted liquors being thick and viscid, in order to answer better the uses they are intended for, nature has provided reservoirs for them to stagnate in, where their thinner parts may be carried off by the numerous absorbent veins dispersed on the sides of those cavities ; or they may exhale where they are exposed to the open air. The mucus of the nose becomes viscid by stagnation ; for when it is immediately secreted, it is thin and watery, as appears from the application of sternutatories, &c. The cerumen of the ears is of a watery consistence when just squeezing out. The mucus of the alimentary canal grows thick in the lacunæ. The bile in the hepatic duct has little more consistence than lymph ; that in the gall-bladder is viscid and strong. The urine is much more watery as it flows from the kidneys, than when it is excreted from the bladder. The seed is thin as it comes from the testicles, and is concocted in the vesiculæ seminales, &c.

54. Hence (§ 53.) we may safely conclude, that a thin liquor is secreted in the cortex encephali and spinal
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marrow ; and seeing the thinness of secreted liquors is generally, as the divisions of the vessels, into small subtle branches, and that the ramifications within the skull are almost infinitely subtle, the liquor secreted in the encephalon may be determined to be among the finest or thinnest fluids.

55. Seeing also that we can observe no large reservoir, where the liquor secreted in the cortical substance is deposited, to have its finer parts taken off, we have reason to think that it goes forward into the nerves in the same condition in which it is secreted.

56. By fine or subtle animal liquors, is meant no more than those which are very fluid, and which seem to consist of a large proportion of watery particles, and a lesser one of the oily, saline, and terrestrious particles. Some of the liquors which we can have in sufficient quantity to make experiments with, are so fluid, and have so little viscosity or cohesion of parts, that when laid upon a piece of clean mirror, they evaporate without leaving a stain. Such is the liquor oozing out from the surface of the pleura, the lymph, and several others.

If then these liquors, which are subject to our examination, the secreting vessels of which are so large that we can see them, have such a small cohesion of parts, it might not be unreasonable to say, that the liquor of the nerves is as much more fine and fluid than lymph as the vessels separating it are smaller ; and therefore that the fluid of the nerves is a defecated water, with a very small proportion of the other principles extremely subtilized.

57. Two experiments are said to contradict this opinion of the liquor of the nerves being so fluid and subtle. One is, that upon cutting the cauda equina of a living animal, a liquor as viscid as the white of an egg drops out. The other is, that a wounded nerve yields a glairy sanies. But these do not appear to be the proper fluid of the nerves ; since it is evident, that
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what is discharged in both these cases comes out of the cellular substance involving the nervous fibrils.

58. Considering how many experiments make it evident, that there is a constant uninterrupted stream of liquors flowing through all the canals of animals, which convey liquors composed of particles smaller than the diameter of their canal, which is always the case of the nerves in a natural state, it is surprising how it ever could be thought, that the liquid of the nerves should be obliged to flow from the brain to each muscle the moment we will; or that this liquor should flow back with the like swiftness from the extremity of each nerve, to which an object of sensation is applied. The nerves, as well as the other excretories of the glands, always are full of liquor; the degree of distention of the canals not being at all times alike even in a sound state. But this happens without inconvenience, as the sides of the canals have a power to accommodate themselves to the present quantity, unless it is very much above or below the natural standard; in both which cases diseases ensue.

59. The motion of the fluid in the nerves is therefore not only constant, but it is also equal, or nearly so: for though the blood in the larger arteries is moved unequally by the unequal forces, the contraction of the ventricle of the heart, and the weaker power, the systole of the arteries; yet the difference between these two moving powers comes to be less and less perceptible as the arteries divide into smaller branches; because of the numerous resistances which the liquors meet with, and because the canals they move in become larger, till in the very small arterious branches there is no sensible difference in the velocity of the liquors from the effect of the heart or arteries. The motion of the fluids must still be more equal in the excretories of glands, and particularly in those where the vessels have divided into very minute branches, and the liquors have no other propelling force but the heart and arteries,
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(see § 1.); therefore the nervous fluid moves constantly, equally, and slowly, unless when its course is altered by the influence of the mind, or by the pressure of some neighbouring active organ.

60. As there is neither proof nor probability of the valves supposed by some in nerves, we are not to assume them in accounting for any phenomena.

61. We have not, and perhaps cannot have, any idea of the manner in which mind and body act upon each other; but if we allow that the one is affected by the other, which none deny, and that the fluid of the nerves (whatever name people please to give it) is a principal instrument which the mind makes use of to influence the actions of the body, or to inform itself of the impressions made on the body, we must allow that the mind can direct this instrument differently, particularly as to quantity and celerity, though we must remain ignorant of the manner how many phenomena depending on this connection of mind and body are produced. Thus we would in vain attempt to account for animals continuing, after their heads were struck off or their hearts were cut out, to perform actions begun before they suffered any injury.

62. Let us now suppose the nervous fluid such as has been argued for, to wit, a very fluid saponaceous water, moving in a constant, equal, flow stream, from the encephalon and spinal marrow, in each of the proper nervous fibres, except when the motion is changed by some accessory cause, such as the mind, pressure of other parts, &c.; and let us examine how well such a supposition will agree with the phenomena of the three great functions, nutrition, sensation, and muscular motion, which the nerves are principal instruments of.

63. In general, we may say, that nerves can carry fluids to the most minute part of the body, to supply what is wanted in any of the solids; that the impression made by the objects of the senses on the very soft pulpy extremities of the nerves of the organs of the senses,

must make such a stop in the equal-flowing nervous fluid, as must instantaneously be perceptible at the fountain-head from which the pipes affected arise; that the constant flow of the liquor of the nerves into the cavities of the muscular fibrillæ, occasions the natural contraction of the muscles, by the as constant nifus it makes to increase the transverse and to shorten the longitudinal diameter of each fibre; and that it is only to allow the mind a power of determining a greater quantity of this same fluid with a greater velocity into what muscular fibres it pleases, to account for the voluntary strong action of the muscles.

64. But since such a superficial account would not be satisfactory, it will be expected, that the principal phenomena of these three functions should be explained by the means of such a fluid as has been supposed, and that the several objections against this doctrine should be answered: let us attempt this; and where we cannot extricate ourselves from difficulties which may be thrown in, let us honestly acknowledge ignorance.

65. α. If water, with a very small proportion of oils and salts from the earth, proves a fit nourishment for vegetables, such a liquor as the fluid of the nerves has been described (§ 56.) may not be unfit for repairing the waste in animals.

β. The slow continual motion of this nervous fluid (§ 58, 59.) to the most minute parts of the body (§ 10.) is well enough calculated to supply the particles that are constantly worn off from the solids by the circulation of the liquors and necessary actions of life.

γ. The greater proportional size of the encephalon in young creatures than in adults, seems calculated for their greater proportional growth: for the younger the animal is, the larger encephalon and speedier growth it has.

δ. A palsy and atrophy of the members generally accompanying each other, show, that nourishment, sensation, and motion, depend on the same cause.

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4. It was said (§ 26.), that the nerves were principal instruments in nutrition: it was not affirmed, that they were the sole instruments; and therefore an atrophy may proceed from the compression or other lesion of an artery, without being an objection to the doctrine here laid down.

66. *a.* All objects of sense, when applied to their proper organs, act by impulse; and this action is capable of being increased by increasing the impelling force. In tangible objects, that is clearly evident; the closer they are pressed to a certain degree, the more distinct perception ensues. Odorous particles need the assistance of air moved rapidly to affect our nose: sapid substances, that are scarce sufficient to give us an idea of their taste by their own weight, are assisted by the pressure of the tongue upon the palate: the rays of light collected drive light bodies before them: sound communicates a vibration to all bodies in harmonic proportion with it.

The impulses made thus by any of these objects on the soft pulpy nerves (§ 21.), which are full of liquor, press their sides or extremities, and their liquor is hindered to flow so freely as it did. The canals being all full (§ 58.) this resistance must instantaneously affect the whole column of fluids in the canals that are pressed, and their origins, and have the same effect as if the impulse had been made upon the origin itself. To illustrate this by a gross comparison: Let any one push water out of a syringe, through a long flexible pipe fixed to the syringe; and he is sensible of resistance or a push backwards, the moment any one stops the orifice of the pipe, or closes the sides of it with his fingers. This impulse made on the nerves, and thus communicated to their origin, varies according to the strength or weakness, the quickness or slowness, the continuance or speedy removal, the uniformity or irregularity, the constancy or alternation, &c. with which objects are applied to the nerves.

b. Whenever any object is regularly applied with due force to a nerve rightly disposed to be impressed by it, and is communicated, as just now explained, to the sensorium, it gives a true and just idea of the object to the mind.

c. The various kinds of impulses which the different classes of objects make, occasion in animals, which ought to have accurate perceptions of each object, a necessity of having the different organs of the senses variously modified, so that the several impulses may be regularly applied to the nerves in each organ; or, in other words, we must have different organs of the senses fitted to the different classes of objects.

d. As the objects have one common property of impulse, so all the organs have most of the properties of the organ of touching in common with the papillæ of the skin. In the nose and tongue this is evident: in some operations of the eyes, we can also perceive this; as we may likewise do in some cases where matter is collected in the internal ear.

e. These properties common to the different objects and organs, occasion frequently uncommon effects in the application of an object to an organ proper to another object of sensation: for sometimes we have the same idea as if the object had been applied to its own proper organ; at other times the object is as it were changed, and we have the idea as if the organ had had its own proper object applied to it. Thus, for example, light is the proper object to be applied to the eye, to give us any idea of colours; yet when all light is excluded from the eyes, an idea of light and colours may be excited in us by coughing, sneezing, rubbing or striking the eye-ball.—A cane vibrating, so as not to excite sound perceptible to the ear, applied to the teeth, raises a strong idea of sound; as a little insect creeping in the meatus auditorius also does. The fingers applied to two rough surfaces, rubbing on each other, are sensible of the sound they make; surgeons of any practice

in the cure of fractured bones can bear witness to the truth of this.—The fingers dipped in acid and several other acrid liquors, have a sensation very like to tasting.—Smelling and tasting, every body knows, are subservient and assisting to each other. From such examples we have further proof of one general cause of our sensations, to wit, impulse from the objects; and of such a similarity and relation in the organs, as might give reason for imagining that any one of them would be capable of producing the effect of another, if the impulses of the different objects could be regularly applied to each.—Hence light and sound may affect insects and other animals that have not eyes or ears.

f. If the impulse of an object is applied with due force, but irregularly, a confused idea of the object is raised. Distant objects are confused to myopes, as very near ones are to presbytæ.

g. If the application of the impulse is regular, but the force with which it is applied too weak, our perception of the object is too faint. One may whisper so low as not to be heard.

h. If the application of objects is too violent, and there is any danger of the tender organs of our senses being hurt or destroyed, an uneasy sensation we call *pain* is raised, whatever the organ thus injured is. The object of feeling affects every organ: thus pressure, stretching, cutting, pricking, acrid salts, pungent oils, great heat, violent cold, &c. occasion pain, wherever they are applied. Besides, every particular organ can be affected with pain by the too violent application of its own proper object. Too much light pains the eyes; very loud sound stuns the ears; very odorous bodies and too sapid objects hurt the nose and tongue. A pretty sure proof this, that the objects of our senses all act, and that the organs are all impressed, in nearly the same way.

i. Since a middle impulse, neither too small, nor too great, is necessary for a clear perception of objects, we

would often be in danger of not distinguishing them, if we were not subjected to another law, to wit, that numerous impulses made at once, or in a quick succession to each other, increase our perceptions of objects. Thus, such sound as would not be heard on a mountain-top, will be distinctly heard in a wainscotted chamber.—We feel much more clearly a tangible object when our finger is drawn along it than when applied with the same force, but by a single pressure upon it.—We make repeated applications of odorous and sapid objects, when we wish to smell or taste accurately.—The end of a burning stick appears much more luminous when quickly whirled in a circle than when at rest.

k, Whenever the uneasy sensation, pain, is raised by the too strong application of objects, a sort of necessity is as it were imposed upon the mind, to endeavour to get free of the injuring cause, by either withdrawing the grieved part of the body from it, as one retires his hand when his finger is pricked or burnt; or the injuring cause is endeavoured to be forced from the body, as a tenesmus excites the contraction which pushes acrid fœces out of the rectum. In both these operations, a convulsive contraction is immediately made in the lesed part, or in the neighbourhood of it; and if the irritation is very strong or permanent, the greater part of the nervous system becomes affected in that spasmodic or convulsive way.—Is it this necessity which obliges the mind to exert herself in respiration, or in the action of the heart, when the lungs or heart are gorged with blood? or the iris to contract the pupil, when the eye is exposed to strong light? or sneezing to be performed when the nose is tickled? &c.—Will not a stimulus of any nerve more readily affect those with which it is any where connected than the other nerves of the body?—May not this sympathy serve as a monitor of the mind rather to employ the organs furnished with nerves thus connected, to assist
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in freeing her of any uneasy sensation, than to make use of any other organs?—Will not this in some measure account for many salutary operations performed in the body, before experience has taught us the functions of the organs performing them?

This nifus of the mind to free the body of what is in danger of being hurtful, may serve to explain the phenomena of a great many diseases, when we are acquainted with the distribution of the particular nerves; and from this we can understand the operation of medicines that stimulate; and may learn how, by exciting a sharp, but momentary pain, we may free the body of another pain that would be more durable; and that, by having it thus in our power to determine a flow of the liquor of the nerves to any particular part, for the benefit of that part, or the relief of any other diseased part, we can do considerable service by a right application of the proper medicines.

1. If a pain giving cause is very violent or long continued, it destroys the organs either irrecoverably, or puts them so much out of order, that they only gradually recover. People have been made blind or deaf for all their lives after a violent effect of light on their eyes, or of sound on their ears; and we are frequently exposed to as much light and sound as to make us unfit to see or hear for a considerable time. I would explain this by a ligature put round the tender branch of an herb. This ligature drawn to a certain degree, may weaken the canals so as to be unfit for the circulation of the juices a good while, till they are gradually explicated and made firm by these juices: A stricter ligature would disorder the structure of the fibres so much, that the liquors could not recover them. The analogy is so plain, that it needs no commentary.—Thus the influence of a nerve tied with an artery in the operation of an aneurism, may cease for some time, but be afterwards recovered.

67. (1.) In applying the fluid of the nerves to the ac-
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tion of muscles, it was said, that the natural or involuntary contraction of muscles was the rîsus which the nervous fluid, flowing constantly into the muscular fibres, makes to distend these fibrils, by enlarging their transverse diameters and shortening their axes; and that voluntary contraction was owing to a greater quantity of that nervous liquor determined towards the muscle to be put in action, and poured with greater momentum into the muscular fibrils, by the power of the mind willing to make such a muscle to act, or obliged to do it by an irritating pain-giving cause (§ 66. k.)

(2.) Some object to this account of muscular motion, that if there is no outlet for the liquor supposed to be poured into muscular fibres, muscles would always be in a state of contraction, which they are not; and if there is a passage from the fibrils, the liquor would flow out as fast as it was thrown in; and therefore no distention of the fibres, or contraction of the muscles, could be made.

(3.) In answer to this objection, it is observed, that notwithstanding the evident outlet from the arteries into the veins, yet the arteries are distended by the systole of the heart, or any other cause increasing the momentum of the blood.

(4.) It has been also objected to § 1. that, if it was true, the volume of the muscle in contraction necessarily would be considerably increased by so much liquor poured into its fibrils; whereas it does not appear, by any experiment, that the volume of a muscle is increased by its being put into action.

(5.) To this it has been answered, 1. That when the axes of muscular fibres are shortened, and their transverse diameters are enlarged, the capacities of their fibres, and consequently their volume, may not be changed, the diminution one way balancing the increase in the other. 2. That the spaces between the muscular fibres are sufficient to lodge these fibres when they

they swell during the contraction of a muscle, without any addition to its bulk; and that it plainly appears that these spaces between the fibrils are thus occupied, by the compression which the larger vessels of muscles, which run in those spaces, suffer during the action of the muscle; it is so great as to drive the blood in the veins with a remarkable accelerated velocity.

(6.) Another objection to the action of muscles being owing to the influx of a fluid into their fibrils is, That muscular fibres are distractile, or capable of being stretched; and therefore, when a fluid is poured into their hollow fibrils, they would be stretched longitudinally, as well as have their transverse diameters increased; that is, a muscle would become longer, as well as thicker, when it is put into action; whereas it is certainly known that a muscle is shortened while it acts.

(7.) In answer to this, it has been remarked, That though muscular fibrils are distractile, yet they will not yield to or be stretched by every force, however small, that might be applied to them. A cord that can be stretched in length by the weight of a pound or two, would not yield in the least to an ounce or two; and it must likewise be observed, that gradually as any body is stretched, its resistance to the stretching force increases. A rope may be stretched to a certain length by a pound weight appended to it, which would require two pounds to stretch it very little further; and therefore the general observation of animal fibres being distractile, cannot be a reasonable objection to the account of muscular motion above-mentioned, unless a proof is brought, that the force which the liquid of the nerves must exert upon each fibre of a muscle, in order to make it act, is capable of distracting or stretching the fibres; which has not yet been attempted to be proved.—It would appear from the pain caused by too great an effort of muscles, especially in weak people, that

that muscular fibres can bear very little distraction without danger of a solution of continuity.

(8.) Muscles ceasing to act when their arteries are tied or cut, and being brought into motion by injecting liquors into the arteries even of a dead animal, has been mentioned as objections to the nervous influence causing their contractions.

To the first of these experiments it may be answered, That the tying or cutting of the nerves sooner produces the effect of making the contraction cease, than stopping the influx of the arterious blood does ; and it will be universally allowed, that the influx of blood into muscles is necessary for performing their functions right.

Whoever observes the motion which injecting water, or any other liquor, into the arteries of a dead animal, causes in its muscles, will not compare it to what contraction, whether voluntary or excited by irritation, he may see in a living one.

(9.) If muscular motion depends on the influx of the nervous liquid, the instantaneous contraction of a muscle, when the mind wills to make it act, will be easily understood from the nerves being always full of their liquor (§ 58, 66, *a.*)

(10.) If either the nerves of any muscle do not furnish a sufficient quantity of their liquor, or if the fibres of a muscle become too easily distractile, such a muscle will be unactive or paralytic.

(11.) If too great a quantity of the liquor of the nerves is determined to a muscle or muscles, by any cause which the mind cannot command, such muscle or muscles will be convulsed.

(12.) If the motion of the liquid of the nerves is not uniform, but by disease becomes irregular, an alternate relaxation and contraction of muscles may be the consequence. Hence trembling palsies, chorea Sancti Viti, &c. Hence also the convulsive tremors which animals have when they lose much blood.

(13.) Though the nerves may not furnish so much liquor as may be sufficient to make muscles contract with strength enough to overcome the resistances to their actions, yet there may be a sufficient quantity of liquor in the nerves to allow the impressions of objects to be conveyed to the sensorium. This may be one cause of a member's being sometimes sensible after it cannot be moved.

(14.) Unless the liquor of the nerves acquires some energy in the brain, which we have no reason to think the circulation of the fluids in the vessels can give it, or unless it has other properties than what we can discover in it, or unless there is an agent regulating its momentum and course to different parts which we are not conscious of; if some of these, I say, do not obtain, the action of the heart continuing of equal force to propel our liquors, notwithstanding all the resistances that are to it, is not to be explained.

(15.) All muscles, but especially the heart, continue to contract in an irregular way, after they are cut away from the animal to whom they belonged; which may be owing to the liquors continuing to flow in the small vessels, and being poured irregularly into the muscular fibrillæ.

(16.) It is said, that a muscle cut out of the body continues some time to be capable of contraction; whereas by tying its arteries or nerves, while it is otherwise entire in the body, it loses its contracting power, which therefore does not depend on these organs, the arteries or nerves.

The loss of the power of acting when the arteries or nerves are tied while the muscle is in the body, is denied by some who made the trial; and it might be expected that the motion of a muscle would be more conspicuous where there is no resistance to it, as is the case when it is cut away from all the parts it is connected with, than when its connection remains with parts resisting its contractile efforts.

(17.) After

(17.) After the heart, or any other muscle cut away from an animal, has ceased to contract, its contraction may again be restored, by breathing upon it, or pricking it with any sharp instrument. That heat or pricking should, by their stimulus (§ 66, *k*.) occasion contraction in a living creature, may be understood; but how they should have the same effect in a muscle separated from an animal, I know not.

68. Some have thought the ganglions of nerves (§ 18, 19, 20.) to be glandular, and to perform a secretion.—Others, from their firm texture, suppose them to be muscular, and to serve to accelerate the motion of the liquor in the nerves which proceed from them; but as no proof is offered of either of these opinions, they cannot be maintained.—Others would make them serve, 1. To divide a small nerve into many nerves, and by these means to increase the number of nervous branches. 2. To make nerves come conveniently by different directions to the parts to which they belong. 3. To re-unite several small nervous fibres into one large nerve.—Since no proof is brought that these three things cannot be done without the interposition of a ganglion, but on the contrary we see them performed where there are no ganglions, we must continue to acknowledge ignorance concerning the uses of these knots, the ganglions.

C H A P. II.

Of the PARTICULAR NERVES.

IT is generally said, that there are 40 pair of nerves in all; of which 10 come out from the encephalon, and the other 30 have their origin from the spinal marrow.

Of the ten pair of nerves which come from the encephalon, the first is the *olfactory*, which long had the name of the *mamillary processes* of the brain, because in the brutes, cows and sheep, which were most commonly dissected by the ancients, the anterior ventricles of the brain are extended forwards upon these nerves, and adhere so firmly to them, that they seem to make the upper side of the nerves. Each of them being large, where it begins to be stretched out, and gradually becoming smaller as it approaches the cribriform bone, was imagined to resemble a nipple. Those who mistook the ventricles for part of the nerves, observing the cavity in them full of liquor, concluded, that these olfactory nerves served to convey the superfluous moisture of the brain to the holes of the ethmoid bone through which it passed into the nose. But in man, the ventricles of whose brain are not thus extended forwards, these nerves are small, long, and without any cavity, having their origin from the corpora striata, near the part where the internal carotid arteries are about to send off their branches to the different parts of the brain; and in their course under the anterior lobes of

of the brain, which have each a depression made for lodging them, the human olfactory nerves become larger, till they are extended to the cribriform bone; where they split into a great number of small filaments, to pass through the little holes in that bone; and being joined by a branch of the fifth pair of nerves, are spread on the membrane of the nose.

The tender structure and sudden expansion of these nerves on such a large surface, render it impossible to trace them far; which has made some authors deny them to be nerves: but when we break the circumference of the cribriform lamella, and then gently raise it, we may see the distribution of the nerves some way on the membrane of the nose, where they form a beautiful net-work.

The contrivance of defending these long soft nerves from being too much pressed by the anterior lobes of the brain under which they lie, is singular; because they have not only the prominent orbital processes of the frontal bone to support the brain on each side, with the veins going into the longitudinal sinus, and other attachments bearing it up, but there is a groove formed in each lobe of the brain itself for them to lodge in.— Their splitting into so many small branches before they enter the bones of the skull, is likewise peculiar to them; for generally the nerves come from the brain in disgregated filaments, and unite into cords, as they are going out at the holes of the bones. This contrivance is the best for answering the purpose they are designed for, of being the organ of smelling; for had they been expanded upon the membrane of the nose into a medullary web, such as the optic forms, it would have been too sensible to bear the impressions of such objects as are applied to the nose; and a distribution in the more common way, of a cord sending off branches, would not have been equal enough for such an organ of sensation.

The *second* pair of nerves, the *optic*, rising from the thalami

lami nervorum opticorum, make a large curve outwards, and then run obliquely inwards and forwards, till they unite at the forepart of the sella turcica ; then soon divide, and each runs obliquely forwards and outwards to go out at its proper hole in the sphenoid bone, accompanied with the ocular artery, to be extended to the globe of the eye, within which each is expanded into a very fine cup-like web, that lines all the inside of the eye, to within a little distance of the edge of the crystalline lens, and is universally known by the name of *retina*.

Though the substance of this pair of nerves seems to be blended at the place where they are joined ; yet observations of people whose optic nerves were not joined, and of others who were blind of one eye from a fault in the optic nerve, or in those who had one of their eyes taken out, make it appear, that there is, no such intimate union of substance ; the optic nerve of the affected side only being wasted, while the other was large and plump. And the same observations are contradictory to the doctrine of a decussation of all the nerves (§ 8.): for the disease could be traced from the affected eye to the origin of the nerve on the same side. In many fishes, indeed, the doctrine of decussation is favoured ; for their optic nerves plainly cross each other, without any union at the part where they are joined in men and most quadrupeds.

Those people whose optic nerves were not joined, having neither seen objects double, nor turned their eyes different ways, is also a plain proof, that the conjunction of the optic nerves will not serve to account for either the uniform motions of our eyes, or our seeing objects single with two eyes, though it may be one cause of the remarkable sympathy of the one eye with the other in many diseases.

The retina of a recent eye, without any preparation, appears a very fine web, with some blood-vessels coming from its centre to be distributed on it ; but, after

ter a good injection of the arteries that run in the substance of this nerve, as is common to other nerves, it is with difficulty that we can observe its nervous medullary substance.—The situation of these vessels in the central part of the optic nerve, the want of medullary fibres here, and the firmness of this nerve before it is expanded at its entry into the ball of the eye, may be the reason why we do not see such bodies, or parts of bodies, whose picture falls on this central part of the retina.—An inflammation in those arteries of the retina, which several fevers and an ophthalmia are generally attended with, may well account for the tenderness in the eyes, and inability to bear the light, which people have in these diseases.—The over-distention of these vessels may likewise serve to account for the black spots observed on bright-coloured bodies especially, and for that smoky fog through which all objects are seen by people in some fevers.—If these vessels lose their tone, and remain preternaturally distended, no object affects our retina, though the eye externally appears sound; or this may be one cause of an amaurosis or gutta serena.—From a partial distention of these vessels, or paralysis of a part of the retina, the central part, or the circumference, or any other part of objects, may be lost to one or both eyes.

The *third* pair rise from the anterior part of the processus annularis; and piercing the dura mater a little before and to a side of the ends of the posterior clinoid process of the sphenoid bone, run along the receptacula, or cavernous sinuses, at the side of the ephippium, to get out at the foramina lacera: after which each of them divides into branches; of which one, after forming a little ganglion, is distributed to the globe of the eye; the others are sent to the musculus rectus of the palpebra, and to the attollens, adductor, deprimens, and obliquus minor muscles of the eye-ball. These muscles being principal instruments in the motions of the eye-lid and eye-ball, this nerve has therefore got
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the name of the *motor oculi*.—I have frequently observed in convulsions the eye-lids widely opened, the cornea turned upward and outwards, and the eye-balls sunk in the orbit; which well described the conjunct action of the muscles which this pair of nerves serves.

—The distention of a considerable branch of the carotid, which passes over this nerve near its origin on each side, may possibly be the reason of the heaviness in the eye-lids and eyes, after drinking hard or eating much.

The *fourth* pair, which are the smallest nerves of any, derive their origin from the back-part of the base of the testes; and then making a long course on the side of the annular protuberance, enter the dura mater a little farther back and more externally than the third pair, to run also along the receptacula, to pass out at the foramina lacera, and to be entirely spent on the musclic trochlears, or superior oblique muscles of the eyes. These muscles being employed in performing the rotatory motions, and the advancement of the eye-balls forward, by which several of our passions are expressed, the nerves that serve them have got the name of *pathetici*.—Why these small nerves should be brought so far to this muscle, when it could have been supplied easily by the motor oculi, I know not.

The *fifth* pair are large nerves, rising from the annular processes, where the medullary processes of the cerebellum join in the formation of that tuber, to enter the dura mater near the point of the petrous process of the temporal bones; and then sinking close by the receptacula at the sides of the sella turcica, each becomes in appearance thicker, forms a distinct ganglion, and goes out of the skull in three great branches.

The first branch of the fifth is the *ophthalmic*, which runs through the foramen lacerum to the orbit, having in its passage thither a connection with the sixth pair. It is afterwards distributed to the ball of the eye with the third; to the nose, along with the olfactory, which

the branch of the fifth that passes through the foramen orbitarium internum joins, as was already mentioned in the description of the first pair. This ophthalmic branch likewise supplies the parts at the internal canthus of the orbit, the glandula lacrymalis, fat, membranes, muscles, and teguments of the eye-lids; its longest farthest extended branch passing through the foramen superciliare of the os frontis, to be distributed to the forehead.

The small fibres which this first branch of the fifth and third pair of nerves send to the eye-ball, being situated on the optic nerve, and, after piercing the sclerotic coat, running along the choroid coat on the outside of the retina in their course to the uvea or iris, may be a cause of the sympathy between the optic nerve and the uvea; by which we more readily acquire the habit of contracting the iris, and thereby lessen the pupil, when too strong light is excluded; and, on the contrary, enlarge the pupil when the light is too faint.—This, with the sympathy which must arise from some of the nerves of the membrane of the nostrils, being derived from this first branch of the fifth pair of nerves, may also be the cause, why an irritation of the retina, by too strong light, may produce sneezing, as if a stimulus had been applied to the membrane of the nose itself;—why pressing the internal canthus of the orbit sometimes stops sneezing;—why irritation of the nose or of the eye causes the eye-lids to shut convulsively, and makes the tears to flow plentifully; and why medicines put into the nose, do often great service in diseases of the eyes.—In the megrim, all the branches of the nerves discover themselves to be affected: for the forehead is racked with pain; the eye-ball is pained, and feels as if it was squeezed; the eye-lids shut convulsively, the tears trickle down, and an uneasy heat is felt in the nose. Hence we can understand where external medicines will have the best effect when applied to remove this disease, to wit, to the mem-

membrane of the nose, and to the fore-head ;—— why alternate pressure near the superciliary hole of the frontal bone, or sneezing, sometimes gives immediate relief in the megrim ;—— why the sight may be lost by an injury done to the supra orbital branch ;—— how it may be restored by agitation of that branch of this nerve.

The second branch of the fifth pair of nerves may be called *maxillaris superior*, from its serving principally the parts of the upper jaw. It goes out at the round hole of the sphenoid bone, and sends immediately one branch into the channel on the top of the antrum maxillare ; the membrane of which and the upper teeth are supplied by it in its passage. As this branch is about to go out at the foramen orbitarium externum, it sends a nerve through the substance of the os maxillare to come out at Steno's duct, to be distributed to the fore-part of the palate ; and what remains of it escaping at the external orbital hole, divides into a great many branches, that supply the cheek, upper lip, and nostril. — The next considerable branch of the superior maxillary nerve, after giving branches which are reflected through the sixth hole of the sphenoid bone, to join the intercostal where it is passing through the skull with the carotid artery, and the portio dura of the seventh pair as it passes through the os petrosus, is sent into the nose by the hole common to the palate and sphenoidal bone ; and the remaining part of this nerve runs in the palato-maxillaris canal, giving off branches to the temples and pterygoid muscles, and comes at last into the palate to be lost. — Hence, the ach in the teeth of the upper jaw occasions a gnawing pain deep-seated in the bones of the face, with swelling in the eye-lids, cheek, nose, and upper lip ; and on the other hand, an inflammation in these parts, or a megrim, is often attended with sharp pain in the teeth. — Hence, an obstruction in the duct of the maxillary sinus, which obliges the liquor secreted there to find out a preternatural route

for itself, may be occasioned by the pain of the teeth.——Hence, the upper lip often suffers when the palate or nose is ulcerated.

The third, or *maxillaris inferior*, branch of the fifth pair going out of the oval hole of the sphenoid bone, serves the muscles of the lower jaw, and the muscles situated between the os hyoides and jaw: All the salivary glands, the amygdalæ, and the external ear, have branches from it: It has a large branch lost in the tongue, and sends another through the canal in the substance of the lower jaw to serve all the teeth there, and to come out at the hole in the fore-part of the jaw, to be lost in the chin and under-lip.——

Hence a convulsive contraction of the muscles of the lower jaw, or the mouth's being involuntarily shut, a great flow of spittle or salivation, a pain in the ear, especially in deglutition, and a swelling all about the throat, are natural consequences of a violent irritation of the nerves of the lower teeth in the toothach; and pain in the teeth and ear, is as natural a consequence of an angina.——Hence alternate pressure on the chin may sometimes relieve the violence of a toothach.——

Hence destroying the nerves of a tooth by actual or potential cauteries, or pulling a carious tooth, so often removes immediately all these symptoms.——Hence no cure is to be found for some ulcers in the upper or lower jaw, but by drawing a tooth.——Hence, in cancers of the upper lip, the salivary glands are in danger of being affected, or the disease may be occasioned to the lip by its beginning in the glands.——Perhaps the sympathy of the organs of tasting and smelling may in some measure depend on their both receiving nerves from the fifth pair.

The *sixth* pair, which is the smallest except the fourth, rises from the forepart of the corpora pyramidalia; and each entering the dura mater some way behind the posterior clinoid process of the sphenoid bone, has a long course below that membrane, and within the receptaculum at the side of the fella turcica, where it is im-

immerfed in the blood of the receptacle ; but for what purpofe, I am ignorant. It goes afterwards out at the foramen lacerum into the orbit, to ferve the abductor mufcle of the eye.—A defect in this nerve may therefore be one caufe of a ftrabifmus.—In the paffage of this nerve below the dura mater, it lies very contiguous to the internal carotid artery, and to the ophthalmic branch of the fifth pair of nerves. At the place where the fixth pair is contiguous to the carotid, a nerve either goes from each of them in an uncommon way, to wit, with the angle beyond where it rifes obtufe, to defcend with the artery, and to form the beginning of the intercoftal nerve, according to the common defcription ; or, according to other authors, this nerve comes up from the great ganglion of the intercoftal, to be joined to the fixth here.

The arguments for this latter opinion are, That, according to the common doctrine, this beginning of the intercoftal nerve, as it is called, would rife in a manner not fo ordinary in nerves. In the next place, it is obferved, that the fixth pair is larger nearer to the orbit, than it is before it comes to the place where this nerve is faid to go off ; and therefore it is more probable, that it receives an addition there, rather than gives off a branch. Laftly, It is found, that upon cutting the intercoftal nerves of living animals, the eyes plainly were affected ; they loft their bright water ; the gum, or gore, as we call it, was feparated in greater quantity ; the pupil was more contracted ; the cartilaginous membrane, at the internal canthus, came more over the eye ; and the eye-ball itfelf was diminished.

To this it is answered, in defence of the more common doctrine, 1^{ft}, That other branches of nerves go off in a reflected way, as well as this does, fupposing it to be the beginning of the intercoftal ; and that the reflection would rather be greater, if it is thought to come up from the intercoftal to the fixth. 2^{dly}, It is

denied that this nerve is for ordinary thicker at its fore than at its back-part; and if it was supposed to be thickest nearer to the orbit, the conclusion made above could not be drawn from this appearance, because other nerves enlarge sometimes where there is no addition made to them, as in the instance already mentioned of the trunk of the fifth pair while below the dura mater. 3dly, The experiments on living animals show indeed, that the eyes are affected upon cutting the intercostal nerve; but not in the way which might have been expected, if the intercostal had furnished such a share of the nerve that goes to the abductor muscle of the eye: for it might have been thought, that this muscle would have been so much weakened immediately upon cutting the intercostal, that its antagonist the adductor would have greatly prevailed over it, and have turned the eye strongly in towards the nose; which is not said to be a consequence of this experiment. So that the arguments are still equivocal; and more observations and experiments must be made, before it can be determined with certainty whether the sixth pair gives or receives a branch here. In the mean time, I shall continue to speak about the origin of the intercostal with the generality of anatomists.

At this place where the intercostal begins, the fifth pair is contiguous and adherent to the sixth; and it is generally said, that the ophthalmic branch of the fifth gives a branch or two to the beginning of the intercostal, or receives such from it. Others deny any such communication between them; and those who affirm the communication confess, that in some subjects they could not see it. After examining the nerves here in a great many subjects, I cannot determine whether or not there are nervous filaments going from the one to the other. Sometimes I have thought that I traced them evidently; at other times I observed, that what I dissected for nervous filaments, was collapsed cellular substance; and in all the subjects where I had pushed an injection

injection successfully into the very small arteries, I could only observe a plexus of vessels connecting the one to the other. In any of these ways, however, there is as much connection as, we are assured from many experiments and observations on other nerves, is sufficient to make a very great sympathy among the nerves here.—Possibly the appearances in the eyes of dogs, whose intercostal nerves were cut, might be owing to this sympathy.

The *seventh* pair comes out from the lateral part of the annular process, behind where the medullary process of the cerebellum are joined to that tuber; and each being accompanied with a larger artery than most other nerves, enters the internal meatus auditorius, where the two large bundles of fibres, of which it appeared to consist within the skull, soon separate from each other: one of them entering by several small holes into the vestibule, cochlea, and semicircular canals, is stretched on this inner camera of the ear in a very soft pulpy substance; and being never seen in the form of a firm cord, such as the other parcel of this and most other nerves become, is called the *portio mollis* of the auditory nerve.

The other part of this seventh pair passes through Galen's foramen cæcum, or Fallopius's aquæduct, in its crooked passage by the side of the tympanum; in which passage, a nerve sent to the lingual branch of the inferior maxillary nerve, along the outside of the tuba Eustachiana, and cross the cavity of the tympanum, where it has the name of *chorda tympani*, is commonly said to be joined to it. The very acute angle which this nerve makes with the fifth, or the sudden violent reflection it would suffer on the supposition of its coming from the fifth to the seventh, appears unusual; whereas, if we suppose that it comes from the seventh to the fifth, its course would be more in the ordinary way, and the *chorda tympani* would be esteemed a branch of the seventh pair going to join the fifth, the size of which is

increased by this acquisition. This smaller bundle of the seventh gives branches to the muscles of the malleus, and to the dura mater, while it passes through the bony crooked canal, and at last comes out in a firm chord named *portio dura*, at the end of this canal, between the styloid and mastoid processes of the temporal bone, giving immediately filaments to the little oblique muscles of the head and to those that rise from the styloid process. It then pierces through the parotid gland, and divides into a great many branches, which are dispersed in the muscles and teguments that cover all the side of the upper part of the neck, the whole face and cranium, as far back as the temples, including a considerable part of the external ear. Its branches having thus a considerable connection with all the three branches of the fifth pair, and with the second cervical, occasion a considerable sympathy of these nerves with it.—Hence in the tooth-ach, the pain is sometimes very little in the affected tooth, compared to what it is all along the side of the head and in the ear.—Hence probably the relief of the toothach from blisters applied behind or before the ear, or by a hot iron touching the antihelix of the ear.—By this communication or connection possibly too it is, that a vibrating string held between one's teeth, gives a strong idea of sound to the person who holds it, which nobody else can perceive.—Perhaps too the distribution of this nerve occasions the head to be so quickly turned upon the impression of sound on our ears.

The *eighth* pair of nerves rise from the lateral bases of the corpora olivaria in disgregated fibres; and as they are entering the anterior internal part of the holes common to the os occipitis and temporum, each is joined by a nerve which ascends within the dura mater from the tenth of the head, the first, second, and inferior cervical nerves: this, every body knows, has the name of the *nervus accessorius*. When the two get out of the skull, the accessorius separates from the eighth, and, descending

scending obliquely outwards, passes through the sternomastoideus muscle, to which it gives branches, and afterwards terminates in the trapezius muscle of the scapula. In this course it is generally more or less joined by the second cervical nerve.——Why this nerve, and several others which are distributed to muscles, are made to pierce through muscles, which they might have only passed near to, I do not know.

The large eighth pair, soon after its exit, gives nerves to the tongue, larynx, pharynx, and ganglion of the intercostal nerve; and being disjoined from the ninth and intercostal, to which it adheres closely some way, runs straight down the neck behind the internal jugular vein, and at the external side of the carotid artery. As it is about to enter the thorax, a large nerve goes off from the eighth of each side: this branch of the right side turns round from the fore to the back part of the subclavian artery, while the branch of the left side turns round the great curve of the aorta; and both of them mounting up again at the side of the œsophagus, to which they give branches, are lost at last in the larynx. These are called the *recurrent nerves*, which we are desired to shun in the operation of bronchotomy, though their deep situation protects them sufficiently.——The muscles of the larynx being in a good measure supplied with nerves from the recurrences, it is to be expected, that the cutting of them will greatly weaken the voice, though it will not be entirely lost so long as the superior branches of the eighth pair are entire.——Why the recurrent nerves rise so low from the eighth pair to go round a large artery, and to have such a long course upwards, I know not.

The eighth pair, above and at or near the place where the recurrent nerves go off from it, or frequently the recurrences themselves, send off small nerves to the pericardium, and to join with the branches of the intercostal that are distributed to the heart; but their size and situation are uncertain.

After

After these branches are sent off, the par vagum on each side descends behind the great branch of the trachea, and gives numerous filaments to the lungs, and some to the heart in going to the œsophagus. The one of the left side running on the forepart of the œsophagus, communicates by several branches with the right one in its descent to be distributed to the stomach: the right one gets behind the œsophagus, where it splits and rejoins several times before it arrives at the stomach, to which it sends nerves; and then being joined by one or more branches from the left trunk, they run towards the cæliac artery, there to join into the great semilunar ganglion formed by the two intercostals.

From the distribution of this par vagum, we may learn, how tickling the fauces with a feather or any such substance, excites a nausea and inclination to vomit;—why coughing occasions vomiting, or vomiting raises a cough.—Hence we see how the nervous asthma and the tussis convulsiva, chincough, are attended with a straitening of the glottis;—why food difficult to digest occasions the asthma to weakly people; and why emetics have frequently cured the asthma very speedily;—why an attempt to vomit is sometimes in danger of suffocating asthmatic people;—why the superior orifice of the stomach is so sensible as to be looked on as the seat of the soul by some;—why people subject to distentions of the stomach, have so often the sensation of balls in their breast and throat;—why the globus hystericus is so often attended with a violent strangulation at the glottis.

The *ninth* pair of nerves comes from the inferior part of the corpora pyramidalia, to go out of the skull at their proper holes of the occipital bone. After their egress they adhere for some way firmly to the eighth and intercostal; and then sending a branch, that in many subjects is joined with branches of the first and second cervical nerves, to be distributed to the thyroid gland, and muscles on the forepart of the trachea arteria, the
ninth

ninth is lost in the muscles and substance of the tongue. Some have thought this nerve, and others have esteemed the third branch of the fifth pair of nerves, to be the proper gustatory nerve. I know no observation or experiments to prove either opinion, or to assure us that both nerves do not serve for tasting and for the motion of the tongue.—May not the distribution of this nerve to the muscles below as well as above the os hyoides, contribute to their acting more uniformly in depressing the lower jaw or head?

The *tenth* pair rises in separate threads from the sides of the spinal marrow, to go out between the os occipitis and first vertebra of the neck. After each of them has given branches to the great ganglion of the intercostal, 8th, 9th, and 1st cervical nerves, it is distributed to the straight, oblique, and some of the extensor muscles of the head. Whether the name of the tenth of the head, or of the first vertebral, ought to be given to this pair of nerves, is of no such consequence as to deserve a debate, though it has some of the marks of the spinal nerves, to wit, its being formed of filaments proceeding from both the fore and back part of the medulla, and a little ganglion being formed where these filaments meet.

In the description of the sixth pair, I followed the usual way of speaking among anatomists, and called that the beginning of the intercostal nerve which comes out of the skull; and therefore shall here subjoin a cursory description of this nerve, notwithstanding its much larger part is composed of nerves coming out from the spinal marrow. There is no greater incongruity in point of method to say, that the nerve we are describing receives additions from others that have not been described, than it is to repeat in the description of a great many nerves, that each of them gives branches to form a nerve which we are ignorant of; which is all the difference between describing the intercostal before or after the spinal nerves.

The branch reflected from the sixth pair, joined possibly by some filaments of the ophthalmic branch of the fifth, runs along with the internal carotid artery, thro' the crooked canal formed for it in the temporal bone, where the little nerve is very soft and pappy, and in several subjects divides and unites again, and is joined by one or more branches from the fifth, particularly of its superior maxillary branch, before it comes out of the skull. May the compression of this nerve by the carotid artery, when stretched during the systole, contribute to the diastole of the heart? As soon as the nerve escapes out of this bony canal, it is connected a little way with the eighth and ninth; then separating from these, after seeming to receive additional nerves from them, it forms a large ganglion, into which branches, from the tenth of the head, and from the first and second cervical, enter. From this ganglion the nerves come out again small to run down the neck along with the carotid artery, communicating by branches with the cervical nerves, and giving nerves to the muscles that bend the head and neck. As the intercostal is about to enter the thorax, it forms another ganglion, from which nerves are sent to the trachea and to the heart; those designed for the heart joining with the branches of the eighth, and most of them passing between the two great arteries and the auricles to the substance of that muscle. The intercostal after this consisting of two branches, one going behind, and the other running over the forepart of the subclavian artery, forms a new ganglion, where the two branches unite below that artery; and then descending along the sides of the vertebræ of the thorax, receives branches from each of the dorsal nerves; which branches appearing to come out between the ribs, have given the name of *intercostal* to the whole nerve. Where the addition is made to it from the fifth dorsal nerve, a branch goes off obliquely forewards; which being joined by such branches from the sixth, seventh, eighth, and ninth dorsal

dorsal, an anterior trunk is formed, and passes between the fibres of the appendix musculosa of the diaphragm, to form, along with the other intercostal and the branches of the eighth pair, a large semilunar ganglion, situated between the cæliac and superior mesenteric arteries: the roots of which are as it were involved in a sort of nervous net-work of this ganglion, from which a great number of very small nervous threads runs out to be extended on the surface of all the branches of those two arteries, so as to be easily seen when any of the arteries are stretched, but not to be raised from them by dissection; and thus the liver, gall-bladder, duodenum, pancreas, spleen, jejunum, ilium, and a large share of the colon, have their nerves sent from this great solar ganglion or plexus.—May not the peristaltic motion of the intestines depend in some measure on the passage of the intercostal nerves through the diaphragm?

Several fibres of this ganglion, running down upon the aorta, meet with other nerves sent from the posterior trunk of the intercostal, which continues its course along the sides of the vertebræ: they supply the glandulæ renales, kidneys, and testes in men, or ovaria in women; and then they form a net-work upon the inferior mesenteric artery where the nerves of the two sides meet, and accompany the branches of this artery to the part of the colon that lies in the left side of the belly, and to the rectum, as far down as to the lower part of the pelvis.

The intercostal continuing down by the side of the vertebræ of the loins, is joined by nerves coming from between these vertebræ, and sends nerves to the organs of generation and others in the pelvis, being even joined with those that are sent to the inferior extremities.

The almost universal connection and communication which this nerve has with the other nerves of the body, may lead us to understand the following and a great many more phenomena:—Why tickling the nose causes

ses sneezing :—Why the too great quantity of bile in the cholera occasions vomiting as well as purging :—Why people vomit in colics, in inflammations, or other irritations of the liver, or of the ducts going from it and the gall-bladder :—Why a stone in the kidneys, or ureters, or any other cause irritating those organs, should so much more frequently bring on vomiting and other disorders of the stomach, than the stone or any other stimulating cause in the bladder does :—Why vomiting is a symptom of danger after child-birth, lithotomy, and other operations on the parts in the pelvis :—Why the obstructions of the menses are capable of occasioning strangulations, belching, colics, stomach-aches, and even convulsions in the extremities :—Why vesicatories, applied from the ears to the clavicles of children labouring under the tussis convulsiva, are frequently of great service :—Why worms in the stomach or guts excite an itching in the nose, or grinding of the teeth :—Why irritations in the bowels or the belly occasion sometimes universal convulsions of the body.

The SPINAL NERVES rise generally by a number of disgregated fibres from both the fore and back part of the medulla spinalis ; and soon after form a little knot or ganglion, where they acquire strong coats, and are extended into firm cords ; but the ganglion is entirely formed by the posterior bundle. They are distinguished by numbers, according to the vertebræ from between which they come out ; the superior of the two bones forming the hole through which they pass, being the one from which the number is applied to each nerve. There are generally said to be thirty pair of them : seven of which come out between the vertebræ of the neck, twelve between those of the back, five between those of the loins, and six from the false vertebræ.

The *first* cervical pair of nerves comes out between the first and second vertebræ of the neck ; and having
given

given branches to join with the tenth pair of the head, the second cervical and intercostal, and to serve the muscles that bend the neck, it sends its largest branches backwards to the extensor muscles of the head and neck; some of which piercing through these muscles, run up on the occiput to be lost in the teguments here; and many fibres of it advance so far forward as to be connected with the fibrils of the first branch of the fifth pair of the head, and of the portio dura of the auditory nerve.—Hence possibly it is, that a *clavus hystericus* changes suddenly sometimes from the forehead to a violent pain and spasm in the back-part of the head and neck.

The *second* cervical is soon joined by some branches to the ninth of the head and intercostal, and to the first and third of the neck; then has a large branch that comes out at the exterior edge of the *sterno-mastoideus* muscle, where it joins with the *accessorius* of the eighth pair; and is afterwards distributed to the *platysma myoides*, teguments of the side of the neck and head, parotid gland, and external ear, being connected to the portio dura of the auditory nerve, and to the first cervical. The remainder of this second cervical is spent on the *levator scapulæ* and the extensors of the neck and head. Generally a large branch is here sent off to join the *accessorius* of the eighth pair, near the superior angle of the scapula.

To the irritation of the branches of this nerve it probably is, that, in an inflammation of the parotid gland, the neck is pained so far down as the clavicle, the head is drawn towards the shoulder of the affected side, and the chin is turned to the other side.—In opening the external jugular vein, no operator can promise not to touch some of the cutaneous branches of this nerve with the lancet; which occasions a sharp pricking pain in the mean time, and a numbness of the skin near the orifice for some time after.

The *third* pair of the neck passes out between the third

third and fourth cervical vertebræ; having immediately a communication with the second, and sending down a branch, which, being joined by a branch from the fourth cervical, forms the *phrenic* nerve. This descending enters the thorax between the subclavian vein and artery; and then being received into a groove formed for it in the pericardium, it has its course along this capsula of the heart, till it is lost in the middle part of the diaphragm. The right phrenic has a straight course; but the left one is obliged to make a considerable turn outwards to go over the prominent part of the pericardium, where the point of the heart is lodged. Hence, in violent palpitations of the heart, a pungent acute pain is felt near the left orifice of the stomach.—The middle of the diaphragm scarce could have been supplied by any other nerve which could have had such a straight course as the phrenic has. If the subclavian artery and vein have any effect upon this nerve, I do not know it.

The other branches of the third cervical nerve are distributed to the muscles and teguments at the lower part of the neck and top of the shoulder. No wonder then that an inflammation of the liver or spleen, an abscess in the lungs adhering to the diaphragm, or any other cause capable of irritating the diaphragm, should be attended with a sharp pain on the top of the shoulder, as well as wounds, ulcers, &c. of this muscle itself.—If the irritation of this muscle is very violent, it may occasion that convulsive contraction of the diaphragm which is called an *hiccough*; and therefore an hiccough in an inflammation of the liver has been justly declared to be an ill symptom.

An irritation of the thoracic nerves which produces sneezing, may sometimes free the phrenic nerves from any spasm they occasion: so that sneezing sometimes takes away the hiccough; and a derivation of the fluid of the nerves any other way may do the same thing: or the hiccough may also be sometimes cured, by drawing

ing up into the nose the smoke of burning paper or other acrid fumes, swallowing pungent or aromatic medicines, and by a surprise, or any other strong application of the mind in thinking, or in distinguishing objects: or, when all these have failed, it has been put away by the brisk stimulus of a blistering plaster applied to the back.

The *fourth* cervical nerve, after sending off that branch which joins with the third to form the phrenic, and bestowing twigs on the muscles and glands of the neck, runs to the arm-pit, where it meets with the *fifth*, *sixth*, and *seventh* cervicals, and *first* dorsal, that escape in the interstices of the muscoli scaleni, to come at the arm-pit, where they join, separate, and rejoin, in a way scarce to be rightly expressed in words; and, after giving several considerable nerves to the muscles and teguments which cover the thorax, they divide into several branches, to be distributed to all the parts of the superior extremity. Seven of these branches I shall describe under particular names.

1. *Scapularis* runs straight to the cavitas femilunata of the upper costa of the scapula, which is a hole in the recent subject, by a ligament being extended from one angle of the bone to the other, giving nerves in its way to the muscles of the scapula. When it has passed this hole, it supplies the supra-spinatus muscle; and then descending at the anterior root of the spine of the scapula, it is lost in the other muscles that lie on the dorsum of that bone.

2. *Articularis* sinks downwards at the axilla, to get below the neck of the head of the os humeri, and to mount again at the back-part of it; so that it almost surrounds the articulation, and is distributed to the muscles that draw the arm back, and to those that raise it up.

3. *Cutaneus* runs down the fore-part of the arm near the skin, to which it gives off branches; and then divides on the inside of the fore-arm into several nerves, which

supply the teguments there, and on the palm of the hand.—In opening the basilic vein of the arm at the ordinary place, the same symptoms are sometimes produced as in opening the external jugular vein, and from a like cause, to wit, from hurting a branch of this cutaneous nerve with the lancet.

4. *Musculo-cutaneus*, or perforans Casseri, passes thro' the coraco-brachialis muscle; and after supplying the biceps flexor cubiti and brachialis internus, passes behind the tendon of the biceps, and over the cephalic vein, to be bestowed on the teguments on the outside of the fore arm and back of the hand.—This nerve is sometimes hurt in opening the cephalic vein, and causes pain and numbness for a short time.

5. *Muscularis* has a spiral course from the axilla, under the os humeri, and backward to the external part of that bone, supplying by the way the extensor muscles of the fore arm, to which it runs between the two brachii muscles, and within the supinator radii longus.—At the upper part of the fore-arm, it sends off a branch, which accompanies the supinator longus till it comes near the wrist, where it passes obliquely over the radius, to be lost in the back of the hand and fingers.—The principal part of this nerve pierces through the supinator radii brevis, to serve the muscles that extend the hand and fingers, whose actions are not injured when the supinator acts. Part of this nerve seems to be lost upon the ligament of the wrist.

6. *Ulnaris* is extended along the inside of the arm, to give nerves to the muscles that extend the fore-arm and to the teguments of the elbow: towards the lower part of the arm, it slants a little backward to come at the groove behind the internal condyle of the os humeri, through which it runs to the ulna: in its course along this bone, it serves the neighbouring muscles and teguments; and as it comes near the wrist, it detaches a branch obliquely over the ulna to the back of the hand, to be lost in the convex part of several

ral fingers. The larger part of the nerve goes straight forward to the internal side of the os pisiforme of the wrist; where it sends off a branch, which sinks under the large tendons in the palm, to go cross to the other side of the wrist, serving the muscoli lumbricales and interossei, and at last terminating in the short muscles of the thumb and fore-finger. What remains of the ulnar nerve after supplying the short muscles of the little-finger, divides into three branches; whereof two are extended along the sides of the sheath of the tendons of the flexors of the little-finger, to furnish the concave side of that finger; the third branch is disposed in the same way upon the side of the ring-finger next to the little-finger.

When we lean or press on the internal condyle of the os humeri, the numbness and prickling we frequently feel, point out the course of this nerve. I have seen a weakness and atrophy in the parts which I mentioned this nerve to be sent to, after a wound in the internal lower part of the arm.

7. *Radialis* accompanies the humeral artery to the bending of the elbow, serving the flexors of the cubit in its way; then passing through the pronator radii teres muscle, it gives nerves to the muscles on the fore-part of the fore-arm, and continues its course near to the radius, bestowing branches on the circumjacent muscles. Near the wrist, it sometimes gives off a nerve which is distributed to the back of the hand, and the convex part of the thumb and several of the fingers, instead of the branch of the muscular. The larger part of this nerve, passing behind the annular ligament of the wrist, gives nerves to the short muscles of the thumb; and afterwards sends a branch along each side of the sheath of the tendons of the flexors of the thumb, fore-finger, mid-finger, and one branch to the side of the ring-finger, next to the middle one, to be lost on the concave side of those fingers.

Though the radial nerve passes through the pronator

muscle, and the muscular nerve seems to be still more unfavourably placed within the supinator brevis; yet the action of these muscles does not seem to have any effect in hindering the influence of these nerves; for the fingers or hand can be bended while pronation is performing vigorously, and they can be extended while supination is exercised.

The manner of the going off of these nerves of the fingers, both from the ulnar and radial, is, that a single branch is sent from the trunk to the side of the thumb and little finger farthest from the other fingers; and all the rest are supplied by a trunk of a nerve, which splits into two some way before it comes as far as the end of the metacarpus, to run along the sides of different fingers that are nearest to each other.

It might have been observed, that, in describing the posterior branches of the ulnar and muscular nerve, I did not mention the particular fingers, to the convex part of which they are distributed. My reason for this omission is, the uncertainty of their distribution; for though sometimes these posterior branches go to the same fingers, to the concave part of which the anterior branches of the ulnar and radial are sent, yet frequently they are distributed otherwise.

The situation of these brachial nerves in the axilla, may let us see how a weakness and atrophy may be brought on the arms by long-continued pressure of crutches, or such other hard substances on this part; and the course of them from the neck to the arm may teach us, how much better effects vesicatories, or stimulating nervous medicines, would have, when applied to the skin covering the transverse processes of the vertebræ of the neck, or at the axilla, than when they are put between the shoulders, or upon the spinal processes, in convulsions or palsies of the superior extremities, where a stimulus is required.

The *twelve dorsal* nerves of each side, as soon as they escape from between the vertebræ, send a branch forward

ward to join the intercostal, by which a communication is made among them all; and they soon likewise give branches backwards to the muscles that raise the trunk of the body, their principal trunk being extended outwards to come at the furrow in the lower edge of each rib, in which they run toward the anterior part of the thorax, between the internal and external intercostal muscles, giving off branches in their course to the muscles and teguments of the thorax.

The *first* dorsal, as was already observed, is particular in this, that it contributes to form the brachial nerves; and that the two branches of the intercostal, which come down to the thorax, form a considerable ganglion with it.

The *six* lower dorsal nerves give branches to the diaphragm and abdominal muscles.

The *twelfth* joins with the first lumbar, and bestows nerves on the musculus quadratus lumborum and iliacus internus.

May not the communications of all these nerves be one reason, why the parts they serve act so uniformly and conjunctly in respiration, and conspire together in the convulsive motions of coughing, sneezing, &c.—The twitching spasms that happen sometimes in different parts of the muscles of the abdomen, by an irritation on the branches of the lower dorsal nerves, are in danger of occasioning a mistake in practice, by their resemblance to the cholic, nephritis, &c.—The communications of these lower ones with the intercostals, may serve to explain the violent effort of the abdominal muscles in a tenesmus, and in child-bearing.

As the intercostal is larger in the thorax than any where else, and seems to diminish gradually as it ascends and descends, there is cause to suspect that this is the trunk from which the superior and inferior pairs are sent as branches.

The *five* lumbar nerves on each side communicate

with the intercostal and with each other, and give branches backwards to the loins.

The *first* communicates with the last dorsal, sends branches to the abdominal muscles, to the psoas and iliacus, and to the teguments and muscles on the fore-part of the thigh; while its principal branch joins with the other nerves, to form the crural nerve.

The *second lumbar* nerve passes through the psoas muscle, and is distributed nearly in the same way as the former: as is also the *third*.

Branches of the second, third, and fourth, make up one trunk, which runs along the fore-part of the pelvis; and passing in the notch at the fore-part of the great hole common to the os pubis and ischium, is spent on the adductor muscles, and on the teguments on the inside of the thigh. This nerve is called the *obturator*, or *posterior crural nerve*.

By united branches from the first, second, third, and fourth lumbar nerves, a nerve is formed that runs along the psoas muscle, to escape with the external iliac vessels out of the abdomen, below the tendinous arcade of the external oblique muscle. This nerve, which is named the *anterior crural*, is distributed principally to the muscles and teguments on the fore-part of the thigh. A branch, however, of this nerve runs down the inside of the leg to the upper part of the foot, keeping near to the vena saphena; in opening of which with a lancet at the ankle, the nerve is sometimes hurt, and occasions sharp pain at the time of the operation, and numbness afterwards.

The remainder of the fourth lumbar and the fifth join in composing the largest nerve of the body, which is soon to be described.

Whoever attends to the course of these lumbar nerves, and of the spermatic vessels and nerves upon the psoas muscle, with the oblique passage of the ureter over that muscle, will not be surpris'd, that when a stone is passing in this canal, or even when it is inflamed, the trunk
of

of the body cannot be raised erect, without great pain; or that the skin of the thigh becomes less sensible, and the thigh is drawn forward, and that the testicle often swells and is drawn convulsively towards the ring of the abdominal muscles.

The *six pair* of the false *vertebræ* consist each of small posterior branches sent to the hips, and of large anterior branches.

The first, second, and third, after coming thro' the three upper holes in the fore-part of the os sacrum, joint together with the fourth and fifth of the loins, to form the largest nerve of the body, which is well known by the name of *sciatic* or *ischiatric* nerve: This, after sending large nerves to the different parts of the pelvis, and to the external parts of generation and the podex, as also to the muscles of the hips, passes behind the great tuber of the os ischium, and then over the quadrigemini muscles to run down near to the bone of the thigh at its back-part, giving off nerves to the neighbouring muscles and teguments. Some way above the ham, where it has the name of the *popliteus* nerve, it sends off a large branch that passes over the fibula, and sinking in among the muscles on the anterior external part of the leg, runs down to the foot, to be lost in the upper part of the larger toes, supplying the neighbouring muscles and teguments every where in its passage. The larger branch of the sciatic, after giving branches to the muscles and teguments about the ham and knee, and sending a large cutaneous nerve down the calf of the leg, to be lost at last on the outside of the foot and upper part of the lesser toes, sinks below the gemellus muscle, and distributes nerves to the muscles on the back of the leg; among which it continues its course, till, passing behind the internal malleolus, and in the internal hollow of the os calcis, it divides into the two plantar nerves: The internal of which is distributed to the toes in the same manner that the radial nerve of the hand serves the concave side of the thumb and fingers; and the external plantar is divided and distributed to the sole of the foot

and toes, nearly as the ulnar nerve is in the palm of the hand, and in the concave part of the fingers.

Several branches of these nerves, that serve the inferior extremities, pierce through muscles.

By applying what was said of the nerves in general to the particular distribution of the nerves of the inferior extremities, we may see how people with fractured legs, especially where there are splinters, should be subject to convulsive startings of the fractured member :— Why, upon tying the blood-vessels in an amputation of the leg, the patients should sometimes complain of violent pain in their toes ;—why such patients should also be troubled with startings ;—why, for a considerable time after the amputation of the diseased limb, when the suppuration is well advanced, they should complain of pain in the sore which occasioned the amputation.

The *fourth*, which, with the two following, is much smaller than the three superior, soon is lost in the vesica urinaria and intestinum rectum.

The *fifth* comes forward between the extremity of the os sacrum and coccygis, to be distributed principally to the levatores ani.

The *sixth*, which may be considered as the termination of a substance called *ligamentum denticulatum*, advances forward below the broad shoulders of the first bone of the os coccygis, and is lost in the sphincter ani and teguments covering it.

The branches of the four last cervical nerves, and of the first dorsal, which are bestowed on the superior extremities, and the two crurals, with the sciatic, which are distributed to the inferior extremities, are much larger proportionally to the parts they serve, than the nerves of the trunk of the body, and especially of the viscera, are ; and for a very good reason, that in the most common necessary actions of life, a sufficient quantity of fluid, on which the influence of nerves seems to depend, may be supplied to the muscles there, which are obliged to perform more frequent and violent contractions

tractions than any other parts do.—The size of the nerves of the inferior extremities seems larger proportionally than in the superior extremities; the inferior extremities having the weight of the whole body to sustain, and that frequently at a great disadvantage.—What the effect is of the nerves here being injured, we see daily: When people happen, by sitting wrong, to compress the sciatic nerve, they are incapable for some time after to support themselves on the affected extremity; and this is still more remarkable in the sciatica or hip-gout, in which the member is not only weakened, but gradually shrivels and wastes.

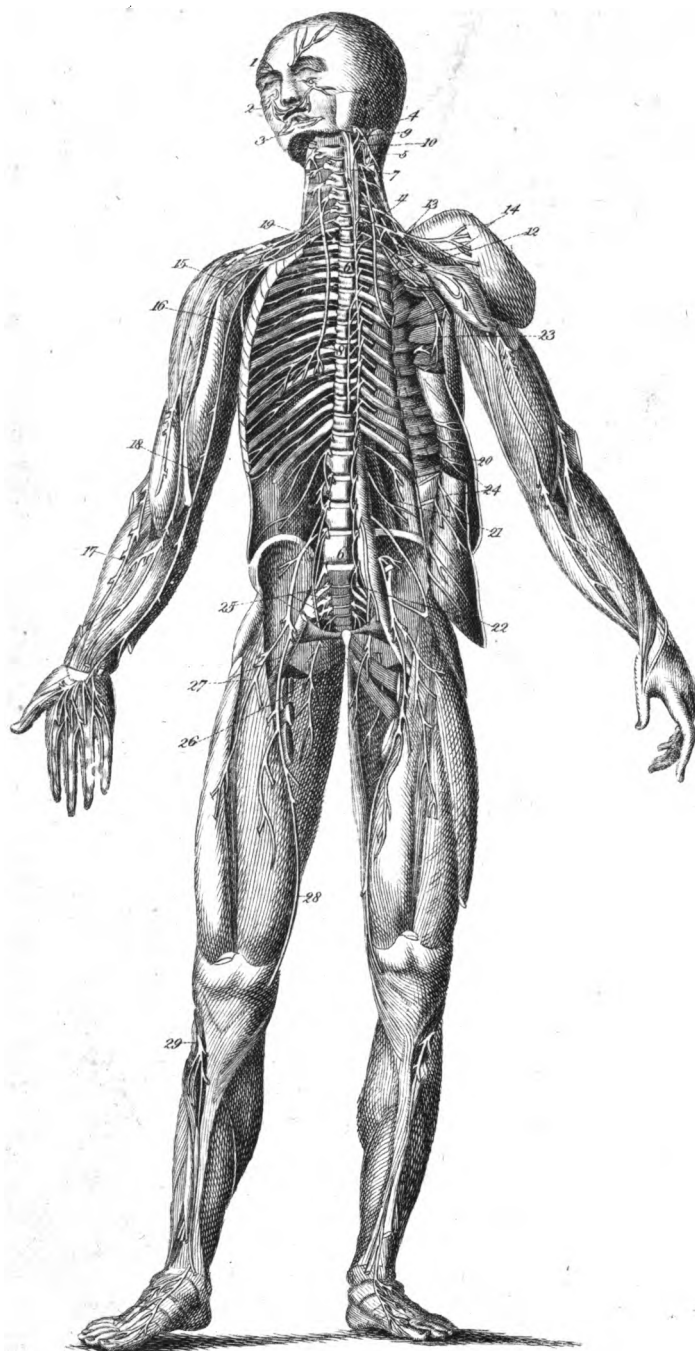
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(28) A branch of the anterior crural nerve, which runs near the vena saphena major. (29) The anterior tibial nerve running down to the foot.

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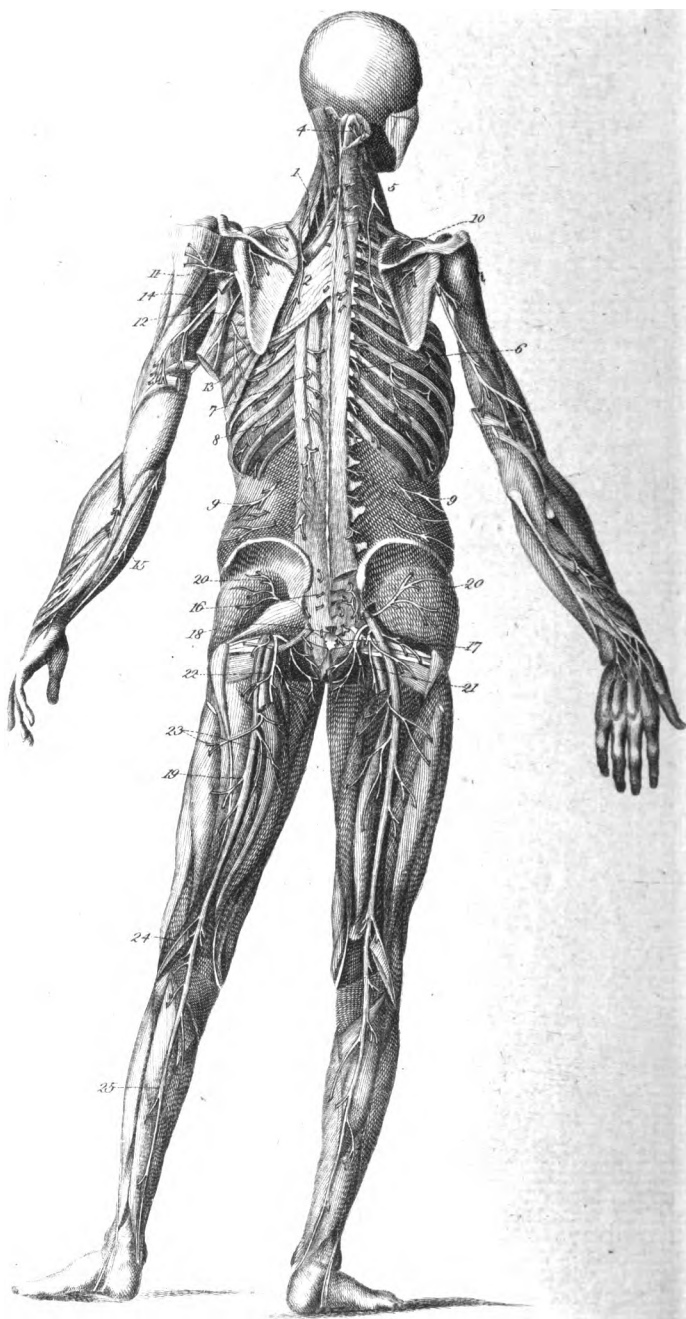
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